FINAL REPORT

Economic valuation of good rangeland management and incentives for efficient implementation for the National Rangeland Strategy

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Part 1: Insertions for the NRMPS Draft - the Executive Summary, and a New Chapter 5

Executive Summary [for insertion in NRMPS Executive Summary]

23. Implementation of the NRMPS is economically efficient. It has been shown that costs associated with implementation of sound rangeland management are recovered through increased financial and economic income. Adoption of sound grazing management plans, with attention to the principles outlined above, holds potential for significantly increased profits and returns on investment for rangeland users. Implementation of the NRMPS will also considerably enhance the contribution that rangeland use makes to the national economy. In the short to medium term lost rangeland productivity can be recovered. As time goes on, with increased adoption, and improved skills and understanding among range users, national income amounting to some N$5 billion might be added to the national economy from the rangeland use sector. Such benefits can go a long way towards mitigating and reversing the anticipated negative effects of climate change and increasing drought incidence in Namibia.

In implementation of the NRMPS, general enforcement measures or the introduction of new taxes and subsides are not recommended. Policy should focus on **incentives**, including ensuring open access to all available markets, and enabling efficient destocking and restocking. Indirect incentives should be provided through training, extension and quantitative scientific research on good rangeland management. Further indirect incentives notably in communal areas should focus on institution building and community mobilisation, to enable common property management of rangelands by communities.

Chapter 5. Economics of Good Rangeland Management

Implementation of the NRMPS will not be possible unless sound rangeland management makes financial and economic sense. As part of policy and strategy development, the economic merits of implementation of good rangeland management practise, incorporating the principles described above, were tested. This chapter describes the methods used in this analysis, the findings as well as the policy implications of these findings.

5.1. Approach

Case studies in semi arid habitats of Namibia, Botswana and elsewhere in southern Africa were examined to identify farm level and experimental systems that have resulted in improved rangeland condition. In particular those that have resulted in improved soil water and nutrient status, and increased presence of perennial grass species were selected. The case studies tended to involve changes at farm level from continuous or rigid rotational grazing to systems with greater mobility of large herds, timely adjustments in stock numbers, short grazing periods, and sufficient rest periods. Others involved reduction of invader bush to levels below 400 to 600 shrubs per hectare. Most case study data was available for the savanna biome.

Financial and economic enterprise models for rangeland use were used to examine the effects at farm level on enterprises of applying good rangeland management. Specifically, any costs associated with application of good rangeland practise were compared with any benefits resulting from such practice. It was important to separate changes in costs and benefits resulting from improved rangeland management from those resulting from improved herd and farm management. The basis of the analysis was to determine whether additional costs incurred to achieve good range management could be recovered through the improvements in range productivity.

The models used were detailed budget and cost-benefit analytical spreadsheets, which track enterprise development over ten years. They were typical empirically-based examples of rangeland use, including initial capital, cost and benefit flows, and detailed herd projections which incorporated stocking rates, calving rates, mortality rates and other parameters. Among many values resulting were the key annual, private **net profit** accruing to the range user (farmer) at full production, the private **internal rate of return** over the ten year period (overall financial rate of return), and the net present value realised by the farmer over the ten years.

The analysis also involved conversion of the transaction values to reflect their real opportunity costs in the national economy. This resulted in measure of the direct net annual change in the **national income** (gross national income) due to the enterprise, as well as the ten year overall **economic internal rate of return** and net present value. The economic analysis involved adjustments to some financial costs and benefits. Unemployment in the economy was reflected in labour costs being adjusted own. Excess demand or foreign exchange was reflected in a premium of the prices for tradable goods. Expenses and income not changing national income, such as taxes and subsidies were removed. Farm level results were aggregated to determine likely overall impacts on the national economy.

Empirically-based rangeland use enterprise models were available for cattle production in the semi arid northern savanna and woodland biomes, Small stock production in the arid Karoo biome, and wildlife use through tourism in the woodland, savanna and Karoo biomes. Case studies with sufficient hard data were limited to cattle enterprises in savanna and the analysis was focused on three cattle range use enterprises: 1. Fenced breeding and rearing on commercial land; 2. unfenced cattle post breeding and rearing around boreholes communal land; and 3. small-scale traditional cattle keeping in open access communal land around villages.

The analysis assessed the effects of improved grazing management, but did not include the effects of invader bush clearance. The costs and benefits of the latter have been analysed in detail separately. Further, the analysis attempted to isolate the changes associated with range management, so that the level of herd and farm management was assumed to remain constant in all cases. Lastly the analysis assessed the effects of improved grazing management over an initial ten year period after adoption, and did not include longer term effects recorded in some case studies.

5.2. Findings

In the commercial farm model the typical base case involved 10,000 hectares fenced into four camps with some 750 head of cattle, primarily aimed at production of 2.5 year old slaughter animals and live animals. Range condition was poor with few perennial grasses and moderate bush encroachment. The case study data showed that initial application of the good rangeland management principles described above would require a judiciously applied grazing plan, involving herd mobility, short heavy grazing, and adequate rest. This could be achieved either through increasing internal fencing and water provision, or through improved herding and water provision. In the ten year analytical framework, range

improvement could be achieved, resulting in a 20% to 40% increase in stocking rates and a small increase in calving rates.

In the cattle post communal land model the typical base case involved unfenced herding around a borehole, using some 6,400 hectares with some 770 head of cattle aimed at production of meat and live animals as well as stock accumulation. Range condition was poor with few perennial grasses and moderate bush encroachment. Case study data suggested that initial good rangeland management according to the principles described above could involve a judiciously applied grazing plan, achieved through improved herding and water provision. In the ten year analytical framework, range improvement could be achieved, resulting in a 30% increase in stocking rates and a small increase in calving rates.

In the small scale unfenced open access communal land model, the typical base case involved a household enterprise with 35 head, making use of some 180 hectares of commonage, and aimed at production of meat, milk, draft power, and stock accumulation. Range condition was very poor with no perennial grasses and moderate bush encroachment. Case study data suggested that initial application of the good rangeland management principles described above could involve combining and herding private herds in a judiciously applied grazing plan, involving herd mobility, short heavy grazing, and adequate rest. This would essentially involve a change in behaviour without additional capital or operating costs. In the ten year analytical framework, range improvement could be achieved, resulting in 5% to 10% in stocking rates and a small increase in calving rate.

Tables 5.2.1 to 5.2.3 summarise the findings of the analysis on rangeland use with cattle. The base case values are compared with the changes in costs, physical benefits and values for enterprise worth in the ten year models.

Table 5.2.1: Effects of improved rangeland practices on the financial and economic values associated with commercial land cattle production enterprise (N$ 2008)

Values	Base case (unchanged)	Good range management	
		With herding	With fencing
Parameter changes			
Internal fencing cost (factor)	1	1	2
Cost of waters (factor)	1	2	2
Labour costs (factor)	1	1.5	1
Stock purchases (factor)	1	1.3	1.8
Stocking rate (hectares/LSU)	13	10	7
Calving rate (%)	65%	66%	68%
Private/ economic value changes			
Total initial capital (N$/hectare)	249	291	400
Private annual gross income (N$/hectare)	83	109	155
Private annual net income (N$/hectare)	10	20	41
Private rate of return over 10 years (%)	8%	10%	13%
Annual national income contribution (N$/hectare)	32	48	79
Economic rate of return over 10 years (%)	14%	17%	20%

Table 5.2.2: Effects of improved rangeland practices on the financial and economic values associated with communal land cattle post enterprise (N$ 2008)

Values	Base case (unchanged)	Good range management with herding
Parameter changes		
Internal fencing cost (factor)	1	1
Cost of waters (factor)	1	2
Labour costs (factor)	1	2
Stock purchases (factor)	1	1.5
Stocking rate (hectares/LSU)	11	7
Calving rate (%)	63%	65%
Private/ economic value changes		
Total initial capital (N$/hectare)	159	229
Private annual gross income (N$/hectare)	59	90
Private annual net income (N$/hectare)	11	17
Private rate of return over 10 years (%)	7.8%	7.8%
Annual national income contribution (N$/hectare)	34	55
Economic rate of return over 10 years (%)	11.3%	11.6%

Table 5.2.3: Effects of improved rangeland practices on the financial and economic values associated with communal land small scale cattle keeping (N$ 2008)

Values	Base case (unchanged)	Good range management	
		Conservative	Optimistic
Parameter changes			
Internal fencing cost (factor)	1	1	1
Cost of waters (factor)	1	1	1
Labour costs (factor)	1	1	1
Stock purchases (factor)	1	1	1
Stocking rate (hectares/LSU)	6.6	6.3	5.9
Calving rate (%)	60%	63%	65%
Private/ economic value changes			
Total initial capital (N$/hectare)	485	485	485
Private annual gross income (N$/hectare)	162	172	182
Private annual net income (N$/hectare)	80	88	96
Private rate of return over 10 years (%)	19%	20%	21%
Annual national income contribution (N$/hectare)	83	94	106
Economic rate of return over 10 years (%)	30%	31%	32%

The findings show the degree to which introduction of good range management increases in capital and recurrent costs for the three analysed enterprises In the commercial farm these include increases in

capital fencing or recurrent labour costs (depending on approach) and increases in water provision. In the cattle post these include increased recurrent labour costs and capital for water provision. In the small scale cattle system no additional costs are assumed, as the initial change here is behavioural.
The findings also show that implementation of a sound grazing plan in the commercial farm system, might increase capital costs by between 20% and 60%. After ten years, annual private profits should increase by between 100% and 300%, and the annual contribution to the economy should increase by 50% to 150%. Both the private and economic rates of return on investment also increase quite significantly. In the cattle post system, implementing a grazing plan increases initial capital by some 44%. Annual private profits increase by some 55%, and contribution to the economy increases by some 60%. Of interest is that overall rates of return on investment in ten years do not change, although the net values per unit area do. In the small scale system there is no change to capital costs with implementation of the grazing plan, but over ten years annual private profits should increase marginally by between 10% and 20%, and the annual contribution to the economy should increase by some 15% to 30%. Both the private and economic rates of return on investment also increase marginally.

Sensitivity analysis on the small scale cattle model shows that dramatically enhanced increases in profitability and economic income will be possible if overall stock densities can be reduced along with application of grazing plans. As work currently being undertaken in the communal lands to develop community-based rangeland and livestock management progresses, such stock reductions should be come possible. The long term potential for improving communal rangeland and the associated values is thus significant.

5.3. Economic impact

All the systems analysed show increased net profits and contributions to the economy in the first ten years of implementation of sound grazing plans. Case studies indicate that over the longer term with good range management, stocking rates can be increased up to two or three times. This means that even greater returns can be expected in following years as stocking rates continue to rise on the basis of sunk, initial capital investments. In addition it is expected that the positive findings will be shown to be similar for other uses of rangelands, in other biomes, with small stock systems, and with wildlife for tourism and meat production. This is because the principles involved are similar, and the benefits of sound rangeland management are manifested primarily in higher potential stocking rates.

Analysis of the costs and benefits of invader bush control, have also shown that returns can be positive if the cleared bush has a market, as fuel. Bush control also has positive effects on the conservation of groundwater. Invader bush control can therefore be an additional economically efficient approach to rangeland improvement. Systems are in place, and currently being developed, which could make it possible for the bush encroachment problem to be ameliorated over large areas.

Implementation of the rangeland policy and strategy is economically efficient. With its implementation and assuming reasonable rates of adoption, it is possible that rangeland productivity lost, in the past, can be recovered in the initial phase of ten years. This would mean an increase in the national income of some N$1.8 billion. With continued implementation, continued adoption of sound grazing management, and continued improvements in the national rangeland condition, this increase in the economic contribution of rangelands could conceivably expand to some N$5 billion in 2011 prices.

Global climate change is expected to cause decreased productivity of rangelands and more severe incidence of drought Namibia during the next 50 years. This will be accompanied by associated losses in economic values. The impact of this could be significantly mitigated and even possibly reversed if the NRMPS is implemented.

5.4. Incentives for sustainable rangeland management

The results presented above show that in the current policy environment there are private market-based incentives for good rangeland management. Investing in sound rangeland management practices can increase stocking rates and also increase profitability for rangeland users in both commercial and communal land. It also increases returns to the national economy making it economically efficient.

These **inherent incentives** for the rangeland user, and the nation as a whole, should form the basis for any future interventions by government and other stakeholders in the management of rangelands. The aim should be to strengthen and consolidate these existing market-based incentives. Efforts should be politically acceptable, economically efficient, cost efficient, and should help land users in the face of climate variability and change. They should address the lack of the skills needed to effectively manage grass, and remove market barriers to effective destocking and restocking. They should also address the security of tenure issue in communal lands.

In this context various policy interventions are available for enhancing productivity and welfare in the agriculture sector. These are commonly categorised as direct or indirect measures. Direct policy measures would include those that are regulatory and those that are economic or fiscal in nature. These have direct effects, in the context of rangeland use, on the farmer or investor, affecting operations and profitability. Indirect measures would include those support measures that affect rangeland use practice by creating the environment for sustainable and profitable use of rangeland.

For rangeland use, regulatory policy might involve enforcement of destocking to allow rangeland to recover from excessive continuous grazing pressure. This is not considered suitable in the Namibian context as it is politically untenable, as well as being impossible to enforce and cost ineffective. Regulatory policy in Namibia affecting rangeland users includes the imposition of quotas on export of live small stock, aimed at forcing domestic processing. This is considered inappropriate for good rangeland use as it hampers the free access to markets needed to allow farmers to respond quickly and efficiently to changes in forage production. On the other hand regulatory policy which ensures **free access to all available markets,** developed to exploit comparative advantages, and able to absorb the products of periodic destocking is needed. Policies that regulate for, or encourage, fencing of open areas, reducing the potential for increased mobility through herding management should be avoided.

Economic and policy measures include taxes and subsidies aimed at capturing economic rents, and enhancing production respectively. Financial profitability of rangeland uses in Namibia is generally low and economic rents or excess profits are small, as expected in a mature industry. Imposition of any new taxes on rangeland users is thus not considered appropriate. General subsidies are aimed at enhancing the incentives for production and correcting fiscal or other distortions. In the Namibian rangeland management context, when applied generally to reduce producer costs or increase producer income, they tend to reduce the inherent incentives for good rangeland management described above. General long term subsidisation can tend also to cause distortions in the market and reduce sector competiveness. Selective, preferably short term subsidy supporting, for example, invader bush reductions could be appropriate for rangeland improvement, but economically efficient use of invader bush has potential to make this unnecessary.

Cross subsidisation, which by implication involves no net tax/subsidy, has a potentially positive role for rangeland improvement. This could happen, for example, in price stabilisation, where product prices are enhanced in times of destocking and reduced in times of restocking. Another example, somewhat more

indirect and less efficient, involves animal carcass grade price differentiation, in favour of fat carcasses from good rangeland. However this can lead to rent capture by speculators at the expense of disadvantaged producers.

In the Namibian context, economically efficient and cost effective support for good rangeland management is suggested in **establishment of a fund to allow cross subsidisation and stabilisation of livestock prices during times of destocking and restocking.**

Indirect incentives for rangeland management are considered likely to have the most potential to improve the national rangelands. Important here are initiatives to **support training and extension services by government, NGOs and other stakeholders** in the principles of good rangeland management. This needs to be accompanied by a **research programme aimed at ongoing quantitative monitoring and analysis of farm-level case studies in good rangeland management**. The emphasis here should be on scientific analysis of range condition and stocking effects.

Apart from extension, indirect incentives could involve the mobilisation of rangeland user communities in the development of a **rangeland performance testing scheme,** where producers can monitor and record improvements in their rangeland condition. Most important, and most notably in the communal areas, are initiatives **supporting property rights.** The development of good rangeland practice in the communal lands requires institutional development of community-based rangeland user entities, and **development of common property rangeland management systems,** long the lines of current initiatives. These initiatives provide the way of overcoming the open access grazing problem in the communal lands, allowing for coordinated and flexible rangeland use and optimal stocking rates. They give potential for significant increases in private profits and economic benefits in communal land rangeland management.

5.5. Recommendations

Recommendations arising from the economic and incentives analysis work include:

- Further research and analysis is needed on the economics of rangeland management. In particular there is a need to further develop case studies. A countrywide network of case studies, where sound rangeland management is being applied, is needed. Ongoing, rigorous collection of quantitative data of the type needed for financial and economic analysis should be undertaken over the long term.

- The adoption of sound rangeland management by rangeland users requires knowledge and skill which most rangeland users currently lack. This explains why, in spite of the financial incentives demonstrated above, adoption of sound range management has not been widespread. There is a need for a network of support structures involving not only government but also NGOs and donor funded projects. These need to provide training, extension in sound principles; grazing plan development, management, and implementation; and facilitation for community-based rangeland and livestock management. There is a case here, for the development of a participatory performance testing scheme where users can track and compare the progress made in rangeland improvements.

- An important rangeland management principle in semi-arid and arid biomes is the timely adjustment of stock numbers to conform to changing availability of forage. Market prices tend to work against this so there is a case for the development of price stabilisation fund which can be used to provide incentive for such stock adjustments.

Part 2: The Main Report

1. Introduction

This study evaluates the economic and financial efficiency in five rangeland-based livestock, wildlife and tourism production systems in Namibia. The focus is on the effect of improved range management practises as described in the NRMPS on the profitability and economic efficiency of three beef production systems in the savanna biome. For this use is made of budget and cost-benefit enterprise models to compare typical financial and economic measures for the systems with those which result from measures to manage the range for recovery, rest and animal impact, to increase production of perennial grasses, and to increase the overall carrying capacity of rangeland.

Although the analytical focus is on extensive grazing of savanna habitats for beef cattle production, which has arguably been the dominant rangeland use in Namibia, the study extends the discussion to other habitats; the woodlands of the north east, the Karoo shrublands of the south and west as well as alternative wildlife and tourism production systems in all the habitats. The discussion is also enhanced by drawing from relevant empirical work done on rangeland economics in Namibia. The implications are then design around the eight principles on which the NRMPS is based. The eight principles are: knowledge of the resource base, management for recovery and rest, managing for effective utilisation of plants, enhancing soil condition, addressing bush encroachment, drought planning, monitoring the resource base and the planning of land use infrastructure. The analysis investigates the impact of measures to improve range management on the costs of rangeland use activities, and investigates whether the benefits accruing to these activities due to rangeland improvements are sufficient to recover these costs. The study does not purport to promote any particular rangeland management practices, as being better than others. The focus is on applying the principles, which can be done in a variety of ways in different localities and settings.

The role of economics in the management of rangelands is important. Rangeland use and enterprises must show viability and sound economic base in order to meet ecological goals and enhancing social structures. They also need to demonstrate resilience and profitability in order to incentivize rangeland managers and owners to manage sustainably and for the long term. There

is thus a reciprocal relationship between the potential positive and negative impacts of the economy or economic agents' activities on the sustainability of rangelands. Promoting sustainable economic activity should therefore be an important facet of the National Rangeland Policy and Strategy. This would enable appropriate resource management, sound business planning and the conservation of biological diversity. Finally, mainstreaming economics in rangeland policy and strategy ensures that a wide range of values (social, cultural, economic, aesthetic and ecological) are considered in making balanced decisions about the rangelands. Economic analysis indicates whether the activity is in the national interest. Financial analysis indicates whether there are incentives for the rangeland user, but making decisions on rangelands management purely on financial grounds is inadequate.

The report contains description, in the next section, of the approach to the economic valuation, presented in the next section with discussion on the production model basic parameters. Analytical results are then discussed in Section 3, whilst section 4 offers concluding remarks and policy implications

2. Method of Analysis

2.1 Cost-benefit analysis

The study applies the standard economic methodology of social cost-benefit analysis to estimate the consumptive use values of alternative production systems within the context of sustainable rangeland management. It takes typical base case models of rangeland use and applies the costs and benefits associated with the implementation of good rangeland management principles, to determine whether there is improvement in the net returns to rangeland use. It attempts to isolate **rangeland** costs and benefits from those due to other factors such as farm and herd management. Cost-benefit analysis is commonly used to guide investment decisions where a particular choice has a future stream of costs and benefits associated with it. The approach uses the standard financial appraisal method of discounting, which brings the future stream of costs and benefits into present day terms, to enable direct comparisons to be made between alternative options. The basis of cost-benefit analysis is the proper representation of the stream of costs and benefits associated with alternative options.

2.2 Financial and economic analyses

Financial and Economic analyses have different perspectives or points of view. Financial analysis involves examining the activities and resource flows of the main entities or stakeholders or groups of entities separately. It embraces all resource flows both in-cash and in-kind. Economic analysis involves examining the impact of these activities and resource flows on society (the economy) as a whole.

Financial Analysis calculates the **incentives** for the main stakeholders, checks the solvency and longer-term sustainability of the project, and helps to design possible cost recovery mechanisms. It prepares the ground for an economic analysis, which calculates **all the income** generated by the activity and the incremental change in this income. It consolidates the cash flows of all the the stakeholders in society into a single cash flow. Economic Analysis also provides valuable information on the contribution of the project in the international context as well as domestic effects in the economy.

2.3 National economic parameters

In project appraisal, there are three important national economic parameters to move from financial analysis to economic analysis. The first national parameter is the economic opportunity cost of capital (EOCK), which measures the economic opportunity cost of using the capital resources in the specific project rather than in alternative uses in the economy. If there are distortions in the capital markets, such as taxes and subsidies, then there will be a discrepancy between the financial cost of capital that is applied to the cash flows in the financial analysis and the economic cost of capital that is applied to the corresponding economic cash flows for the investment project.

The second national parameter is the economic opportunity cost of foreign exchange (EOCF). Distortions in the markets that determine the supply and demand of foreign exchange (commonly, trade and other indirect taxes on tradable goods) also result in the economic exchange rate differing from the financial (official or market) exchange rate. Typically these distortions result in the economic value of the foreign exchange being higher than the financial value of the foreign exchange, in which case there is a positive foreign exchange premium (FEP).

Trade taxes and taxes on consumption (such as sales taxes, VAT or excise duties), importantly, tend to reduce the market demand for imports which, in turn, reduce the demand for foreign exchange. This results in the strengthening in the market exchange rate or a positive foreign exchange premium. In the calculations of the conversion factors for the converting line items in the financial analysis to their economic values, we have to take into account the value of the foreign exchange premium.

The third parameter is the economic opportunity cost of labour (EOCL) is the value to the economy of the set of activities given up by the workers including the nonmarket activities (costs and benefits) associated with changes in employment due to the project. The EOCL is the value to the economy of the set of activities given up by the workers including the non-market activities (costs and benefits) associated with changes in employment due to the project.

Humavindu (2007, 2008) presents the first formal and empirical analysis of estimating national economic parameters of the Namibian economy. The derived parameters are presented in Table 1 below:

Table 1: National Economic Parameters

Economic cost of capital (EOCK)	7.2%
Foreign exchange premium (FEP)	4%
Economic cost of unskilled & semi skilled urban labour	32% (economic cost as a share of financial costs)
Economic cost of unskilled and semi skilled rural labour	54%(economic cost as a share of financial costs)
Economic cost of foreign labour	59%(economic cost as a share of financial costs)

2.4 Development of rangeland use enterprise models

The livestock systems and tourism wildlife viewing enterprises in selected rangeland areas were modelled to provide financial and economic measures of value. Standardised financial and economic, spreadsheet, enterprise appraisal models as developed in the Environmental

Economics Unit of Ministry of Environment and Tourism (MET) were developed for each enterprise.

The models for rangeland use available for analysis of good rangeland management are detailed spreadsheets which track the enterprise over ten years incorporating capital costs, annual operating costs and benefits, and they include herd projections for the ten year period. They thus include annualised budgets at full production, and ten-year enterprise development streams valued in Namibia dollars (N$) at constant 2008 prices, where N$1.00 is equivalent to US$0.14. Capital is accounted for in discounted net-benefit flows as direct expenditures and residual values. While private return estimates include land rental costs, the economic returns reflect land use before, rather than after, inclusion of land opportunity costs. This allowed direct comparison between different models regarding returns to land. The economic models' project boundaries embraced the same enterprises as the financial models and so did not include central government expenditures in support of the agricultural sector.

All models contained livestock herd/flock projections, incorporating birth rates, mortality rates, off-takes and purchases, within the constraint of prevailing range carrying capacity. 'Economic' carrying capacity was defined as the area of habitat required to support one large stock unit, while maximum sustainable yield was possible. 'Ecological' carrying capacity was the area that could support the maximum possible number of LSU sustainably, regardless of yield. Livestock stocking rate was calibrated in large stock unit equivalents (LSU), where one LSU was the metabolic mass equivalent of a 450 kilogram bovine steer or ox, as determined for various species and intra-specific age groups by Meissner (1982).

For the purpose of this study, the parameters, assumptions and estimations for the base case models were derived from work done in Namibia and Botswana at various times. Parameters for the savanna biome livestock models were determined using empirical data for semi arid savannas collated and synthesised by Barnes et al. (2001, 2008). Table 2 shows how the key parameters in the base case models vary between the three savanna beef cattle production systems. It must be noted that these are long term average figures, and that there tends to be considerable temporal variation around these mostly as a result of climatic variation.

The parameters for the wildlife viewing tourism models in the Savanna biome were determined using data from Massyn et al. (2008). The Karoo biome livestock parameters were derived from

Barnes & Humavindu (2003). These were then valued to estimate financial values for initial and ongoing capital requirements, recurrent variable and fixed operating expenses, and recurrent enterprise gross income. The annual net income (profit), income accruing to local communities was determined. The overall financial return on investment was measured as the ten-year internal rate of return, and the ten-year net present value. Tables 2 to 4 show some of the parameters used in the enterprise models.

The financial analyses measured the *profitability* for investors or the financial incentive to engage in the activity. The economic analyses measured the value added by these activities to the national income, measured as the *direct* net change in *gross national income*. No account was taken of the indirect value added associated with the activities, through backward and forward linkages. The empirical work on backward and forward linkages of Namibia's economic sectors is very recent. Although this is a major limitation, the result from Humavindu & Stage (2010) on agriculture's linkages to the rest of the economy serves as an important inference. Table 5, below, depicts the importance of the sector's linkages with the rest of the economy. Based on the overall results, Agriculture is a key sector in the economy with widely spread effects. If the current work depicts that application of sustainable rangeland management practises is welfare enhancing, it is therefore vital that efficiencies are enhanced within the sector to ensure its contribution as a key sector in the economy.

In addition, no account was taken of indirect use values (ecosystem service values), and non-use values (existence, bequest and option values).

The livestock systems modelled for the savanna biome included:

(a) Small-scale cattle keeping with unfenced, open access tenure for milk, beef and transport service production as well as wealth generation, in more densely settled communal lands. This is mostly found in the north central Cuvelai area and along the main rivers in Kavango and Caprivi.

(b) Cattle-post livestock-keeping with unfenced, *de facto* partially exclusive access, for beef Production, and wealth generation, in the more remote, less settled communal land areas of the north and east.

(c) Commercial livestock production, with exclusive access, for beef production, typified in the northern and central parts of the commercial farm lands.

All these are dominated by cattle and entailed some form of breeding and rearing. In the Karoo biome, the livestock system, dominated by small stock, is modelled on a fenced large scale commercial small stock ranching on commercial land. This involved breeding of karakul sheep primarily for pelts, with some hair and meat production. Although the karakul system is not representative of the small stock industry, it was most comprehensive in terms of data. To enhance the analysis further, literature review was carried out on other small stock economics wherever possible to analyse whether the principles extracted from the karakul system are in congruence from the other studies. The tourism system modelled in the savanna biome involved exclusive fenced commercial large scale non-consumptive tourism with lodge development on commercial land.

Table 2: Key parameters used in base case models for the savannah biome beef cattle livestock systems

Parameters	Traditional small-scale	Cattle Post	Commercial Ranch
Land used (hectares)	180	6,400	10,000
No. cattle (head)	34	750	989
No. goats (head)	3	59	100
ñEconomicò carrying capacity (ha/LSU)	12	14	14
Stocking rate (ha/LSU)	6.5	8.3	12.9
Calving rate (% cows)	60%	63%	65%
Calving rate (% heifers)	60%	63%	65%
Mortality rate (% calves)	18%	8%	5%
Mortality rate (% others)	11%	5%	3%
Bull rate (% herd)	5%	5%	5%
Goat reproductive rate	20%	25%	30%
Average total herd growth rate	0.7%	8%	4.6%
Cattle off-take rate (% herd)	9%	12%	18%
Goat off-take rate (% flock)	20%	25%	30%
Milk yield (litres/lactating cow/annum)	158	n/a	n/a
Transport/draft (days/span of four/annum	55	n/a	n/a

The use of enterprise models for quantitative assessment of rangeland management effects and associated sensitivity analysis was restricted to the savanna beef cattle production land uses described above.

Table 3: Key parameters used in base case model for the Karoo biome small stock production system

Parameters	Commercial unit
Land available (hectares)	87,000
Land used (hectares per enterprise)	52,200
No. livestock (head)	10,346
No. large stock units (LSU)	871
Stocking rate (ha/LSU)	60
ñEconomicò carrying capacity (ha/LSU)	60
Lambing/kidding rate (% of ewes)	130%
Lambing/kidding rate (% of young ewes)	130%
Mortality rate (% of lambs)	28%
Mortality rate (% of adults)	5%
Ram rate (% of flock)	3%
Stock off-take rate (% of stock numbers)	31%
Biomass production (% of stock LSU)	24%

Table 4: Key parameters used in base case models for the tourism wildlife viewing enterprises in the savanna biomes (2008)

Parameters	Commercial unit
Land used (hectares)	27,000
Game density	3.11
Core wildlife area	16,835
ñEconomicò carrying capacity (ha/LSU)	13
Hectares per tourist bed	218
No of lodges	3
Number of tourist beds	124
Occupancy rate (per annum)	63%
Average length of stay	4
Daily tariffs ï Up-market Lodge (N$)	3,000
Daily tariffs - Roadside Lodge (N$)	1,300
Daily tariffs - Mid-market Lodge (N$)	1,300
Daily tariffs - Camping (N$)	n/a

Table 5: Agriculture linkages with the rest of the Namibian economy

Agriculture (subsector)	Backward multiplier	Forward multiplier	Classification
Commercial cereal crops	0.572965	1.615369	Forward oriented sector with widely spread effects
Commercial other crops	0.62345	0.874001	
Commercial animal products	1.066109	0.72826	Backward oriented sector with widely spread effects
Traditional agriculture	1.367334	1.269056	Key sector with widely spread effects

Source: Humavindu & Stage (2010)

3. Results and Analysis

3.1 Biophysical results of improved rangeland management

The study of effects of rangeland management on the economics of beef production systems involved a review of Namibian Rangeland Forum case studies where improved rangeland management has been tested, to identify any quantitative results. Specifically, empirical results which show change in rangeland carrying capacity, herd calving rates, mortality rates, resulting from change in rangeland management, were sought. Similarly data on changes in capital and production costs associated with changes in rangeland management were sought. The best data were obtained for the savanna biome. De Klerk (2011) showed research and case study results for semi arid savanna in Namibia and South Africa, which showed that stocking rates for rangeland in good condition could be two or three time higher than that in poor condition. Nott & Goldberg (2010), described initiatives in the northern communal lands where common property grazing management was being implemented with positive results. Wolkmann et al. (2011) described a case study on fenced commercial beef production in the Ghanzi District of Botswana, where rangeland carrying capacities have been increased substantially, up to three times, through provision of high animal densities combined with long recovery periods and rest.

The data for the Ghanzi case study show that in commercial production two strategies might make a large difference to rangeland carrying capacities.

1. One is to invest in greater herding capacity, more and better-paid herders, to provide better herd and grazing management for range recovery and rest.
2. Another is to invest in more internal fencing instead of more herding to allow fine-tuned herd and grazing management for range recovery and rest.

Both these strategies also require investment in more widespread provision of water points. The results indicate that in the initial ten years of implementation, long term average stock carrying capacities can be increased by some thirty percent with strategy 1 and also suggest that strategy 2 could increase long term average stock carrying capacities by some eighty percent. With both these strategies the improvements in range condition and the more intensive herd management would allow increases in long term average calving rate of some four to eight percent (i.e. from

around 65% to 66% or 68%). It must be noted that increases in calving rates considered to be due to better herd management were excluded from the analysis.

These findings could be extended to the communal lands setting where range under both the cattle post and small-scale open access systems can benefit from greater herd mobility, allowing animal impact, recovery and rest to take place effectively. Further, literature review through the currently ongoing Millennium Challenge Account (MCA) communal lands livestock project (the Community-Based Rangeland and Livestock Management Project) has tended to confirm these findings and have formed the basis for ongoing communal land case studies. Nott & Goldberg (2010) described the principles and initial findings associated with this work.

In the unfenced cattle post setting application of a strategy similar to the commercial farm strategy 1, above, involving investment in herding, better-paid and more herders, as well as increased and more widespread water provision, could, in the first ten years, enhance range carrying capacities by some fifty percent, and increase calving rates by one or two percent.

In the small-scale communal cattle keeping setting, the base case system is inherently productive, but constrained by low herd productivity due to open access. Making use of economies of scale with cooperative herd management is allowing greater mobility and planning of grazing, with little or no increase in capital or operating costs. The same principles at work in strategy 1 above could in the first ten years of implementation, improve average calving rates by some four to eight percent (i.e. from 60% to 63% or 65%), as well as slightly higher range stocking rates, possibly some five to ten percent higher. In both the cattle post and small scale farming systems it is difficult to apply and incentivise the principles of sound rangeland management. This results in smaller initial improvements in the resource base and hence less profitable enterprises.

Formalising and supporting both individual and communal land access and management rights can be expected over the medium and longer term to allow for lower overall stocking rates with higher herd productivity and significant improvements in rangeland condition. Thus it can be expected that rangelands in the communal lands under this programme will increase to the same degree as those for strategy 1 in the Ghanzi commercial farm setting, above.

In the Karoo biome where the small stock base case model is set, there are insufficient quantitative data to hand regarding the biophysical effects of sound range management to enable

an analysis of financial and economic effects. Ongundeji et al. (2011) provided the only available quantitative economic policy analysis of small stock production, but this did not incorporate rangeland data. It can be expected however that similar principles to those above, will be found to hold. The commercial small stock system modelled by Barnes & Humavindu (2003) and Barnes et al. (2010) using the parameters in Table 2, can almost certainly exhibit higher biophysical productivity with improved range management.

In the tourism systems examined, management options with wild animals are fewer. However, in the system modelled by Barnes et al. (2010) using the parameters in Table 3, it is expected that healthy rangeland and ecosystems will enhance the main attributes involved in the tourism product. Tourism financial and economic value can be expected to be positively affected.

Based on the findings from the case studies, the three cattle enterprises in the savanna biome were used in the detailed analysis below. Findings from case studies and the parameters used in the analysis were compared with evidence from other workers in other parts of the world, including that of Macleod & McIvor (2004), Briske et al. (2008), Norton (2003), Mugweni (2003), Condon (1968), Davies (2007), Perkins (1996) and Rodriquez (2008). To varying degrees these studies helped corroborate the principles and parameters applied in the analysis.

This analysis did not deal specifically with range improvements that can be achieved with targeted control of bush encroachment in the savanna biome. These improvements have been shown to be significant, and they provide a strategy for rangeland improvement, additional to that of sound grazing management. De Klerk (2004) showed this, and a detailed cost-benefit analysis of bush control strategies was conducted by Honsbein et al. (2009). They showed that removal of invader bush had positive economic returns when a market for the removed products could be secured. Colin Christian & Associates (2010) conducted an exhaustive study on the effects of invader bush control on ground water, in the savanna biome. Here, the impact of bush removal on groundwater levels was shown to be positive. Reduction of invader bush in the bush encroached savanna and woodland areas of Namibia holds significant promise as an economically efficient strategy for rangeland improvement.

3.2 Financial and economic effects of improved rangeland management

Improvements in range carrying capacity allow increased stocking rates and higher calving rates allow improved herd productivity growth in all the systems. At least in the case of commercial and cattle post production these improvements require new, additional investment in capital and operating costs. The results below, in Tables 6, 7 and 8, derived from application of these changes to the enterprise models, show how various financial and economic value measures are affected by the changes.

Table 6: Effects of improved rangeland practices on the financial and economic values associated with commercial beef cattle production enterprise (N$ 2008)

	Range Management Strategy					
Parameter Changes	**Base case**		**Herded**		**Fenced**	
Internal fencing (factor)	1.00		1.00		2.00	
Waters (factor)	1.00		2.00		2.00	
Labour (factor)	1.00		1.50		1.00	
Stock purchases (factor)	1.00		1.30		1.80	
Stocking rate (Ha/LSU)	13.26		10.09		7.15	
Calving rate (%)	65%		66%		68%	
Value Changes	**Total**	**Per ha**	**Total**	**Per ha**	**Total**	**Per ha**
Total Financial Capital (TCI)	2,485,140	249	2,911,595	291	4,002,093	400
Financial Gross Income	828,721	83	1,091,871	109	1,548,477	155
Variable Financial Costs	397,863	40	519,015	52	727,995	73
Fixed Financial Costs	328,760	33	374,720	37	408,368	41
Net Private Income	102,098	10	198,136	20	412,114	41
FRR (@ 10 Years) (%)	8%	-	10%	-	13%	-
FNPV (@ 10%, @ 10 Years)	(283,839)	(28)	50,118	5	841,308	84
Total Economic Capital	2,375,476	238	2,791,016	279	3,838,716	384
Economic Gross Income	901,207	90	1,190,883	119	1,695,958	170
Economic Costs	578,701	58	713,694	71	907,518	91
Gross Value Added to NI	322,506	32	477,189	48	788,440	79
Net Value Added to NI	254,309	25	416,061	42	708,903	71
ERR (@ 10 Years) (%)	14%	-	17%	-	20%	-
ENPV (@ 10%, @ 10 Years)	984,827	98	1,705,580	171	3,074,145	307
Economic Capital Cost/Job	475,095	-	558,203	-	767,743	-

Applying range management strategy 1, described above, in a savanna commercial beef production enterprise by increasing the herding labour costs by fifty percent and doubling the water provision capital costs could allow a doubling of the annual net income or profit, and an

increase the annual contribution made by the enterprise to the national income of fifty percent. Applying strategy 2 above in the same system by doubling the internal fencing and water provision capital investments could allow the net income or profit to quadruple, and increase the contribution made by the enterprise to the national income by 2.5 times.

Table 7: Effects of improved rangeland practices on the financial and economic values associated with communal land cattle post enterprise (N$ 2008)

	Range Management Strategy			
Parameter Changes	**Base case**		**Herding**	
Internal fencing (factor)	1.00		1.00	
Waters (factor)	1.00		2.00	
Labour (factor)	1.00		2.00	
Stock purchases (factor)	1.00		1.50	
Stocking rate (Ha/LSU)	11.20		7.18	
Calving rate (%)	63%		65%	
Value Change	**Total**	**Per ha**	**Total**	**Per ha**
Total Financial Capital (TCI)	1,019,732	159	1,468,604	229
Financial Gross Income	374,960	59	579,070	90
Variable Financial Costs	214,978	34	331,813	52
Fixed Financial Costs	91,695	14	141,434	22
Net Private Income	68,288	11	105,822	17
Local Community Income	108,788	17	186,822	29
FRR (@ 10 Years)	7.80%	-	7.82%	-
FNPV (@ 10%, @ 10 Years)	(177,644)	(28)	(268,815)	(42)
Total Economic Capital	916,798	143	1,319,476	206
Economic Gross Income	503,058	79	790,329	123
Economic Costs	285,057	45	439,449	69
Gross Value Added to NI	218,001	34	350,880	55
Net Value Added to NI	195,204	31	326,297	51
ERR (@ 10 Years)	11.27%	-	11.57%	-
ENPV (@ 10%, @ 10 Years)	328,005	51	534,659	84
Economic Capital Cost/Job	229,199	-	329,869	-

In the cattle post setting, application of rangeland management strategy 1, might result in a doubling of herding labour costs and a doubling of the capital water provision costs. However, resulting rangeland improvements made possible could increase the annual net income or profit of the enterprise by seventy percent. Similarly, this could result in the economic contribution of the enterprise to the national income increasing by some sixty percent.

Table 8: Effects of improved rangeland practices on the financial and economic values associated with communal small-scale cattle keeping enterprise (N$ 2008)

	Range Management Strategy Sensitivity					
Parameter Changes	**Base case**		**Moderate**		**High**	
Internal fencing (factor)	1.00		1.00		1.00	
Waters (factor)	1.00		1.00		1.00	
Labour (factor)	1.00		1.00		1.00	
Stock purchases (factor)	1.00		1.00		1.00	
Stocking rate (Ha/LSU)	6.62		6.27		5.94	
Calving rate (%)	60%		62.5%		65%	
Value Changes	**Total**	**Per ha**	**Total**	**Per ha**	**Total**	**Per ha**
Total Financial Capital (TCI)	87,345	485	87,345	485	87,345	485
Financial Gross Income	29,237	162	30,956	172	32,753	182
Variable Financial Costs	4,865	27	5,128	28	5,399	30
Fixed Financial Costs	10,017	56	10,017	56	10,017	56
Net Private Income	14,355	80	15,811	88	17,337	96
Local Community Income	21,375	119	22,831	127	24,357	135
FRR (@ 10 Years)	19%	-	20%	-	21%	-
FNPV (@ 10%, @ 10 Years)	40,437	225	45,406	252	50,572	281
Total Economic Capital	78,335	435	78,335	435	78,335	435
Economic Gross Income	29,802	166	32,071	178	34,454	191
Economic Costs	14,873	83	15,082	84	15,298	85
Gross Value Added to NI	14,929	83	16,989	94	19,156	106
Net Value Added to NI	13,716	76	15,776	88	17,943	100
ERR (@ 10 Years)	30%	-	31%	-	32%	-
ENPV (@ 10%, @ 10 Years)	98,336	546	104,778	582	111,478	619
Economic Capital Cost/Job	60,258	-	60,258	-	60,258	-

In the case of the small-scale cattle keeping enterprise in the more densely settled and highly stocked communal lands, options for improving management appear more limited. Application of rangeland management strategy 1 could involve greater mobility in larger communal herds where better use of forage is possible. This would not entail specific increases in capital or operation costs, but it could increase the calving rate to some extent. This could increase the enterprise net income by about ten or twenty percent. The economic contribution made to the national income could increase by some twelve to thirty percent.

It must be noted that in both the cattle post and small scale systems the contribution to the national income can be increased beyond these levels if a favourable policy and support process is in place to overcome the tendency for open access grazing. With these measures in place it is expected that much higher increases in production, along the lines of that expected with the commercial beef production system. Sensitivity analysis on the small scale communal land model shows that that the economic contribution of the communal lands systems could likely double in the longer term with implementation of initiatives such as the Community-Based Rangeland and Livestock Management project.

3.3 Incentives for sustainable rangeland practices

The results presented above show that in the current policy environment there are private market-based incentives for good rangeland management. Investing in sound rangeland management practices can increase stocking rates and also increase profitability for rangeland users in both commercial and communal land. It also increases returns to the national economy making it economically efficient. These inherent incentives for the rangeland user, and the nation as a whole, should form the basis for any future interventions by government and other stakeholders in the management of rangelands. The aim should be to strengthen and consolidate these existing market-based incentives.

Efforts to support the adoption and practise of good rangeland management should be politically acceptable, economically efficient and cost efficient, helping land users to generate increased income and jobs, in the face of climate variability and change. Among rangeland users there is a lack of the skills needed to effectively manage grass for maximum production and profits. In the market there are barriers which make it difficult for them to cope with variation in grass production through effective destocking and restocking. In communal lands there are institutional weaknesses due to lack of secure property rights, which hamper attempts by individuals or groups to better manage their rangelands.

In this context various policy interventions are available for enhancing productivity and welfare in the agriculture sector (Ritson 1977; Reynolds & Stafford Smith 2002). These are commonly categorised as direct or indirect measures. Direct policy measures would include those that are regulatory and those that are economic or fiscal in nature. These have direct effects, in the context of rangeland use, on the farmer or investor, affecting operations and profitability.

Indirect measures would include those support measures that affect rangeland use practice by creating the environment for sustainable and profitable use of rangeland.

For rangeland use, regulatory policy might involve enforcement of destocking to allow rangeland to recover from excessive continuous grazing pressure. This is not considered suitable in the Namibian context as it is politically untenable, as well as being impossible to enforce and cost ineffective. Regulatory policy in Namibia affecting rangeland users includes the imposition of quotas on export of live small stock, aimed at forcing domestic processing. This is considered inappropriate for good rangeland use as it hampers the free access to markets needed to allow farmers to respond quickly and efficiently to changes in forage production. On the other hand regulatory policy which ensures free access to all available markets, developed to exploit comparative advantages, and able to absorb the products of periodic destocking is needed. Policies that regulate for, or encourage, fencing of open areas, reducing the potential for increased mobility through herding management should be avoided.

Economic and policy measures include taxes and subsidies aimed at capturing economic rents, and enhancing production respectively. Financial profitability of rangeland uses in Namibia is generally low and economic rents or excess profits are small, as expected in a mature industry. Imposition of any new taxes on rangeland users is thus not considered appropriate. General subsidies are aimed at enhancing the incentives for production and correcting fiscal or other distortions. In the Namibian rangeland management context, when applied generally to reduce producer costs or increase producer income, they tend to reduce the inherent incentives for good rangeland management described above, as shown by Barnes et al. (2008). General long term subsidisation can tend also to cause distortions in the market and reduce sector competiveness. Selective, preferably short term subsidy supporting, for example, invader bush reductions could be appropriate for rangeland improvement, but economically efficient use of invader bush has potential to make this unnecessary.

Cross subsidisation, which by implication involves no net tax/subsidy, has a potentially positive role for rangeland improvement. This could happen, for example, in price stabilisation, where product prices are enhanced in times of destocking and reduced in times of restocking. Another example, somewhat more indirect and less efficient, involves animal carcass grade price differentiation, in favour of fat carcasses from good rangeland. However this can lead to rent capture by speculators at the expense of disadvantaged producers.

In the Namibian context, economically efficient and cost effective support for good rangeland management is suggested in establishment of a fund to allow cross subsidisation and stabilisation of livestock prices during times of destocking and restocking.

Indirect incentives for rangeland management are considered likely to have the most potential to improve the national rangelands. Important here are initiatives to support training and extension services by government, NGOs and other stakeholders in the principles of good rangeland management. This needs to be accompanied by a research programme aimed at ongoing monitoring and analysis of farm-level case studies in good rangeland management. The emphasis here should be on scientific analysis of range condition and stocking effects.

Apart from extension, indirect incentives could involve the mobilisation of rangeland user communities in the development of a performance testing scheme, where producers can monitor and record improvements in their rangeland condition. Most important, and most notably in the communal areas, are initiatives supporting property rights. The development of good rangeland practice in the communal lands requires institutional development of community-based rangeland user entities, and development of common property rangeland management systems, long the lines of the current MCC initiative (Nott & Goldberg 2010). These initiatives provide the way of overcoming the open access grazing problem in the communal lands, allowing for coordinated and flexible rangeland use and optimal stocking rates. They give potential for significant increases in private profits and economic benefits in communal land rangeland management.

4. Conclusions and Recommendations

The analysis of ten year investment models for beef cattle production in the savanna areas indicates consistently that introduction of sound range management practices, incorporating the NRMPS principles, can increase average carrying capacity for stock. Investments in these practices can be expected to be financially profitable and economically efficient. Profitability values can be enhanced significantly in the commercial and cattle post systems. Annual gross and net contributions to the national income, economic rates of return, and economic net present values and can also be expected to increase in most cases significantly. In the case of the small

scale open access cattle keeping system, improvements in range condition and herd productivity appear to be possible with common property rangeland management initiatives. These might increase long term average profitability for farmers in the first ten years by up to ten percent. Economic contributions might increase by up to thirty percent. As outlined in the previous sections if these efforts are combined with an effective policy and support environment then the financial profitability and economic contributions in the longer term will in all likelihood be significantly larger than presented.

Case study data shows that initial gains in rangeland improvement will tend in the longer term to increase further. Thus, the increases in rangeland carrying capacity applied in the models analysed here could double or triple in the longer term. Once initial costs are sunk, the profitability and economic efficiency measures measured in the analysis are likely to increase further.

In terms of the other biomes in the country, the woodlands of the north east are expected to have similar properties, and the same conclusions could be applied here. The profitability and economic efficiency of rangeland use with small stock in the Karoo biome should show similar gains with good grazing management investments. However for analysis of this, more quantitative empirical evidence is needed. Recent research, though not comprehensive enough, provides further evidence on the small stock economics. Ogundeji et al (2011) uses a Policy Analysis Matrix (PAM) to measure the impact of policy interventions on the commercial dorper sheep industry in southern Namibia. They found that scarce resources are used efficiently and that the subsector is competitive. However, possible contributions of good rangeland practices to these measures were not modelled. For wildlife-based tourism enterprises, which can generate very high profits and economic contributions in places, there is likely to be a looser relationship between active management for improved range and financial and economic performance. Nevertheless it is highly likely that investment in good range management, in wildlife-based rangeland use enterprises will also be positive financially and economically.

Besides good grazing management, the practice of removal of invader bush has shown significant promise in terms increased livestock carrying capacities, financial profitability and economic rewards. The high costs of partial bush eradication can be offset with income the products of clearing such as charcoal. Honsbein et al. (2009) conducted a detailed cost-benefit analysis of the various options for this. Thinning of invader bush increases livestock and wildlife

carrying capacities significantly, but it also contributes to groundwater conservation. Colin Christian & Associates (2010) estimated that invader bush leads to water loss amounting to the order of 12 million m^3 on a 5,000 hectare farm.

There is a case here for payments for environmental services (PES) to be made to incentivise the thinning of invader bush. These are mechanisms to translate external, non-market values of the environment into real financial incentives for local actors to invest in environmental improvements. Pagiola et al. (2007) demonstrate how such systems were used to encourage Nicaraguan farmers to restore degraded pastures, conserve biodiversity and sequester carbon through the planting of trees and other practices. The government could therefore increase current efforts to subsidise the removal of invader bush through various schemes which could also include direct payments.

The current annual contribution of livestock production to the national income as measured by Barnes et al (2010) and Turpie et al (2010), has been measured at some N$2,500 million of which about 80% is generated in the commercial sector. From this analysis and given the results presented, it can be estimated that implementation of the NRMPS over ten years with good adoption could reverse the current loss to Namibia due to past poor rangeland management. Thus some N$1.8 billion in national income could be recovered. Successive phases of implementation with increasing adoption and continued rangeland improvement could increase the contribution of rangelands to national economy by a further N$3.3 billion.

Implementation of the NRMPS could go a long way towards mitigating and reversing the anticipated negative effects of global climate change on rangeland productivity. Turpie et al. (2010) showed that during the next 50 years climate change effects could reduce rangeland productivity in Namibia significantly, as a result of higher temperatures and increased frequency and severity of drought. They used a similar analytical approach to that used here to show that without adaptation through improved rangeland, herd and farm management, losses to the rangeland use sector might amount to some N$2.0 billion.

There is clearly an important need for government to invest in indirect incentives addressing the shortfalls of the range based sector. Information regarding sound rangeland management can be improved within the government extension service, as well as many support organisations and farmers. The policy environment in the communal areas is inadequate resulting in the full benefit

of improved rangeland management not being realised in the communal setting. Incentives will assist farmers to shift the industry in the right direction.

Several points are important regarding the implementation of the NRMPS:

1) Many stakeholders are ignorant of the correct rangeland management principles and information needs to be provided to all stakeholders with respect to the NRMPS and the sharing of lessons from successes, through media and exchange programs. Farmers need to be aware that in order to be successful livestock farmers they need to be successful grass farmers. This paradigm shift needs to be facilitated at a national, regional and local level in Namibia's parks, communal and privately owned land.

2) A critical factor in the communal areas is the need to address the rangeland policy shortfalls created by the previous regime. In terms of rangeland the operational environment is inadequate and does not allow sound management principles to be applied. This result in continued degradation of the resource base, reduced stocking rates, higher risk, poor economic development and many other social problems. Here indirect incentives apply. A conducive policy environment should address the rangeland issue in a similar way to the Communal Conservancy legislation has done with wildlife. In this case, people wanting to work together are allowed to define who will work together, and to put structures and rules in place locally. Farmers can thus apply the principles of sound rangeland management in a way appropriate to them. Mechanisms for self-enforcement need to be developed that are derived and applied at local level, but are also supported by government entities to enable plans to be enforced by communities themselves. In addition, synergies between different land uses (livestock, wildlife, cropping, and forestry), need to be developed through local level land use planning. Rangeland policy development should also develop synergies between the Communal Conservancy, Community Forest, and Community Based Water Management policies in such a way that these policies can all be flexibly combined as required in each setting. Policy changes need to accommodate communal management of the resource base as well as privately managed farms.

3) Effective technical and managerial support to improve rangeland management in Namibia’s parks, communal and privately owned farms needs to be developed. This support should follow other successful models where a partnership between government,

private sector, NGOs and farmers is combined to provide effective and efficient delivery of information, services and support.

4) Certain direct economic incentives need to be created to shift practice towards improved rangeland management. These incentives should cover assisting farmers to track fodder production cycles by destocking and restocking at appropriate times to enable the principles of sound rangeland management to be applied. Policies need to include drought prediction mechanism that enable drought to be predicted early and steps taken early in the dry season to avert large-scale livestock losses. This includes marketing support to ensure unrestricted marketing, as well as the provision of price subsidies to encourage the sale of animals early in the dry season at the right time. Adjustment – also needs to be considered to enable animals to be moved to where conditions are favourable in a given season and then back again. If done correctly all parties can benefit. Any other subsidies related to the farming sector should be linked to sound management practises. For example, subsidies for bush clearing should be linked to sound rangeland management following clearing.

5) Economic and social indicators, which have unambiguous empirical associations with other indicators of rangeland biophysical trends, need to be developed and tracked at the national level. There may be challenges to this in the interim such as dealing with issues associated with the unit of analysis (scale) or overcoming the unavailability of indicator data. However, readily available indicators such as the value of capital investment in rangelands, investments in rangeland improvement, and investments in tourism infrastructure can be used in the interim. Other indicators such as the value of forage harvested from rangeland by livestock, and other values of non-livestock products should be developed through the application of market and non-market valuation techniques.

As mentioned above, a similar modelling approach was used by Turpie et al. (2010) to assess the impact of climate change on livestock/rangeland systems. The results of this study suggest that adaptation to likely hotter and drier conditions with climate change will be facilitated with more mobility and less fencing. This suggests that, where possible, policy direction should lead towards encouraging herding as an important element of sound rangeland management. Besides being more labour intensive and less financially intensive, herding allows more mobility and flexibility

both within and between seasons. This could be an important climate change adaptation factor for the livestock wildlife and tourism sector.

Specific **recommendations** arising from the analysis work include:

- Further research and analysis is needed on the economics of rangeland management. In particular there is a need to further develop case studies. A countrywide network of case studies, where sound rangeland management is being applied, is needed. Ongoing, rigorous collection of quantitative data of the type needed for financial and economic analysis should be undertaken over the long term.
- The adoption of sound rangeland management by rangeland users requires knowledge and skill which most rangeland users currently lack. This explains why, in spite of the inherent financial incentives demonstrated above, adoption of sound range management has not been widespread. There is a need for a network of support structures involving not only government but also NGOs and donor funded projects. These need to provide training, extension in sound principles; grazing plan development, management, and implementation; and facilitation for community-based rangeland and livestock management. There is a case here, for the development of a participatory performance testing scheme where users can track and compare the progress made in rangeland improvements.

An important rangeland management principle in semi-arid and arid biomes is the timely adjustment of stock numbers to conform to changing availability of forage. Market prices tend to work against this so there is a case for the development of price stabilisation fund which can be used to provide incentive for such stock adjustments.

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ANNEXURE 1: Example of a Savanna Rangeland Model

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

ASSUMPTIONS*

Production System:	Beef breeding and rearing for production of three and a half year old steers, with very limited use of goats and game											
Site:	Ranch in the Kunene Region of Namibia south-west of the Etosha National Park											
Ranch Size:	10000	Hectares or,	100	Square Kilometres								
Carrying Capacity:	14	Hectares per LSU Equivalent	or,	7.14	LSU Equivalents/Sq. Km.							
Stock Density:	7.51	LSU Equivalents/Sq. Km. or,	13.3	Hectares per LSU Equivalent								
	100%	Initial Purchase of Breeding C	105									
Calving Rates	100%	Heifers:	65%	Cows less than 7 Yr	65%	Cows more than 7 Yr	65%					
Bull Rate	100%	5.0%	Bull Replacement Rate:	20%								
Mortality Rates	100%	Calves:	5.0%	Cows:	3.0%	Steers:	3.0%	Heifers:	3.0%	Bulls	3.0%	
Selected Prices:	50%	Capital Items	100%	Livestock	(Variations from Normal for Sensitivity Analysis)							
Capital Sources:	100%	Loan =	25%	Equity =	75%	and:	100%	Foreign	0%	Domestic	100%	
Interest Rates:	100%	Rate for Capital Loans:	13%	Rate for Working Capital Loans:	25%							
Working Capital as Proportion of Annual Operating Costs				20%								
Marketing Fees	100%	MEATCO/Agents Fee as % of Turnover	2.28%									
Land Rental and Resource Royalty (N$):		100%	Rental:	0.00	per Ha.	100%	Royalty:	0%	of Turnover			
Manpower Needs:	100%	Managers	1	Skilled Labour	1	Unskilled Labour	3					
		Management:		Foreign	0%	Citizen	100%					
Shadow Wage Adjustment:	100%	Managers	1.00	Skilled Labour	1.00	100%	Unskilled Labour	0.54				
Foreign Exchange Premium:	100%	4%	Adjustment Factor =	1.04								
Tax Adjustments:	100%	General VAT/Sales Tax:	11%	Import Taxes: from SACU:	0%	to SACU:	n/a					
Discount Rates:	100%	Financial Discount Rate:	10%	Economic Discount Rate:	7%							
Opportunity Cost of Capital	100%	7%										

Static models depict enterprise at full production. Static financial model includes interest, amortisation government fees, royalties and land rentals. Static economic model takes foreign inflows and outflows into account, excludes other interest and transfers and values enterprise in economic prices before land and government costs

Dynamic models presented over 5 and 10 years, to measure IRR and NPV. Financial dynamic model, at constant prices, excludes interest and depreciation, and includes asset residual values. Economic model includes foreign inflows and outflows, and measures value of enterpise in economic prices before inclusion of land costs and public expenditures.

* Shaded cells indicate degree of conformity with base case values. Percentages in underlined shaded cells can be changed

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 1: CAPITAL REQUIREMENTS

ITEM	UNIT	QUANT.	PRICE NAD	FINAN. COST	LIFE Years	AMORT. + INT.	DEPREC-IATION	ECON. DEPR.	FOREX ADJ.	TAX ADJ.	ECON. COST
FIXED CAPITAL											
DOMESTIC ITEMS											
Houses Manager		1	43313	21656	40	3037	541	482	1.00	0.89	19274
Houses Labour		4	17325	34650	40	4859	866	771	1.00	0.89	34650
Office/Storerooms		1	23100	11550	40	1620	289	257	1.00	0.89	10280
Tourist/Hunter Lodges		0	46200	0	40	0	0	0	1.00	0.89	0
Boreholes		2	51975	51975	40	7288	1299	1156	1.00	0.89	46258
Plunge Dip		0	27720	0	40	0	0	0	1.00	0.89	0
Resevoirs/Pipes/Troughs		2	33017	33017	40	4630	825	735	1.00	0.89	29385
Firebreaks/Roads	(km)	60	2310	69300	40	9717	1733	1542	1.00	0.89	61677
Power/Road to Site		1	69300	34650	40	4859	866	771	1.00	0.89	30839
CONTINGENCIES @ 5%				12840	40	1800	321	286	1.00	0.89	11428
SUBTOTAL DOMESTIC ITEMS				269638							243790
TRADABLE ITEMS											
Pens, Boma		1	12936	6468	20	907	323	299	1.04	0.89	5987
Scale and Crush		1	13860	6930	15	1059	462	428	1.04	0.89	6414
Pump/Windmill/Borehole Equipment		2	2310	2310	15	353	154	143	1.04	0.89	2138
Fencing Perimeter	(km)	45.00	10418	234407	15	35805	15627	14464	1.04	0.89	216967
Fencing Internal	(km)	30.00	9471	142065	15	21700	9471	8766	1.04	0.89	131495
CONTINGENCIES @ 5%				19609	15	2995	1307	1210	1.04	0.89	18150
SUBTOTAL TRADABLES				411789							381152
SUBTOTAL- FIXED CAPITAL				681428							624942
MOVABLE CAPITAL											
TRADABLE ITEMS											
LDVs/Trucks		1	231000	115500	4	38629	28875	26727	1.04	0.89	106907
Tools/Ranch Equipment		1	46200	23100	6	5738	3850	3564	1.04	0.89	21381
Office/Other Equipment		1	43890	21945	6	5451	3658	3385	1.04	0.89	20312
Feed/Salt Drums		1	8663	4331	6	1076	722	668	1.04	0.89	4009
CONTINGENCIES @ 10%				16488	6	4096	2748	2543	1.04	0.89	15261
SUBTOTAL TRADABLES				181364							167870
DOMESTIC ITEMS			ECON.	FIN.							
Breeding Stock/Calves	(batch)	1	718232	718232	40	100710			1.00	0.89	639227
Other Heifers, Steers	(batch)	1	451543	451543	40	63315			1.00	0.89	401873
Bulls	(batch)	1	38578	38578	40	5409			1.00	0.89	34334
Goats/Sheep	(batch)	1	21945	21945	40	3077			1.00	0.89	19531
Game	(batch)	1	137330	137330	40	19256			2.00	0.89	244447
Horses and Donkeys	(batch)	1	6930	6930	40	972			1.00	0.89	6168
CONTINGENCIES @ 10%				137456	40	19274			1.00	0.89	122336
SUBTOTAL- DOMESTIC ITEMS				1512013							1467915
SUBTOTAL- MOVABLE CAPITAL				1693377							1635785
WORKING CAPITAL				LOAN	INTEREST						
VARIABLE				79117	19779				1.04	1.00	82282
OVERHEAD				30763	7691				1.04	1.00	31993
SUBTOTAL- WORKING CAPITAL				109880	27470						114275
TOTALS				2484684	27470	367632	73938	68197			2375002

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 2: STOCK COMPOSITION BY SPECIES AT FULL PRODUCTION

ITEM	HEAD	OFF-TAKE (NO.)	LSU FACTOR	LSU
Breeding Cows	313	61	1.00	313
Breeding Heifers	88	18	0.70	62
Bulls	20	6	1.33	27
Surplus Heifers	0	22	1.00	0
Calves	249	0	0.31	77
1st Year Steers	120	0	0.71	86
1st Year Heifers	120	0	0.61	73
2 Year Steers	77	33	0.89	69
3 Year Steers	0	73	1.11	0
4 Year Oxen	0	0	1.18	0
5 Year Oxen	0	0	1.25	0
6 Year Oxen	0	0	1.25	0
7 Year Oxen	0	0	1.25	0
8 Year Oxen	0	0	1.25	0
9 Year Oxen	0	0	1.25	0
Goats/Sheep	100	38	0.14	14
Donkeys/Horses	5	0	0.63	3
Gemsbok	25	3	0.40	10
Kudu	25	3	0.45	11
Ostrich	20	3	0.26	5
TOTAL	1164	259		751

STOCK DENSITY: 7.51 LSU PER SQ.KM.; RANCH SIZE: 10000 HECTARES

TABLE 3: SALES AT FULL PRODUCTION

ITEM	QUANTITY (HEAD)	FINANCIAL VALUE	FOREX ADJ.	TAX ADJ.	ECON. VALUE
Cull Cows	61	225484	1.04	0.89	208708
Cull Heifers	18	58786	1.04	0.89	54412
Heifers	22	62691	1.04	0.89	58027
Steers/Oxen	106	406537	1.04	0.89	376290
Weaners	0	0	1.04	0.89	0
Bulls	6	33370	1.04	0.89	30887
Goats/Sheep	38	16459	1.04	1.00	17117
Gemsbok	3	4893	1.04	1.00	5088
Kudu	3	5489	1.04	1.00	5708
Ostrich	3	7013	1.04	1.00	7294
Milk		8000	1.04	1.00	8320
TOTALS	259	GROSS INCOME : 828721			771852

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 4: VARIABLE EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES N$/LSU	N$/HA.	VALUE	FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES N$/LSU	N$/HA.	VALUE
TRADABLE ITEMS								
Supplements	185.38	13.91	139138	1.04	0.89	171.59	12.88	128786
Dip Costs	0.00	0.00	0	1.04	0.89	0.00	0.00	0
Replacement Bulls	33.35	2.50	25028	1.04	0.89	44.46	3.34	33370
Ear Tags	3.30	0.25	2479	1.04	0.89	3.06	0.23	2295
Transport	13.68	1.03	10266	1.04	0.89	12.66	0.95	9502
Fuels, Oils	21.60	1.62	16211	1.04	0.89	19.99	1.50	15005
Live Game: Aerial Support	0.00	0.00	0	1.04	0.89	0.00	0.00	0
: Field Ops.	0.00	0.00	0	1.04	0.89	0.00	0.00	0
: Transport	0.00	0.00	0	1.04	0.89	0.00	0.00	0
Cropping: Ammunition	0.81	0.06	607	1.04	0.89	0.75	0.06	562
: Supplies and Packaging	0.32	0.02	243	1.04	0.89	0.30	0.02	225
: Transport	4.62	0.35	3464	1.04	0.89	4.27	0.32	3207
: Other	0.00	0.00	0	1.04	0.89	0.00	0.00	0
Miscellaneous Costs	25.62	1.92	19226	1.04	0.89	23.71	1.78	17796
SUBTOTAL TRADABLES	288.67	21.67	216662			280.78	21.07	210747
DOMESTIC ITEMS								
Veterinary and Medicine Costs	95.59	7.17	71747	1.00	0.89	85.08	6.39	63855
MEATCO Marketing Fees	22.08	1.66	16574	1.00	1.00	0.00	0.00	0
Game Licence Fees	5.39	0.40	4047	1.00	1.00	0.00	0.00	0
VAT/Sales Tax	115.32	8.66	86555	1.00	1.00	0.00	0.00	0
SUBTOTAL DOMESTIC ITEMS	238.39	17.89	178924			85.08	6.39	63855
TOTAL VARIABLE EXPENDITURE	527.05	39.56	395586			365.86	27.46	274602

TABLE 5: OPERATING OVERHEAD EXPENDITURE AT FULL PRODUCTION

ITEM	FINANCIAL VALUES P/LSU	N$$/HA.	VALUE	FOREX ADJ.	TAX ADJ.	ECONOMIC VALUES P/LSU	N$$/HA.	VALUE
DOMESTIC ITEMS								
Salaries and Wages: Unskilled Labour	41.55	3.12	31185	1.00	1.00	41.55	3.12	16840
: Skilled Labour	41.55	3.12	31185	1.00	1.00	41.55	3.12	31185
: Managers	76.94	5.78	57750	1.00	1.00	76.94	5.78	57750
Administration	9.23	0.69	6930	1.00	0.89	9.23	0.69	6168
Maintenance and Repairs	23.58	1.77	17696	1.00	0.89	23.58	1.77	15750
Insurance	12.08	0.91	9068	1.00	0.89	12.08	0.91	8071
Miscellaneous Fixed Costs	0.00	0.00	0	1.00	0.89	0.00	0.00	0
TOTAL OPERATING OVERHEAD EXPEND.	204.93	15.38	153814			204.93	15.38	135763

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 6: STATIC FINANCIAL MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Ranch Extent	Hectares		10000
Ranch Stock	Large Stock Units (LSU)		751
Total Capital Requirement	NAD		2484684
	P/LSU	P/HECTARE	NAD
GROSS INCOME	1104.13	82.87	828721
VARIABLE COSTS	527.05	39.56	395586
GROSS MARGIN	577.08	43.31	433134
OVERHEAD COSTS			
Overhead Operating Costs	204.93	15.38	153814
Loan Amortisation and Interest	122.45	9.19	91908
Provisions for Capital Replacement	73.88	5.55	55454
Interest on Variable Working Capital	26.35	1.98	19779
Interest on Overhead Working Capital	10.25	0.77	7691
Land Rental	0.00	0.00	0
Resource Royalty	0.00	0.00	0
TOTAL OVERHEAD COSTS	437.86	32.86	328646
NET CASH INCOME	139.21	10.45	104488
NET CASH INCOME/P100 TOTAL CAPITAL INVESTMENT	4.21		
"TOTAL BENEFITS"*/P100 TOTAL CAPITAL INVESTMENT	13.35		
"TOTAL BENEFITS"*/HECTARE	33.18		

* "Total Benefits" = all of Net Cash Income, Salaries and Wages, Licences and Duties, Rental and Royalties.

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 7: STATIC ECONOMIC MODEL (AT FULL PRODUCTION)

ITEM	UNITS		TOTAL
Ranch Extent	Hectares		10000
Ranch Stock	Large Stock Units (LSU)		751
Total Capital Requirement	NAD		2375002
Economic Depreciation Cost	NAD		68197
Foreign Financing (Prorated)	NAD		0
Foreign Amortisation	NAD		0
Foreign Capital Replacement Provision	NAD		0
Foreign Interest Cost	NAD		0
Domestic Interest Cost	NAD		321164
ECONOMIC BENEFITS	P/LSU	P/HECTARE	NAD
Gross Income	1028.36	77.19	771852
Stock Appreciation	172.34	12.94	129355
TOTAL ECONOMIC BENEFITS	1200.70	90.12	901207
ECONOMIC COSTS			
DOMESTIC COMPONENT			
Shadow Unskilled Citizen Wages	22.44	1.68	16840
Other Citizen Wages	118.49	8.89	88935
Opportunity Cost of Capital	221.50	16.63	166250
Other Domestic Economic Costs	125.03	9.38	93843
SUBTOTAL DOMESTIC COMPONENT	487.46	36.59	365868
TRADABLE COMPONENT			
Foreign Remuneration	0.00	0.00	0
Foreign Services	0.00	0.00	0
Foreign Interest	0.00	0.00	0
Foreign Lease Payments	0.00	0.00	0
Foreign Rentals	0.00	0.00	0
Foreign Net Income	0.00	0.00	0
Other Tradable Economic Costs	280.78	21.07	210747
SUBTOTAL TRADABLE COMPONENT	280.78	21.07	210747
TOTAL ECONOMIC COSTS	768.24	57.66	576615
NET ECONOMIC BENEFIT (Gross Value Added)	432.46	32.46	324592
NET VALUE ADDED (Excluding Depreciation)	341.60	25.64	256394
DOMESTIC RESOURCE COST RATIO =	1.22		
NET VALUE ADDED/P100 TOTAL CAPITAL COST =	10.80		
CAPITAL COST/EMPLOYMENT OPPORTUNITY CREATED =	475000		
NUMBER OF EMPLOYMENT OPPORTUNITIES/1000 HA.	0.50		

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 8: CAPITAL PHASING, DEPRECIATION SCHEDULE AND CALCULATION OF RESIDUAL VALUE

ITEM	LIFE (Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
DEPRECIABLE ASSETS												
"Forty Year" Items	40											
Total Expenditure		269638										
Phased Expenditure		161783	107855	0	0	0	0	0	0	0	0	0
Depreciation		4045	6741	6741	6741	6741	6741	6741	6741	6741	6741	6741
Residual value		161783	265594	258853	252112	245371	238630	231889	225148	218407	211666	204925
"Twenty Year" Items	20											
Total Expenditure		6468										
Phased Expenditure		6468	0	0	0	0	0	0	0	0	0	0
Depreciation		323	323	323	323	323	323	323	323	323	323	323
Residual value		6468	6145	5821	5498	5174	4851	4528	4204	3881	3557	3234
"Fifteen Year" Items	15											
Total Expenditure		405321										
Phased Expenditure		243193	162129	0	0	0	0	0	0	0	0	0
Depreciation		16213	27021	27021	27021	27021	27021	27021	27021	27021	27021	27021
Residual value		243193	389108	362087	335066	308044	281023	254001	226980	199958	172937	145916
"Six Year" Items	6						6					
Total Expenditure		65864						65864				
Phased Expenditure		46105	19759	0	0	0	0	46105	19759	0	0	0
Depreciation		7684	10977	10977	10977	10977	10977	10977	10977	10977	10977	10977
Residual value		46105	58180	47202	36225	25248	14271	49398	58180	47202	36225	25248
"Four Year" Items	4											
Total Expenditure		115500				115500				115500		
Phased Expenditure		115500	0	0	0	115500	0	0	0	115500	0	0
Depreciation		28875	28875	28875	28875	28875	28875	28875	28875	28875	28875	28875
Residual value		115500	86625	57750	28875	115500	86625	57750	28875	115500	86625	57750
NON DEPRECIABLE ASSETS												
Stock	-											
Phased Fin, Expenditure		1208352	14995	14995	18590	21298	25015	29665	30646	31444	33251	33370
Phased Econ. Expenditure		1208352	14995	14995	18590	21298	25015	29665	30646	31444	33251	33370
Residual value		1407474	1486274	1664599	1912813	2235323	2599962	2816956	2997306	3149871	3207968	3246736
Working Capital	-											
Phased Expenditure		109880	0	0	0	0	0	0	0	0	0	0
TOTAL PHASED CAPITAL EXPENDITURE												
Domestic Component		1370135	122850	14995	18590	21298	25015	29665	30646	31444	33251	33370
Tradable Component		411265	181888	0	0	115500	0	46105	19759	115500	0	0
Total Financial Value		1781401	304738	14995	18590	136798	25015	75770	50405	146944	33251	33370
Total Economic Value		1600088	277692	13345	16545	125862	22263	69076	45564	134892	29593	29699
TOTAL ASSET RESIDUAL VALUE												
Domestic Component		1569257	1751867	1923452	2164924	2480694	2838592	3048845	3222454	3368278	3419634	3451661
Tradable Component		411265	540058	472861	405664	453966	386769	365677	318239	366542	299345	232147
Financial Value		1980523	2291925	2396312	2570588	2934660	3225361	3414521	3540692	3734820	3718979	3683809
Economic Value		1777306	2059039	2149552	2302265	2628009	2884341	3051942	3162546	3337039	3320548	3286854

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION

STOCK ON HAND (AUGUST)

	Growth	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows		105	132	176	218	250	294	296	306	314	312	313
Breeding Heifers		31	49	49	40	53	65	75	75	89	92	88
Bulls		7	9	11	13	15	18	19	19	20	20	20
Surplus Heifers		0	0	0	0	0	0	0	0	0	0	0
Calves		104	84	112	139	159	187	222	229	235	248	249
1st Year Steers		51	50	41	54	67	77	91	107	111	114	120
1st Year Heifers		51	50	41	54	67	77	91	107	111	114	120
2 Year Steers		49	35	34	28	37	46	52	62	73	75	77
3 Year Steers		0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen		0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	0.3	125	125	125	125	125	125	125	125	125	125	125
Donkeys/Horses	0.0955	5	5	5	5	5	5	5	5	5	5	5
Gemsbok	0.12	25	25	25	25	25	25	25	25	25	25	25
Kudu	0.12	25	25	25	25	25	25	25	25	25	25	25
Ostrich	0.138	20	20	20	20	20	20	20	20	20	20	20
TOTALS		598	610	664	746	848	964	1044	1105	1152	1175	1189
PERCENT OF ORIGINAL NO.		100%	102%	111%	125%	142%	161%	175%	185%	193%	197%	199%
PERCENT OF FINAL NO.		50%	51%	56%	63%	71%	81%	88%	93%	97%	99%	100%
ANNUAL INCREASE (%)			2%	9%	12%	14%	14%	8%	6%	4%	2%	1%

STOCK SALES (No.)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	0	0	0	0	0	0	43	43	44	61	61
Breeding Heifers	0	0	0	0	0	0	10	11	11	17	18
Bulls	0	2	3	3	4	5	5	6	6	6	6
Surplus Heifers	0	0	0	0	0	0	0	13	16	16	22
Calves	0	0	0	0	0	0	0	0	0	0	0
1st Year Steers	0	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	0	0	0	0	0	0	0	0	0	0	0
2 Year Steers	15	15	15	12	16	20	22	26	31	32	33
3 Year Steers	0	48	34	33	27	36	44	51	60	71	73
4 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	0	38	38	38	38	38	38	38	38	38	38
Donkeys/Horses	0	0	0	0	0	0	0	0	0	0	0
Gemsbok	0	3	3	3	3	3	3	3	3	3	3
Kudu	0	3	3	3	3	3	3	3	3	3	3
Ostrich	0	3	3	3	3	3	3	3	3	3	3
TOTALS	15	64	51	48	46	60	124	150	168	203	213
PERCENT OFFTAKE RATE (No	2%	11%	8%	6%	5%	6%	12%	14%	15%	17%	18%
PERCENT OF FINAL SALES	7%	30%	24%	23%	22%	28%	58%	70%	79%	96%	100%

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION (Continued)

STOCK PURCHASES (No.)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	105	0	0	0	0	0	0	0	0	0	0
Breeding Heifers	31	0	0	0	0	0	0	0	0	0	0
Bulls	7	2	3	3	4	5	5	6	6	6	6
Surplus Heifers	0	0	0	0	0	0	0	0	0	0	0
Calves	104	0	0	0	0	0	0	0	0	0	0
1st Year Steers	51	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	51	0	0	0	0	0	0	0	0	0	0
2 Year Steers	49	0	0	0	0	0	0	0	0	0	0
3 Year Steers	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	50	0	0	0	0	0	0	0	0	0	0
Donkeys/Horses	5	0	0	0	0	0	0	0	0	0	0
Gemsbok	25	0	0	0	0	0	0	0	0	0	0
Kudu	25	0	0	0	0	0	0	0	0	0	0
Ostrich	20	0	0	0	0	0	0	0	0	0	0
TOTALS	398	3	3	3	4	5	5	6	6	6	6

LSU ON HAND (AUGUST)

	LSU /UNIT	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	1.00	105	132	176	218	250	294	296	306	314	312	313
Breeding Heifers	0.70	22	35	34	28	37	46	52	52	62	64	62
Bulls	1.33	9	12	15	17	20	24	25	25	27	27	27
Surplus Heifers	1.00	0	0	0	0	0	0	0	0	0	0	0
Calves	0.31	32	26	35	43	49	58	69	71	73	77	77
1st Year Steers	0.71	36	36	29	39	48	55	64	76	79	81	86
1st Year Heifers	0.61	31	31	25	33	41	47	55	66	68	69	73
2 Year Steers	0.89	44	31	30	25	33	41	47	55	65	67	69
3 Year Steers	1.11	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	1.18	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	0.14	18	18	18	18	18	18	18	18	18	18	18
Donkeys/Horses	0.63	3	3	3	3	3	3	3	3	3	3	3
Gemsbok	0.40	10	10	10	10	10	10	10	10	10	10	10
Kudu	0.45	11	11	11	11	11	11	11	11	11	11	11
Ostrich	0.26	5	5	5	5	5	5	5	5	5	5	5
TOTAL STOCK LSU		279	302	344	402	478	564	608	651	687	698	707
PERCENT OF ORIGINAL LSU		100%	108%	123%	144%	171%	202%	218%	233%	246%	250%	253%
PERCENT OF FINAL LSU		39%	43%	49%	57%	68%	80%	86%	92%	97%	99%	100%

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION (Continued)

LSU SALES

	LSU /UNIT	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	1.00	0	0	0	0	0	0	43	43	44	61	61
Breeding Heifers	0.70	0	0	0	0	0	0	7	8	8	12	12
Bulls	1.33	0	3	4	4	5	6	7	7	8	8	8
Surplus Heifers	1.00	0	0	0	0	0	0	0	13	16	16	22
Calves	0.31	0	0	0	0	0	0	0	0	0	0	0
1st Year Steers	0.71	0	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	0.61	0	0	0	0	0	0	0	0	0	0	0
2 Year Steers	0.89	13	13	13	11	14	17	20	23	28	29	30
3 Year Steers	1.11	0	53	37	37	30	40	49	56	66	79	81
4 Year Oxen	1.18	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	0.14	0	5	5	5	5	5	5	5	5	5	5
Donkeys/Horses	0.63	0	0	0	0	0	0	0	0	0	0	0
Gemsbok	0.40	0	1	1	1	1	1	1	1	1	1	1
Kudu	0.45	0	1	1	1	1	1	1	1	1	1	1
Ostrich	0.26	0	1	1	1	1	1	1	1	1	1	1
TOTAL LSU SALES		13	69	54	52	49	63	126	151	169	204	214
PERCENT OFFTAKE RATE (LS		5%	23%	16%	13%	10%	11%	21%	23%	25%	29%	30%
BEEF PRODUCTION (% LSU)		6%	32%	25%	24%	23%	30%	59%	71%	79%	96%	100%

LSU PURCHASES

	LSU /UNIT	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	1.00	105	0	0	0	0	0	0	0	0	0	0
Breeding Heifers	0.70	22	0	0	0	0	0	0	0	0	0	0
Bulls	1.33	9	3	4	4	5	6	7	7	8	8	8
Surplus Heifers	1.00	0	0	0	0	0	0	0	0	0	0	0
Calves	0.31	32	0	0	0	0	0	0	0	0	0	0
1st Year Steers	0.71	36	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	0.61	31	0	0	0	0	0	0	0	0	0	0
2 Year Steers	0.89	44	0	0	0	0	0	0	0	0	0	0
3 Year Steers	1.11	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	1.18	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	1.25	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	0.14	7	0	0	0	0	0	0	0	0	0	0
Donkeys/Horses	0.63	3	0	0	0	0	0	0	0	0	0	0
Gemsbok	0.40	10	0	0	0	0	0	0	0	0	0	0
Kudu	0.45	11	0	0	0	0	0	0	0	0	0	0
Ostrich	0.26	5	0	0	0	0	0	0	0	0	0	0
TOTAL LSU PURCHASES		279	3	4	4	5	6	7	7	8	8	8

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION (Continued)

VALUE OF STOCK ON HAND (AUGUST) (NAD)

	Value NAD	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	3724	390991	491233	655182	812251	930588	1093003	1101748	1138179	1167837	1162290	1166452
Breeding Heifers	3310	102617	163757	161959	130782	174430	216247	247752	247343	293320	303019	292626
Bulls	5511	38578	49983	61966	70993	83384	98883	102153	104815	110837	111234	110677
Surplus Heifers	2837	0	0	0	0	0	0	0	0	0	0	0
Calves	2160	224624	181384	241921	299918	343613	403583	478603	494428	507312	536459	538380
1st Year Steers	2837	144671	143082	115539	154100	191043	218876	257076	304862	314943	323150	341716
1st Year Heifers	2837	144671	143082	115539	154100	191043	218876	257076	304862	314943	323150	341716
2 Year Steers	3310	162201	114630	113371	91547	122101	151373	173426	203694	241558	249545	256048
3 Year Steers	4059	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	4059	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	3957	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	3856	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	3653	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	3450	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	3247	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	439	54863	54863	54863	54863	54863	54863	54863	54863	54863	54863	54863
Donkeys/Horses	1386	6930	6930	6930	6930	6930	6930	6930	6930	6930	6930	6930
Gemsbok	1631	40772	40772	40772	40772	40772	40772	40772	40772	40772	40772	40772
Kudu	1830	45738	45738	45738	45738	45738	45738	45738	45738	45738	45738	45738
Ostrich	2541	50820	50820	50820	50820	50820	50820	50820	50820	50820	50820	50820
TOTALS		1407474	1486274	1664599	1912813	2235323	2599962	2816956	2997306	3149871	3207968	3246736
PERCENT OF ORIGINAL AMT.		100%	106%	118%	136%	159%	185%	200%	213%	224%	228%	231%
PERCENT OF FINAL AMT.		43%	46%	51%	59%	69%	80%	87%	92%	97%	99%	100%
ANNUAL VALUE INCREASE			78799	178325	248214	322511	364639	216993	180350	152566	58097	38768

VALUE OF SALES (N$, 2008)

	Value NAD	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	3723.72	0	0	0	0	0	0	159032	160304	165605	226560	225484
Breeding Heifers	3310.23	0	0	0	0	0	0	31464	36048	35988	56904	58786
Bulls	5511.11	0	11573	14995	18590	21298	25015	29665	30646	31444	33251	33370
Surplus Heifers	2836.68	0	0	0	0	0	0	0	37405	44357	45824	62691
Calves	2159.85	0	0	0	0	0	0	0	0	0	0	0
1st Year Steers	2836.68	0	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	2836.68	0	0	0	0	0	0	0	0	0	0	0
2 Year Steers	3310.23	48660	49127	48588	39235	52329	64874	74326	87298	103525	106948	109735
3 Year Steers	4058.85	0	192917	136337	134840	108884	145224	180038	206268	242268	287302	296802
4 Year Oxen	4058.67	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	3957.20	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	3855.74	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	3652.80	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	3449.87	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	3246.94	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	438.90	0	16459	16459	16459	16459	16459	16459	16459	16459	16459	16459
Donkeys/Horses	1386.00	0	662	662	662	662	662	662	662	662	662	662
Gemsbok	1630.86	0	4893	4893	4893	4893	4893	4893	4893	4893	4893	4893
Kudu	1829.52	0	5489	5489	5489	5489	5489	5489	5489	5489	5489	5489
Ostrich	2541.00	0	7013	7013	7013	7013	7013	7013	7013	7013	7013	7013
TOTALS		48660	253618	199920	192665	182511	235113	474525	557969	623188	756789	786868
PERCENT OF FINAL VALUE		6%	32%	25%	24%	23%	30%	60%	71%	79%	96%	100%

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION (Continued)

FINANCIAL VALUE OF PURCHASES (NAD)

	Value NAD	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	3723.72	390991	0	0	0	0	0	0	0	0	0	0
Breeding Heifers	3310.23	102617	0	0	0	0	0	0	0	0	0	0
Bulls	5511.11	38578	11573	14995	18590	21298	25015	29665	30646	31444	33251	33370
Surplus Heifers	2836.68	0	0	0	0	0	0	0	0	0	0	0
Calves	2159.85	224624	0	0	0	0	0	0	0	0	0	0
1st Year Steers	2836.68	144671	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	2836.68	144671	0	0	0	0	0	0	0	0	0	0
2 Year Steers	3310.23	162201	0	0	0	0	0	0	0	0	0	0
3 Year Steers	4058.85	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	4058.67	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	3957.20	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	3855.74	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	3652.80	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	3449.87	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	3246.94	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	438.90	21945	0	0	0	0	0	0	0	0	0	0
Donkeys/Horses	1386.00	6930	0	0	0	0	0	0	0	0	0	0
Gemsbok	1630.86	40772	0	0	0	0	0	0	0	0	0	0
Kudu	1829.52	45738	0	0	0	0	0	0	0	0	0	0
Ostrich	2541.00	50820	0	0	0	0	0	0	0	0	0	0
TOTALS		1208352	14995	14995	18590	21298	25015	29665	30646	31444	33251	33370

ECONOMIC VALUE OF PURCHASES (NAD)

	Value (NAD)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Breeding Cows	3723.72	390991	0	0	0	0	0	0	0	0	0	0
Breeding Heifers	3310.23	102617	0	0	0	0	0	0	0	0	0	0
Bulls	5511.11	38578	11573	14995	18590	21298	25015	29665	30646	31444	33251	33370
Surplus Heifers	2836.68	0	0	0	0	0	0	0	0	0	0	0
Calves	2159.85	224624	0	0	0	0	0	0	0	0	0	0
1st Year Steers	2836.68	144671	0	0	0	0	0	0	0	0	0	0
1st Year Heifers	2836.68	144671	0	0	0	0	0	0	0	0	0	0
2 Year Steers	3310.23	162201	0	0	0	0	0	0	0	0	0	0
3 Year Steers	4058.85	0	0	0	0	0	0	0	0	0	0	0
4 Year Oxen	4058.67	0	0	0	0	0	0	0	0	0	0	0
5 Year Oxen	3957.20	0	0	0	0	0	0	0	0	0	0	0
6 Year Oxen	3855.74	0	0	0	0	0	0	0	0	0	0	0
7 Year Oxen	3652.80	0	0	0	0	0	0	0	0	0	0	0
8 Year Oxen	3449.87	0	0	0	0	0	0	0	0	0	0	0
9 Year Oxen	3246.94	0	0	0	0	0	0	0	0	0	0	0
Goats/Sheep	438.90	21945	0	0	0	0	0	0	0	0	0	0
Donkeys/Horses	1386.00	6930	0	0	0	0	0	0	0	0	0	0
Gemsbok	1630.86	40772	0	0	0	0	0	0	0	0	0	0
Kudu	1829.52	45738	0	0	0	0	0	0	0	0	0	0
Ostrich	2541.00	50820	0	0	0	0	0	0	0	0	0	0
TOTALS		1208352	14995	14995	18590	21298	25015	29665	30646	31444	33251	33370

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 9: STOCK PROJECTION (Continued)

ASSUMPTIONS

	Growth Rate	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Calving Rate: Cows		0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Calving Rate: Heifers		0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Mortality Rate: Calves		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Mortality Rate: Others		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Culling Rate: Breeding Stock		0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.20	0.20
%age 2nd Year Heifers Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.20	0.20
Bull Rate		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
%age 1st Year Steers Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 1st Year Heifers Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 2nd Year Steers Sold		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
%age 3rd Year Steers Sold		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
%age 4th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 5th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 6th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 7th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 8th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%age 9th Year Oxen Sold		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Goats/Sheep (% Sold)	0.30	0.00	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Donkeys/Horses (% So	0.10	0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Gemsbok (% Sold))	0.12	0.00	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Kudu (% Sold)	0.12	0.00	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Ostrich (% Sold)	0.14	0.00	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 10: LOAN FINANCING SCHEDULE

ITEM	PERIOD (Yrs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
LONG TERM LOANS												
TWENTY YEAR LOAN	20											
Total Expenditure		447030										
Loan Disbursements		268218	178812	0	0	0	0	0	0	0	0	0
Loan Payments		37609	62682	62682	62682	62682	62682	62682	62682	62682	62682	62682
Amortisation		13411	22351	22351	22351	22351	22351	22351	22351	22351	22351	22351
Interest Payments		24199	40331	40331	40331	40331	40331	40331	40331	40331	40331	40331
Loans Outstanding		268218	433619	411267	388916	366564	344213	321861	299510	277158	254807	232455
FIFTEEN YEAR LOAN	15											
Total Expenditure		101330										
Loan Disbursements		75998	25333	0	0	0	0	0	0	0	0	0
Loan Payments		11609	15478	15478	15478	15478	15478	15478	15478	15478	15478	15478
Amortisation		5067	6755	6755	6755	6755	6755	6755	6755	6755	6755	6755
Interest Payments		6542	8723	8723	8723	8723	8723	8723	8723	8723	8723	8723
Loans Outstanding		75998	96264	89508	82753	75998	69242	62487	55732	48976	42221	35466
SIX YEAR LOAN	6						6					
Total Expenditure		16466						16466				
Loan Disbursements		11526	4940	0	0	0	0	11526	4940	0	0	0
Loan Payments		2863	4090	4090	4090	4090	4090	4090	4090	4090	4090	4090
Amortisation		1921	2744	2744	2744	2744	2744	2744	2744	2744	2744	2744
Interest Payments		942	1346	1346	1346	1346	1346	1346	1346	1346	1346	1346
Loans Outstanding		11526	14545	11801	9056	6312	3568	12349	14545	11801	9056	6312
FOUR YEAR LOAN	4											
Total Expenditure		28875				28875				28875		
Loan Disbursements		28875	0	0	0	28875	0	0	0	28875	0	0
Loan Payments		9657	9657	9657	9657	9657	9657	9657	9657	9657	9657	9657
Amortisation		7219	7219	7219	7219	7219	7219	7219	7219	7219	7219	7219
Interest Payments		2438	2438	2438	2438	2438	2438	2438	2438	2438	2438	2438
Loans Outstanding		28875	21656	14438	7219	28875	21656	14438	7219	28875	21656	14438
SHORT TERM LOANS												
Working Capital	1											
Overdraft		109880	109880	109880	109880	109880	109880	109880	109880	109880	109880	109880
Interest Payments		27470	27470	27470	27470	27470	27470	27470	27470	27470	27470	27470
TOTAL LONG TERM LOAN DISBURSMENTS												
Domestic Component		384617	209084	0	0	28875	0	11526	4940	28875	0	0
Foreign Component *		0	0	0	0	0	0	0	0	0	0	0
TOTAL LONG TERM LOAN AMORTISATION												
Domestic Component		27617	39070	39070	39070	39070	39070	39070	39070	39070	39070	39070
Foreign Component *		0	0	0	0	0	0	0	0	0	0	0
TOTAL INTEREST PAYMENTS												
Domestic Component		61591	80308	80308	80308	80308	80308	80308	80308	80308	80308	80308
Foreign Component *		0	0	0	0	0	0	0	0	0	0	0
TOTAL LOANS OUTSTANDING												
Domestic Component		384617	566084	527014	487944	477749	438679	411135	377005	366810	327740	288671
Foreign Component *		0	0	0	0	0	0	0	0	0	0	0

* Economic Values

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 11: PROJECT FINANCIAL ANALYSIS - 5 YEARS (N$, 2008)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
EXPENDITURE						
Capital Expenditure	1781401	304738	14995	18590	136798	25015
Variable Expenditure	39559	237352	395586	395586	395586	395586
Overhead Expenditure	153814	153814	153814	153814	153814	153814
TOTAL EXPENDITURE	1974774	695904	564396	567990	686199	574416
INCOME						
Gross Income	359254	379367	424884	488240	570560	663633
Asset Residual Value	0	0	0	0	0	3225361
TOTAL INCOME	359254	379367	424884	488240	570560	3888995
NET BENEFIT/COST	-1615520	-316537	-139511	-79750	-115638	3314579

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 5 YEARS = 8.86%
PROJ. NET PRESENT VALUE (NPV) @ 10.00% = -90351 Per Hectare = -9.04

TABLE 12: PROJECT FINANCIAL ANALYSIS - 7 YEARS (N$, 2008)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
EXPENDITURE								
Capital Expenditure	1781401	304738	14995	18590	136798	25015	75770	50405
Variable Expenditure	39559	237352	395586	395586	395586	395586	395586	395586
Overhead Expenditure	153814	153814	153814	153814	153814	153814	153814	153814
TOTAL EXPENDITURE	1974774	695904	564396	567990	686199	574416	625170	599806
INCOME								
Gross Income	359254	379367	424884	488240	570560	663633	719020	765054
Asset Residual Value	0	0	0	0	0	0	0	3540692
TOTAL INCOME	359254	379367	424884	488240	570560	663633	719020	4305747
NET BENEFIT/COST	-1615520	-316537	-139511	-79750	-115638	89218	93850	3705941

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 7 YEARS = 8.80%
PROJ. NET PRESENT VALUE (NPV) @ 10.00% = -133975 Per Hectare = -13.40

TABLE 13: PROJECT FINANCIAL ANALYSIS - 10 YEARS (NAD, 2008)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
EXPENDITURE											
Capital Expenditure	1781401	304738	14995	18590	136798	25015	75770	50405	146944	33251	33370
Variable Expenditure	39559	237352	395586	395586	395586	395586	395586	395586	395586	395586	395586
Overhead Expenditure	153814	153814	153814	153814	153814	153814	153814	153814	153814	153814	153814
TOTAL EXPENDITURE	1974774	695904	564396	567990	686199	574416	625170	599806	696345	582652	582771
INCOME											
Gross Income	359254	379367	424884	488240	570560	663633	719020	765054	803996	818825	828721
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	3683809
TOTAL INCOME	359254	379367	424884	488240	570560	663633	719020	765054	803996	818825	4512529
NET BENEFIT/COST	-1615520	-316537	-139511	-79750	-115638	89218	93850	165249	107651	236174	3929758

PROJ. FINANCIAL RATE OF RETURN (FRR) OVER 10 YEARS = 8.20%
PROJ. NET PRESENT VALUE (NPV) @ 10.00% = -271668 Per Hectare = -27.17

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 14: ECONOMIC ANALYSIS - 5 YEARS (NAD, 2008)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ECONOMIC COSTS						
Capital Expenditure	1600088	277692	13345	16545	125862	22263
Unskilled Wages	16840	16840	16840	16840	16840	16840
Other Domestic Costs	73111	109667	146222	182778	182778	182778
Tradable Costs	21075	84299	168598	210747	210747	210747
Foreign Amortisation	0	0	0	0	0	0
Foreign Profits	0	0	0	0	0	0
Foreign Loans Outst.	0	0	0	0	0	0
TOTAL COSTS	1711114	488497	345005	426910	536227	432628
ECONOMIC BENEFITS						
Gross Income	334601	353334	395728	454736	531407	618093
Asset Residual Value	0	0	0	0	0	2884341
Foreign Financing	0	0	0	0	0	0
TOTAL BENEFITS	334601	353334	395728	454736	531407	3502434
NET BENEFIT/COST	-1376512	-135163	50722	27826	-4820	3069806

ECONOMIC RATE OF RETURN (ERR) OVER 5 YEARS = 16.34%
NET PRESENT VALUE (NPV) @ 7.20% = 679912 Per Hectare = 67.99

TABLE 15: ECONOMIC ANALYSIS - 10 YEARS (NAD, 2008)

ITEM	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
ECONOMIC COSTS											
Capital Expenditure	1600088	277692	13345	16545	125862	22263	69076	45564	134892	29593	29699
Unskilled Wages	16840	16840	16840	16840	16840	16840	16840	16840	16840	16840	16840
Other Domestic Costs	73111	109667	146222	182778	182778	182778	182778	182778	182778	182778	182778
Tradable Costs	21075	84299	168598	210747	210747	210747	210747	210747	210747	210747	210747
Foreign Amortisation	0	0	0	0	0	0	0	0	0	0	0
Foreign Profits	0	0	0	0	0	0	0	0	0	0	0
Foreign Loans Outst.	0	0	0	0	0	0	0	0	0	0	0
TOTAL COSTS	1711114	488497	345005	426910	536227	432628	479441	455929	545257	439958	440064
ECONOMIC BENEFITS											
Gross Income	334601	353334	395728	454736	531407	618093	669679	712554	748824	762636	771852
Asset Residual Value	0	0	0	0	0	0	0	0	0	0	3286854
Foreign Financing	0	0	0	0	0	0	0	0	0	0	0
TOTAL BENEFITS	334601	353334	395728	454736	531407	618093	669679	712554	748824	762636	4058706
NET BENEFIT/COST	-1376512	-135163	50722	27826	-4820	185465	190238	256625	203567	322677	3618642

ECONOMIC RATE OF RETURN (ERR) OVER 10 YEARS = 13.93%
NET PRESENT VALUE (NPV) @ 7.20% = 997560 Per Hectare = 99.76

FINANCIAL/ECONOMIC MODEL - COMMERCIAL LIVESTOCK BREEDING - SAVANNA BIOME - BASE CASE (N$2008)

TABLE 16: SUMMARY OF RESULTS

ITEM	UNITS	TOTAL
Ranch Extent	Hectares	10000
Stock	Large Stock Units (LSU)	751

ITEM	% of TCI	N$/LSU	N$/HECTARE	NAD
Total Financial Capital (TCI)	-	3310.42	248.47	2484684
Financial Gross Income	33.35%	1104.13	82.87	828721
Variable Financial Costs	-	527.05	39.56	395586
Fixed Financial Costs	-	437.86	32.86	328646
Net Cash Income	4.21%	139.21	10.45	104488
Local Community Cash Income	4.83%	160.04	12.01	120120
Land Rental	-	0.00	0.00	0
Resource Royalty	-	0.00	0.00	0
FRR (@ 10Years)	-	-	-	8.20%
FNPV (@ 10%, @ 10 Years)	-	-	-27.17	-271668
Total Economic Capital	-	3164.28	237.50	2375002
Economic Gross Income	37.95%	1200.70	90.12	901207
Economic Costs	24.28%	768.24	57.66	576615
Net Economic Benefit	13.67%	432.46	32.46	324592
Net Value Added	10.80%	341.60	25.64	256394
ERR (@ 10 Years)	-	-	-	13.93%
ENPV (@ 10%, @ 10 Years)	-	-	99.76	997560
Economic Capital Cost/Job	-	-	-	475000
Domestic Resource Cost Ratio	-	-	-	1.22

Policy Analysis Matrix	: Effects of Policy / Market Imperfections	: on Output	-72486
		: on Tradable Inputs	-5915
		: on Domestic Factors	-73505
	: Net Effects of Policy / Market Imperfections	: on Annual Net Income	-151906
		: on Net Present Value (10 Years)	-1269227