



USAID
FROM THE AMERICAN PEOPLE

SOUTHERN AFRICA

Establishing Priorities through use of Multi-criteria Decision Analysis for a Commodity Based Trade approach to Beef Exports from the East Caprivi Region of Namibia

FINAL REPORT

Cassidy, D.,
Thomson, G.,
Barnes, J.,

February 25, 2013

CONTENTS

ACRONYMS/INITIALISMS	5
EXECUTIVE SUMMARY	7
1 BACKGROUND / INTRODUCTION	8
1.1 Commodity based trade	8
1.2 Multi criteria decision analysis.....	9
2 OVERVIEW OF THE SANITARY AND PHYTOSANITARY SITUATION IN NAMIBIA	10
2.1 Introduction	10
2.2 Prior reviews of Sanitary and Phytosanitary (SPS) requirements and capacity building in Namibia in the context of agricultural policy.....	10
2.3 Background and status of Namibia in respect of compliance to the World Trade Organization Sanitary and Phytosanitary Agreement and reporting obligations	11
3. ESTABLISHING SANITARY AND PHYTOSANITARY PRIORITIES USING A MULTI-CRITERIA DECISION-MAKING FRAMEWORK.....	12
Stage 1: Compilation of information dossier	12
Stage 2: Developing a series of reviews.....	12
Stage 3: Definition of choice set	12
Stage 4: Definition of decision criteria and weights	14
Stage 5: Construction of information cards.....	14
Stage 6: Construction of spider diagrams.....	16
Stage 7: Derivation of quantitative priorities	16
Stage 8: Validation	17
4 FINDINGS.....	17
4.1 Land use options for the Caprivi region.....	17
4.2 Results.....	20
5 CONCLUSIONS.....	26
APPENDIXES	28
APPENDIX 1; SELECTED REFERENCES AND BIBLIOGRAPHY	28
Animal production in Namibia	28
Biodiversity	29
Economic and financial studies.....	31
Food safety.....	32
Kavango-Zambezi Transfrontier Conservation Area - general.....	32
Kavango-Zambezi Transfrontier Conservation Area - tourism	33
Kavango-Zambezi Transfrontier Conservation Area wildlife	33
Land degradation	34
Land use options – Kwandu, Kwando, Salambala and state land.....	35
Land use options - conservancies	36
Animal production policy in Namibia.....	38
Social background papers in Namibia.....	39
Economic reviews of Commodity Based Trade.....	40
Technical studies and papers on commodity based trade (CBT).....	41

Carbon sequestration and land management	43
APPENDIX 2; LIST OF PERSONS CONSULTED	46
APPENDIX 3; REVIEWS CARRIED OUT IN THE COURSE OF THE STUDY	47
Introduction; the Kavango-Zambezi Trans Frontier Conservation Area	47
Purpose and establishment of the Conservation Area	47
3.1 Carbon balances in savanna under different management regimes.....	50
3.2; Literature review and discussion document; Ecological values attributed to land use patterns in the Kavango-Zambezi Transfrontier Conservation Area	56
Introduction	56
Carbon sequestration	56
Plant species diversity.....	57
Animal diversity	57
3.3 Land use systems in the Caprivi area of Namibia	58
Introduction	58
Protected areas.....	58
Traditional communal lands	59
Private land	61
Concessions.....	62
Populating an Alternatives list for multi criteria decision analysis.....	62
3.4 Possible social impacts of land use options and commodity based trade in beef in the Caprivi	63
Introduction	63
Agricultural productivity	63
Poverty impacts	64
Impact on vulnerable groups/areas.....	64
Number of households involved.....	65
Women	66
Children.....	66
Vulnerable areas	66
Smallholders	66
Unemployed.....	67
3.5 Scenarios for beef cattle production and beef exports from the Caprivi area of Namibia	70
Introduction	70
Option 1; Status quo	70
Option 2; Initiative to have foot and mouth disease treated like some transboundary animal diseases with a wildlife component, i.e. where wildlife are essentially ignored when it comes to management of trade risk.....	71
Option 3; Have the Caprivi recognized as a zone free from foot and mouth disease with vaccination.....	81
Option 4. Creation of one or more foot and mouth disease -free compartments within the Caprivi.....	82
Option 5; Apply Article 8.5.25 of the Terrestrial Animal Health Code as it currently stands, i.e. dispense with requirement for quarantine of animals & meat but introduce requirement for motorized transport of cattle to QS/abattoir	83
Option 6; Modifications of 8.5.25 that achieve equivalence (Appropriate Level of Protection)	83

Option 7; Develop exclusively commodity based trade (CBT)/hazard analysis and critical control point (HACCP)-based system founded on dedicated risk assessment/management for specific processed products (value chain risk management).....	84
Option 8. Give up the idea of export from the Caprivi & rather develop beef processing systems for poor quality beef aimed at producing beef-based products with extended shelf-life for local consumption & sale in rural areas south of the Veterinary Cordon Fence.....	84
3.6 Analysis of Namibia’s trade data	85
Trade in sanitary and phytosanitary sensitive agri-food products	85
Terrestrial animal product exports	88
Terrestrial animal disease control services.....	88
Marketing.....	90
Cross referencing Revealed Comparative Advantage data with other studies for Namibia	93
Revealed Comparative Advantage in Namibia’s agri-food exports	93
Stability of the revealed comparative advantage indices.....	94
APPENDIX 4; LAND USE OPTION CARDS	95
ENDNOTES AND SELECTED REFERENCES.....	103

ACKNOWLEDGEMENTS

This study was carried out as part of the USAID sanitary and phytosanitary support for regional trade in Southern Africa. The authors wish to acknowledge the considerable help given in the preparation of this study by Elzadia Washington-Danaux, Susanne Thalwitzer, Cyprianus Khaiseb, and Mary Lou Penrith

DISCLAIMER

The authors’ views do not necessarily reflect the views of the United States Agency for International Development or the United States Government. Any errors are those of the authors

Acronyms/initialisms

ALOP	appropriate level of protection
ALR	acceptable level of risk
ASF	African swine fever
AU	African Union
BSE	bovine spongiform encephalopathy
CAADP	Comprehensive African Agriculture Development Programme
CBNRM	community based natural resource management
CBPP	contagious bovine pleuropneumonia
CBT	commodity based trade
CODEX	Codex Alimentarius
COMESA	Common Market for Eastern and Southern Africa
CSF	classical swine fever
DTIS	Diagnostic Trade Integration Study
DVS	Directorate of Veterinary Services
EAC	East African Community
EIF	Enhanced Integrated Framework
EIRR	Economic Internal Rate of Return
EU	European Union
FAN	Farm Assured Namibian Meat Scheme
FAO	Food and Agriculture Organization
FMD	foot and mouth disease
FMDV	foot and mouth disease virus
GDP	Gross Domestic Product
HACCP	hazard analysis and critical control points
HPAI	highly pathogenic avian influenza
HS	Harmonized System
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
KAZA-TFCA	Kavango-Zambezi Transfrontier Conservation Area
LSU	livestock units
MCA	Millennium Challenge Account
MCDA	multi-criteria decision analysis
MoAWD	Ministry of Agriculture, Water, and Rural Development
NCA	Northern Communal Areas
NDP4	Fourth National Development Plan
NNI	Net National Income
NPV	Net Present Value
OIE	World Animal Health Organization
PCE	Phytosanitary Capacity Evaluation
RASFF	Rapid Alert System for Food and Feed
RCA	Revealed Comparative Advantage
SACU	Southern Africa Customs Union
SADC	Southern African Development Community
SAT	Southern African Territories
SPS	sanitary and phytosanitary

STDF	Standards and Trade Development Facility
TAD	transboundary animal diseases
TAHC	Terrestrial Animal Health Code
VCF	Veterinary Cordon Fence
WCS	Wildlife Conservation Society
WHO	World Health Organization
WITS	World Integrated Trade Solution
WTO	World Trade Organization

EXCHANGE RATES

Calculations used in the analysis are primarily the Namibian Dollar designated as N\$ or NAD. Bid rates against the US\$ given in OANDA for the period between 1st December 2012 and 28th February 2013 are;

Period Average	0.1279
Period High	0.1482
Period Low	0.1096

Executive summary

The Sanitary and Phytosanitary Annex to the Tripartite Agreement between the Southern African Development Community (SADC), the Common Market for Eastern and Southern Africa (COMESA) and the East African Community (EAC) together with the SADC Phakalane Declaration on adoption of non-geographic approaches for management of foot and mouth disease (FMD) take issue with costs associated with current geographic, i.e. zonation-based, approaches to managing animal disease-associated trade risks. Such policies have significant negative repercussions for free-ranging wildlife, largely related to the requirement for veterinary cordon fencing. Given the importance of Africa's unique wildlife to its tourism sector new approaches to disease risks that both help Africa's pastoralists and farmers and facilitate wildlife-based tourism are needed. The concept of commodity-based trade, is a non-geographic alternative method of preventing the spread of transboundary animal diseases of trade concern. This approach substitutes geographically based measures with product-specific risk management similar to the hazard analysis and critical control points (HACCP) approach universally adopted for food safety management. The SADC Phakalane Declaration recommends that a cross-sectoral economic impact analysis is necessary in locations where livestock and wildlife are both important as contributors to gross domestic product (GDP).

The World Trade Organization's Standards and Trade Development Facility (WTO/STDF) have promoted the use of a cost-benefit economic analysis methodology, including multi-criteria decision analysis (MCDA), to assist governments and private sector organizations to understand the cross sectoral issues implicit in Sanitary and Phytosanitary (SPS) investment decisions. MCDA is a structured framework that enables the costs and benefits of alternative capacity-building investments to be defined and identifies those options that offer the greatest return over a range of interacting criteria. In the current study MCDA is used to examine four land use options in the Caprivi region according to criteria that include conventional costs and benefits on livestock production, tourism, impact on trade, agricultural productivity, as well as their impacts on environment and human socio-economic well being. The four land use options examined were;

1. *status quo* of conservancies and multispecies land use including formal and informal beef production (no additional investment);
2. two options where investments are made in slaughter for chilled beef or processed meat production;
3. an option to create FMD free compartments.

The results of the analysis strongly indicate that implementing either the commodity-based trade option based on the World Animal Health Organization (OIE) Terrestrial Animal Health Code standard (Article 8.5.25 of the Terrestrial Animal Health Code with modifications), or developing a *sous vide* processing facility were the most favorable investment scenarios across most criteria. The study represents a contribution to the economic, social and environmental analysis of commodity based trade in animal products, though the results need to be revisited and revised on an ongoing basis in the light of improvements in the availability and/or quality of scientific and other data, as well as changes in policy priorities that would shift the decision weights and/or introduce new decision criteria.

1 Background / Introduction

1.1 Commodity based trade

The argument for commodity based trade (CBT) in chilled de-boned beef is outlined in a series of papers (Thompson, et al., 2008, Thompson, 2009)¹ & ² and has been accepted as policy for the development in regional trade in meat by the African Union (AU) and both SADC (³ & ⁴) and COMESA⁵. The starting point of the argument is the issue of animal diseases, in particular foot and mouth disease (FMD), but also Rift Valley Fever, bovine brucellosis, and Crimean-Congo Hemorrhagic fever, that are both indigenous and endemic to Africa and where exports of beef are impossible under current requirements by the OIE which *de facto* require geographic freedom from these diseases. Any effort to eradicate any or all of these diseases will require an attempt that will likely have severe consequences on a number of Africa's ecosystems. The harm will potentially outweigh the benefits and will add to the increasing pressure on the African biosphere. Given that Botswana, for example, earns more from ecotourism than beef that country is likely to resist implementing programs that severely affect the former.

The zoosanitary case for the processing and export of de-boned beef from infected zones where the risk of disease transmission is reduced to an acceptable level of risk, (ALR) by incorporating best practice into a formal hazard analysis and critical control point (HACCP) program operated by the meat processors in any infected zone is currently the subject of a technical and marketing study in Namibia (Thalwitzer, 2012)⁶. A likely outcome of this project is that the introduction of best practice into abattoirs in areas with endemic animal diseases such as FMD will, if acceptable to trading partners in the region, enhance trade prospects. In particular the emerging middle classes of countries such as South Africa, which is largely FMD free, represent a significant market for producers in other parts of Africa. However, it must be pointed out that such trade will require fundamental changes of current South African import requirements.

The analysis presented in this study is a product of the USAID SPS Coordinators with the full engagement of MeatCo in Namibia who are the project leaders for the Millennium Challenge Account (MCA) project looking at resolving technical issues relating to use options Commodity Based Trade in chilled de-boned beef (hereafter CBT) from the Kavango-Zambezi Transfrontier Conservation Region (KAZA-TFCA) of Namibia. The government of Namibia, through the Department of Veterinary Services at the Ministry of Agriculture, Water and Forestry and the Ministry of Tourism and Environment have been apprised of the study and fully consulted as it has progressed. A full list of direct participants and their institutions is given in Appendix 2.

1.2 Multi criteria decision analysis

The underlying motivation/objectives of the study as well as the methodology used are described below. While multi criteria decision analysis can use scalar inputs (ordinal data such as Yes/No information), results are enhanced by the use of linear data in the form of cardinal numbers. The analysis used various types of data much of which is difficult to obtain. In order to provide the analysis with as much hard data as possible various reviews have been conducted including the collection of a vast number of documents produced by other authors and institutions (references are summarized in Appendix 1) together with reviews of policies, economic studies, social and environmental issues as well as reviews of Namibian trade flows and trade performance (see Appendix 3).¹

The framework employed in this study aims to present a more comprehensive analysis of options for SPS capacity-building that can feed into the development of a prioritised action plan for the enhancement of SPS capacity. Thus, the ultimate objective is to *generate a prioritization of options for SPS-related capacity-building in the KAZA-TFCA and similar areas in Africa where wildlife – domestic animal interactions preclude international trade in animals and chilled/frozen meat because buffalo are symptomless carriers of foot and mouth disease (FMD)*. Using a purely business case, the justification for investing in the development of such trade has been found to be weak but such studies are rare and have ignored other economic, environmental and social considerations that may, at least on the face of it, be difficult to reconcile.⁷ The basic assumption of this study is that the rationale for investments in SPS capacity-building is not just compliance with export market SPS requirements *per se*, but the economic and social benefits that might flow from such compliance, whether in terms of enhanced exports, environmental protection, incomes of small-scale producers and/or vulnerable groups, promotion of agricultural productivity and/or domestic public health, etc. The MCDA framework provides an approach for different decision criteria to be taken into account, even though they may be measured in quite different ways. In pursuit of this objective, the framework aims to:

- Identify the current set of options in the context of existing and/or potential land uses and CBT export alternatives, the *choice set*.
- Determine the *decision criteria* that should drive the establishment of priorities between land use/CBT options as well as the default *status quo*, and the relative importance (*decision weights*) to be attached to each.
- Prioritize the identified CBT/land use options on the basis of the defined decision criteria and decision weights.
- Examine the sensitivity of the established priorities to changes in parameters of the framework.

The framework employs a highly structured process that aims to be applied in a wide variety of contexts and to provide various diagrammatic and numerical outputs. An overview of the MCDA framework and

its practical implementation in the case of this study are described in Section 3 and in more detail in a draft user's guide.⁸

2 Overview of the Sanitary and Phytosanitary situation in Namibia

2.1 Introduction

Namibia, on the Atlantic coast of Southern Africa has the driest climate in sub-Saharan Africa, with a mean annual rainfall of less than 400 mm. Just under half of the total land area is under permanent pasture. The low rainfall limits farming in Namibia, in effect, to extensive livestock farming – primarily of cattle. Agriculture provides employment for over half the workforce (70% of the population if one counts subsistence farmers) though it only contributes about 10% to GDP. Livestock production is an important component of this sector being responsible for about seven percent of GDP and 80-90% of the value of commercial agricultural production. The national cattle herd size is over two million head. There are two cattle production systems in Namibia: commercial using freehold and communal lands, the latter based on the commons form of land use. Production is concentrated in the north and east of the country. The commercial sector is capital-intensive, and export oriented, and occupies 52 percent of the grazing land. Communal farmers utilize the remainder (Sweet and Burke 2000⁹). While the two sub-sectors maintain more or less equal holdings of cattle, commercial producers are the primary suppliers of beef production, providing 75-80 percent of annual off-take.¹⁰

2.2 Prior reviews of Sanitary and Phytosanitary (SPS) requirements and capacity building in Namibia in the context of agricultural policy

National agricultural strategy documents, referred to as Comprehensive African Agriculture Development Programme (CAADP) compacts are published by AU countries. Since enhanced regional trade in agricultural products is one deliverable of the Regional Economic Communities within the African Union a significant trade promotion component is usually a major part of a national CAADP Compact. Namibia is in the early stages of the CAADP Roundtable process though some preliminary mechanisms are in place^{11&12}. Namibia has already started moving towards the CAADP budgetary target of 10% to the agricultural sector and agricultural growth target rate of 6% per year though it still falls short of the CAADP targets.¹³ Development goals in the Namibian agricultural sector are outlined in the Fourth National Development Plan (NDP4) which has no specific linkages to the African Union CAADP process. The NDP4 is a high-level plan with three overarching goals:

- High and sustained economic growth
- Increased income equality
- Employment creation

The achievements of these goals are envisaged as being delivered in the key focus sectors of logistics, tourism, manufacturing, and agriculture.¹⁴

As Namibia is a member of the Southern Africa Customs Union (SACU), World Trade Organization (WTO) relationships with Namibia are partially mediated through SACU. Namibia has been a WTO member

since 1 January 1995. SPS support for national agricultural policy from the WTO and the SPS international bodies is through a number of tools used for assessing national SPS capacity. In addition to SPS specific toolkits, there are more general trade diagnostic studies including that of the Enhanced Integrated Framework (EIF) and the Diagnostic Trade Integration Study (DTIS). The main SPS and trade evaluation tools are listed and their status in terms of completion and availability in the case of Namibia is shown in Table 1.

Table 1; Existing reviews of SPS compliance and capacity for Namibia:

Source	Completed
Enhanced Integrated Framework	No
Diagnostic Trade Integration Study	No
Trade Policy Review by WTO (was done for SACU)	Yes ¹⁵
CAADP Compact?	No
Fourth National Development Plan (NDP4)	No
Integrated Approach to Food Safety, Plant & Animal Health: National Biosecurity Capacity Evaluation	No
Evaluation of Performance of Veterinary Services (PVS) Tool ¹⁶	Yes
Pilot of Food and Agriculture Organization (FAO) Guidelines to Assess Capacity-Building Needs to Strengthen National Food Control	No
Phytosanitary Capacity Evaluation (PCE) Tool ¹⁷	Yes
Ad hoc and other national case studies	Yes

Key: Yes = Conducted and in public domain;
 (Yes) = Conducted but not in public domain;
 No = not aware of any.

2.3 Background and status of Namibia in respect of compliance to the World Trade Organization Sanitary and Phytosanitary Agreement and reporting obligations

The SPS mechanisms put in place by the WTO and allied organizations, including FAO, the World Health Organization (WHO) and the OIE, have been in place for over a decade though the bodies themselves pre-date the founding of the WTO. The mechanisms are accompanied by a number of processes to help poorer countries in terms of compliance. Namibia's international SPS compliance is essentially with the various sub structures of the International Plant Protection Convention (IPPC), CODEX (CODEX Alimentarius) and OIE.¹⁸ In addition Namibia is a signatory to two international treaties, The Convention on Biological Diversity of 5 June 1992 and the Cartagena Protocol on Biosafety which is an Annex to the Convention on Biological Diversity,¹⁹ &²⁰ both of which have some bearing on the workings of the SPS Agreement and have led to the additional requirement for a Biosafety National Focal Point to be set up in countries that are signatories to the convention.²¹ & ²² The status of Namibia's compliance with setting up and notifying of national SPS contact points is shown in Table 2.

Table 2; Contact points with various international SPS organizations for Namibia as of January 2013 (Sources: various)²³

WTO TBT enquiry point	Biosafety national focal point	WTO SPS national notification authority	WTO SPS enquiry point	Codex contact point ²⁴	NPPO contact point ²⁵	OIE contact point ²⁶	Official SPS website
Yes	No information	Yes	Yes	Yes	Yes	Yes	No

3. Establishing Sanitary and Phytosanitary priorities using a Multi-criteria Decision-Making Framework

A relatively brief outline of the seven stages of the application of the MCDA framework is provided, with a particular focus on how they were implemented in Namibia (Figure 1). The methodology and data fed into the analysis are described in this section provides a more detailed description and rationale for each of the 4 land use options considered in the priority-setting analysis (see Section 4.1). The land use options are considered in the context of varying approaches to CBT exports and are detailed in Appendix 3.3 and 3.5. The land use options are based on the preliminary reviews of the literature followed by a series of discussions with stakeholders over a period between August 2012 and February 2013. The primary decision on the analysis using land use options was based on the prevailing circumstances in the Caprivi region and the more practical options going forward. This particularly relates to the issue of conservancies versus total wildlife exclusion and modifications that would comply with OIE guidelines on exports from regions where FMD is endemic.

Stage 1: Compilation of information dossier

The first stage of the analysis involved the compilation of a comprehensive dossier of existing information on the SPS challenges facing agri-food exports from Namibia and the associated capacity-building needs with particular reference, in this case, to animal and animal product exports. In so doing, the aim was to ascertain what work had already been undertaken to identify land use options and the definition of priorities for related investments. The principal documents/information collected in the dossier are itemised in Appendix 1.

Stage 2: Developing a series of reviews

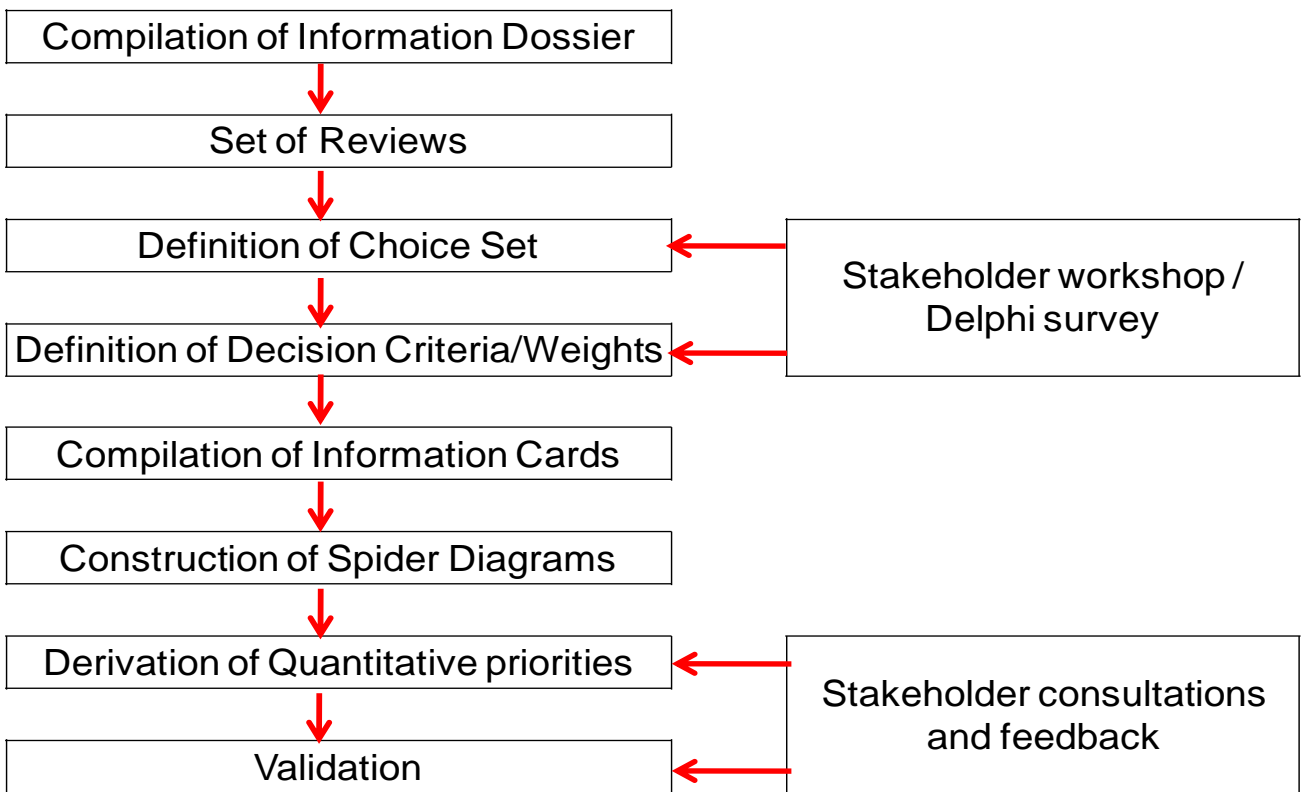
A series of reviews for collating information on the various land use options and criteria were prepared in advance of the main analysis (see Appendix 3). A particular issue facing the authors review was the variety of criteria suggested for assessing the various land use options.²⁷ In a very real sense there has been no concerted attempt to gather together data, observations and studies in how changes in land use might affect subjective concepts such as the environment, social needs or public health. In fact there are a great many studies in these areas but much of the data is qualitative and derived for other purposes. The reviews looked at what data was available in all the potential measurement criteria and from that proposed ways, where possible, in which linear, i.e. continuous, data might be fed into the analysis. For instance environmental impact has been measured by four separate sub criteria (carbon sequestration, plant diversity, wild animal diversity and wild animal densities). Only where it has proved impossible to determine cardinal values have ordinal scales been employed and, where possible, in the context of authoritative qualitative studies.²

Stage 3: Definition of choice set

² A “Likert Item” is a statement that, for example, a person is asked to evaluate. In the context of this study the item, “How does this option affect public health ” is a Likert item — and the table of such items as a whole is the Likert scale.

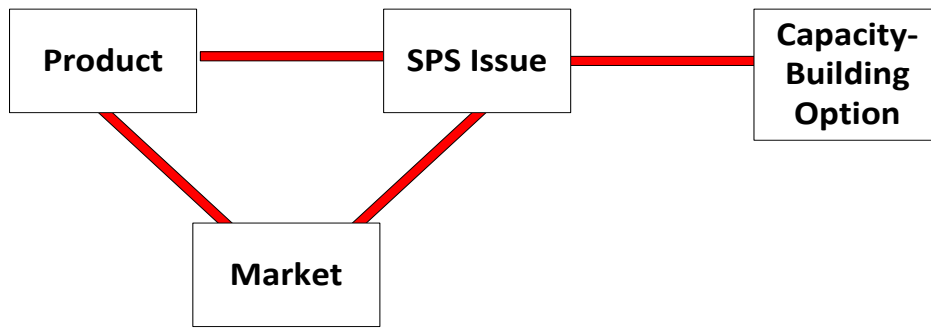
In order to identify the SPS land use options to be considered in the priority-setting framework, a number of stakeholders were consulted directly or via e-mail between August 2012 and January 2013. As many Namibian stakeholders as possible (Appendix 2) were consulted, drawn from government, the parastatal, and private sectors. The choice set has been finalized so as to duplicate that of the parallel WCS study as this reflects the realities of the Eastern Caprivi region in terms of land use and the realistic options presented by the existing services and facilities.²⁸ However for the purposes of completeness a fourth option is included, the creation of FMD compartments within Caprivi, though this is not considered feasible in the context of the existence of the KAZA-TFCA and the conservancies in the region.

Figure 1; Stages in multi-factorial prioritisation of SPS capacity building options



The land use options have been examined to ensure that they make sense from an SPS perspective using Figure 2. The triangle of product: market: SPS issue is clearly the same for all four land use options.

Figure 2; Definition of land use options in an SPS context



Stage 4: Definition of decision criteria and weights

A total of 18 criteria have been included in the analysis and collecting data for these this has been made easier by the relatively small number of options (Table 3). Weights were elicited at a stakeholders meeting in Caprivi on the 19th February (Table 4). In addition two further analyses have been conducted with initial modeling using grouped criteria, i.e. economic and financial, trade, agricultural productivity, environment and social indicators. The series of alternative analyses were run using equal weights for each individual criteria, and equal weights for each group of criteria and finally for each group of criteria individually. The software used is able to determine the stability of the options and thus the sensitivity to changes in weights.

Stage 5: Construction of information cards

Having identified the choice set of land use options and the decision criteria and weights to be applied in the priority-setting exercise, information was assembled into a series of information cards. The aim of these cards is not only to ensure consistency in the measurement of each decision criterion across the land use options, but also to make the priority-setting exercise more transparent and open to scrutiny (Appendix 4). The specific nature of each of the land use options is described in some detail on the basis of existing documentation, consultation with stakeholders, etc and these are set out in Section 4 below; (see **4.1 Land use options for the Caprivi region**).

The metrics to be employed for each of the 18 decision criteria were then defined, taking account of currently available data and the range of plausible ways in which each of the criteria might be represented. Table 3 sets out the final metrics. Note that the choice of metrics involves a sometimes difficult compromise between the availability and quality of data, and the desirability of using continuous quantitative measures. Partially for this reason the series of mini reviews were carried out (Appendix 3). However, it is important to recognise that the aim of the framework is not to provide a final and definitive prioritisation of the land use options. Rather, the priorities as well as options that are derived should be revisited on an on-going basis and revised as more and/or better data for the decision criteria become available.

Information cards for each of the four land use options were then compiled. These are reported in Appendix 4. Each card presents data for the eighteen decision criteria, measured according to the scales

outlined in Table 3.³ For each criterion, details are provided of how measures for each of the decision criteria were derived. There is also an indicator of the level of confidence in the measure reported. Where there is a lack of underlying data and/or these data are of dubious quality, a low or medium level of confidence is indicated. Conversely, where fairly rigorous and comprehensive prior research is available, a high level of confidence is reported. These confidence measures need to be considered in interpreting the results of the prioritisation exercise, and in considering how the analysis might be refined in the future.

Table 3; Decision criteria measurement

Criterion	Measurement
Economic impact	
Economic Internal Rate of Return (EIRR) of contribution to net national income	Discounting term in %
Net Present Value (NPV) of contribution to net national income	A number in money terms (N\$) discounted at 7%
Cost of implementation	
Up-front investment	Absolute value expressed in N\$
Annual on-going costs	Absolute value expressed in N\$
Trade impact	
Absolute change in value of exports	Estimated absolute value when project implemented (approximately 2017) using 2013 N\$
Trade diversification	Estimated change in HS two figure value of exports as a result of implementing the project expressed in N\$
Domestic agri-food impacts	
Income from tourism and hunting	Aggregated amount for Caprivi in N\$
Income from agriculture	Aggregated amount for Caprivi in N\$
Domestic public health	Scalar value; <ul style="list-style-type: none"> • Large negative (-2) • Negative (-1) • No impact (0) • Positive (+1) • Large positive (+2)
Environmental protection	Four sub components of, carbon sequestration, plant diversity, animal diversity and animal density expressed in various linear units
Social impacts	

³ As noted in Table 4 the environmental impacts are composed of four sub criteria

Criterion	Measurement
Impact on; <ul style="list-style-type: none"> - Women - Children - vulnerable groups/areas - Smallholders - Unemployed 	Each category scored using scalar number; <ul style="list-style-type: none"> • Large negative (-2) • Negative (-1) • No impact (0) • Positive (+1) • Large positive (+2)

Stage 6: Construction of spider diagrams

Through Stages 1 to 5, the inputs to the priority-setting process were collected and then assembled into the series of information cards. The aim of Stage 6 was to present the information in the information cards in a manner that permits easier comparison of the four land use options. Thus, spider diagrams were derived that plotted the four land use options against a number of the Decision Criteria i.e.

1. Contributions to net national income (NNI)
2. Upfront costs
3. Ongoing costs
4. Change in value of exports
5. Increased diversity of exports
6. Change in level of non agricultural income
7. Changes in agricultural income

Scrutiny of these diagrams (**Section 4.2 Results**) identified the decision criteria against which each of the land use options performed relatively well/badly compared to the other land use options in the choice set.

Stage 7: Derivation of quantitative priorities

The formal priority-setting analysis involved the use of outranking through the D-Sight V3.5.1 software package. The mechanics of the analysis are described in some detail in the user guide to the framework.²⁹ The inputs to the model are the data assembled in the information cards. For most of the decision criteria preferences were modelled using a level function since these were measured using categorical scales. However, the up-front investment, on-going cost and criteria were measured continuously and modelled using linear functions. Four models were estimated using D-sight:

- *Baseline model 1* in which weights elicited at a stakeholders workshop in Caprivi and all criteria are used
- *Baseline model 2* in which weights elicited at a stakeholders workshop in Caprivi are used and economic data (EIRR and NNI) are excluded as criteria
- *Equal weights model* in which all of the decision criteria are weighted equally
- *Costs and trade impact model* in which only the cost and trade impact decision criteria are included in the analysis, all of which are equally weighted.

The baseline model is considered to provide the most reliable set of priorities, in that it uses the full set of information derived through Stages 1 to 4. The three subsequent models were estimated in order to examine the extent to which the derived priorities are sensitive to changes in the decision weights and combinations of criteria. If the broad ranking of the four land use options remains broadly the same under the various scenarios presented by these models, we can be reasonably confident that the results of the framework are robust.

Stage 8: Validation

The final stage of the priority-setting analysis consists of feedback on the draft results. The aim of the validation process is to ensure that the results of the priority-setting framework are broadly in accordance with expectations, or that unexpected rankings can be explained through the pattern of data in the information cards. To facilitate this process, the draft report was disseminated to stakeholders using a variety of methods with requests for comments.

4 Findings

4.1 Land use options for the Caprivi region

The options described below are alternative scenarios for the same land area and which form the basis for the land use options in the analysis. Option 1, the *status quo*, describes the existing situation prevailing in most of the communal areas of the Caprivi and projects likely developments in the near future i.e. using the past as a guide. Options 2, 3, and 4 describe various possible investments that would change the way in which cattle off take from the smallholder farmers could be managed. The list of policy (land use) options was created as an output of a stakeholders meeting held in late 2012 (Barnes, 2013).³⁰ From this list the three options were selected aimed at realistic policy alternatives to the *status quo*. The three other scenarios include two alternative scenarios based on the CBT approach of OIE Article 8.5.25, and a third involving the introduction to East Caprivi of three fenced FMD-free compartments. The four options are described below. More detailed descriptions and background information is given in Appendix 3.5.

Option 1; *status quo* of conservancies and multispecies land use including formal and informal beef production (no additional investment)

In communal areas agro-pastoral systems are still the norm, combining extensive livestock management with small-scale cropping, and a diverse use of trees and other wild resources. Residents of communal lands have use-rights over arable land, rangeland, and some trees, but no individual ownership of the land or resources (Ashley, 1996).³¹ Community based natural resource management (CBNRM) of wildlife oriented conservancies to benefit the local community by providing an opportunity to develop a resource management plan in which explicit extraction and use quotas are set out. Income generated from the use of these resources³² is intended to benefit the community directly (Dusenberry 2012).

Livestock are sold on local informal markets and to MeatCo to earn cash. From 1992-96 annual cattle sales to MeatCo generally ranged between 4,000 and 5,000 animals according to the MeatCo Katima

Mulilo office and these numbers have not changed substantially in the current millennium.³³ The scale of informal sales is unknown but may amount to 50% or more of total formal sales.

Assumptions in this option are that animal disease management based on the existing geographic approach and present policies continues together with currently planned investments, livestock vaccination, surveillance, and quarantine, continue as presently conducted. Management of FMD outbreaks include extended abattoir closures. The option assumes continued low slaughter throughputs with a continued emphasis on exports to northern SADC markets. Current CBNRM developments and tourism expansion around protected areas and within conservancies are all assumed to continue.

Option 2; Investment made in slaughter for exports of chilled de-boned beef

Article 8.5.25 of the Terrestrial Animal Health Code contains provisions with respect to FMD that represent the nearest the OIE has come to developing guidelines for commodity-based trade in beef. The title of the Article is: 'Recommendations for importation from FMD infected countries or zones, where an official control program for FMD, involving compulsory systematic vaccination of cattle, exists'. The scenario is currently the subject of a research project being carried out by a group led by the Meat Board of Namibia.³⁴

The option assumes the application of CBT OIE Article 8.2.25, but with modifications as applicable to the ongoing MCA initiative in Caprivi. These include continued FMD vaccination, and enhanced FMD surveillance together with motor transport to abattoir. In addition a three-week pre-slaughter quarantine is retained as for option 1. Improved income for livestock suppliers serving the abattoir is built in to the model but without 'finishing off' of stock prior to slaughter. Other benefits are the reduction of abattoir down time with some changes in abattoir management, coupled with expenditure on minor upgrades to the abattoir, - particularly by expansion of chiller capacity. Additional income via access to regional markets for deboned beef is assumed as at present (Angola-Zambia-Zimbabwe) with the possible addition of South Africa. The option allows for reduced restrictions on wildlife movement, additional corridors opened between national parks and state forest and north to Zambia, and from Botswana border to conservancies in East Caprivi coupled with expanded CBNRM development and consequent improved growth in wildlife income

Option 3; investment made in slaughter for processed meat production

The option is based on the observation that currently beef produced in the Caprivi as well as most of the rest of the NCA is of poor quality and not suited to most export markets other than those for processing beef. Given that, the population of the NCAs of Namibia are overwhelmingly young and poor with consequent limited access to diets containing sufficient high quality protein it is logical that locally available meat that is processed to make it more palatable and to increase its shelf-life in an environment where refrigeration is not widely available, may constitute a worthwhile investment. The assumption used in this analysis is that of *sous vide* processing (akin to the pasteurization of milk in that the highest temperatures reached at the core of the meat are considerably lower than the boiling point of water). However such temperatures would be sufficient to inactivate FMDV. Additionally the output

of such a process could be exported as either chilled meat for sale to retail outlets or for further processing.

In summary this scenario is a variant of Scenario 2 with the addition of a processing plant where processing would comply with standards for inactivating FMDV and would involve product heating and thus investment in capital and product lines. The abattoir would thus be extended with the addition of a processing plant. There would be improved livestock enterprise income but no finishing prior to slaughter. The scenario would allow access to a wider range of markets in SADC, including South African markets. Quarantine requirements would be the same as for Scenarios 1 and 2 and would be accompanied by the same loose restrictions on wildlife movement with corridors opened between national parks and state forest and north to Zambia, and from Botswana border to conservancies in East Caprivi. The expanded CBNRM development with improved growth in wildlife income would also be accommodated by the option.

Option 4; Creation of FMD free compartments

Chapter 8.5 of the TAHC makes provision for the creation of FMD-free compartments in otherwise 'infected' countries or zones (Article 8.5.6), i.e. creation of production enterprises – which can be physically separated and that are managed on the basis of integrated bio-security systems targeting FMD. Theoretically therefore, it would be possible for compartments to be established in the Caprivi which contain livestock but exclude wildlife, particularly buffalo. To achieve that in practical terms would require that the compartments be separated by physical barriers (e.g. game-proof fences) from areas where wildlife occur. In other words, domestic livestock in specific locations could be fenced off from FMD-infected wildlife populations.

The scenario specifically modeled in this option involves the introduction of three 200,000 hectare fenced FMD-free compartments in those parts of East Caprivi, where livestock numbers are high and wildlife numbers are minimal. The compartments would separate wildlife from livestock with game proof fencing and would be community-based and integrated with conservancy development among communities living in and on edges of the compartments. A sound biosecurity plan is a requirement, including identification of critical control points and associated procedures for prevention of FMD entry into the area. A surveillance system adequate to detect FMD occurrence but also subclinical infection of animals (certified for the preceding 12 months) that would be more rigorous currently conducted surveillance. A risk assessment based re-examination of the rule that no vaccination against FMD may take place and no animal vaccinated within the last 12 months may be present within the compartment would need to be conducted. Other accompanying measures would include improved animal identification and traceability system, but no finishing prior to slaughter. Incomes to livestock producers will be greater and access to a wider range of markets for beef in SADC, including South African markets will be possible. However wildlife corridors will be cut off in East Caprivi and development of new ones precluded together with restrictions on the development of wildlife based tourism and CBNRM restricted with no growth beyond current levels.

4.2 Results

From the descriptions presented above, and the results of discussions with various stakeholders imply that all of these options are credible options for land use alternatives though perhaps would need clarification of rules and associated technical issues. However, the associated costs and resulting benefits do differ substantially, such that it is possible to define clear priorities amongst the options on the basis of the defined decision criteria and using variations on weights to simulate various viewpoints on their relative importance. In this section the results are presented using outranking through the software package D-Sight v3. To ensure that the results are robust the stability of the analysis was further examined by examining the stability intervals. These intervals indicate the range in which the weight of a criterion can be changed without affecting the ranking. This showed that for all criteria excepting, impact on children, the results were stable. Weightings would have to change by two to three times the current values for the ranking order to change.

To provide a first scan of the relative strengths and weaknesses of the four land use options 'spider diagrams' were constructed of the linear values inputted into the MCDA model for; economic internal rate of return (EIRR) of contribution to net national income, (Figure 3) net present value (NPV) of contribution to net national income, (Figure 4), cost of implementation both upfront (Figure 5) and ongoing (Figure 6), change in value of exports (Figure 7), change in diversity of trade impact (Figure 8), change in level of non agricultural income (Figure 9), and change in agricultural income (Figure 10). Spider diagrams are a useful way in which to present some of the information on the options to more senior decision-makers.

Examination of the figures shows that no one land use option dominates across all the criteria. For example while option 3 (CBT processing) scores highly in many areas it does poorly on costs. Again while option 2 (CBT Base) also does well in most criteria it is outscored by option three (CBT processing) in trade impacts. So while it appears that both the CBT Baseline and CBT processing options do well over many of the criteria it is not immediately evident how they compare with each other and by what margin even when looking at criterion scores. Therefore any results must be the subject of various types of sensitivity analyses. That is where the outranking analysis comes in; it compares each of the land use options on a pair-wise basis with respect to each of the nine decision criteria in turn. Each of these comparisons determines whether one option dominates (or is dominated) by another and by how much. The aggregate of all of these comparisons, taking account of the defined decision weights, gives an overall measure of preference, what is termed the net flow.⁴ Thus, options with a positive and larger net flow are given a higher priority.⁵

⁴ The analysis includes varying these weights to determine 'switching points', i.e. determining when the rankings might change according to the weights given to individual criteria.

⁵ Not all sub criteria are shown in Tables 3 and 4. The full set of sub-criteria used in the analysis is shown in Appendix 4; Land use Option Cards and the reviews on which these are based are in Appendix 3

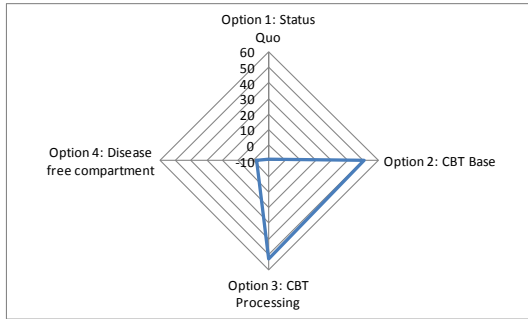


Figure 3; EIRR for contribution to net national income (NNI)

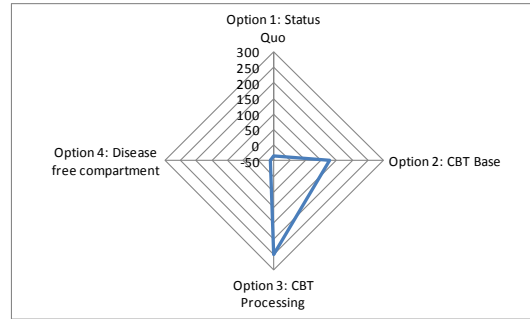


Figure 4; NPV of contribution to net national income (NNI)

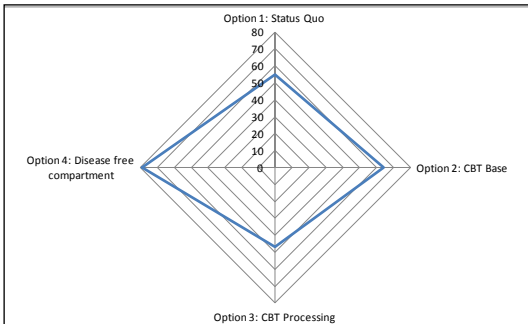


Figure 5; Upfront costs of various land use options

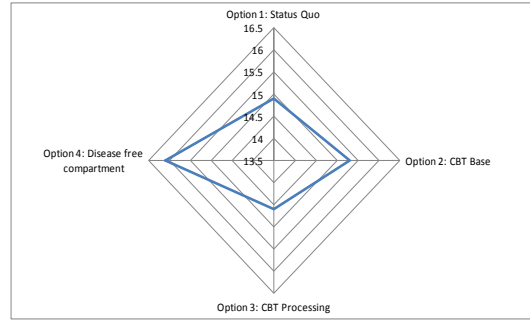


Figure 6; Ongoing costs of various land use options

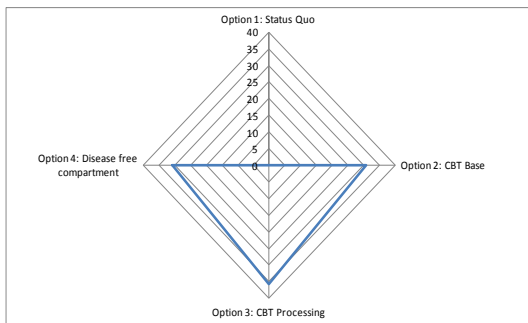


Figure 7; Change in value of exports with land use option

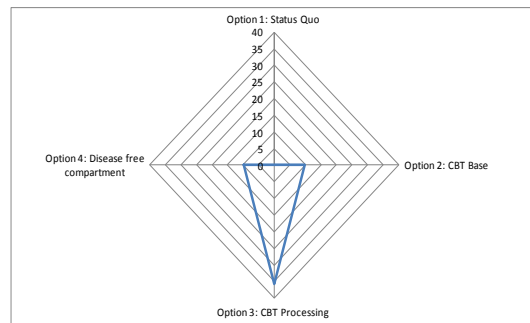


Figure 8; increased diversity of exports with land use option

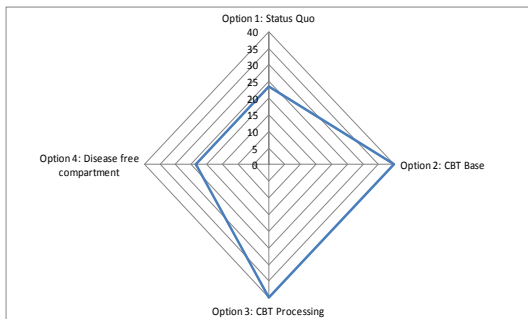


Figure 9; Change in level of non agricultural income with land use option

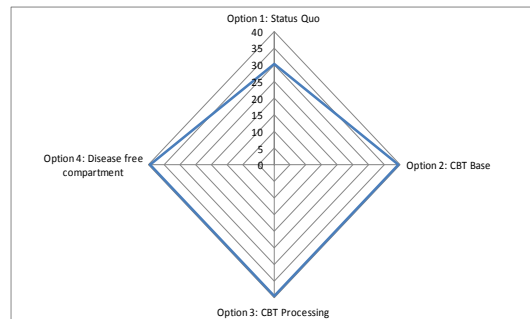


Figure 10; Agricultural income for *status quo* and other land use options

Table 4; Weights allocated to the grouped and individual criterion in the Caprivi stakeholders workshop on 19th February 2013

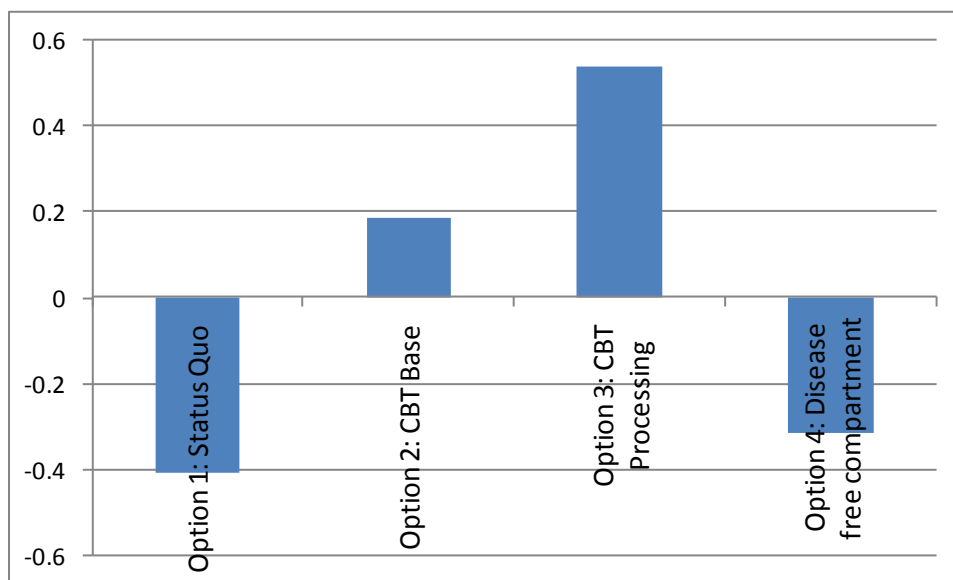
Category	Aggregate weight	Decision Criterion	Criterion weight
Economic impact	10.60%	Increased contribution to net national income	10.6%
Costs	14.20%	Up-front investment	7.2%
		Annual on-going costs	7.0%
Income and trade	30.50%	Absolute change in value of exports	9.0%
		Trade diversification	4.7%
		Tourism (hunting and non consumptive)	5.1%
		Agricultural / fisheries productivity	7.0%
		Domestic public health	4.7%
Environment	3.30%	Environmental protection	3.3%
Vulnerable groups	41.50%	Women	5.1%
		Children	8.4%
		Vulnerable areas	7.2%
		Smallholders	10.2%
		Unemployed	10.6%

Figure 11 reports the net flows for the four land use options for the baseline model; that is the prioritization derived using the decision weights set at the Caprivi stakeholders workshop held on 19 February 2013. The weighting determined in the stakeholders workshop is shown in Table 4. Thus, the analysis suggests the top priority options are the two CBT scenarios with the *sous vide* option, Option 3, showing the greatest net positive flow. The other options of the *status quo* and the creation of FMD disease free compartments have negative net flows indicating that they are dominated overall on the basis of the chosen decision criteria and weights.

The prioritization of the four options reflects a trade-off or compromise between the 18 decision criteria.⁶ As discussed above, none of the options dominates all others with respect to every one of the decision criteria. Thus, in choosing an option that is given a high priority, meaning it generally performs well with respect to the chosen decision criteria, there is an inevitable compromise in terms of under-performance with respect to certain of these criteria, relative to other land use options.

⁶ Note that some are aggregated in Table 5

Figure 11; Net flows for baseline model for the four land use options



It is possible to examine the performance of each of the land use options through their scores for each of the decision criteria, as shown below in Figures 12 to 15. It can be seen that both the *status quo* and foot and mouth free compartments options, (Figures 12 and 15), have a significant number of negative criterion scores whereas the two commodity based options are generally positive, (Figures 13 and 14). The commodity based trade processing option has, however, strong negative scores for upfront investment and ongoing costs and the *status quo* option has positive scores for ongoing costs, impact on the environment and on children.

The foregoing discussions presents the core results of the analysis, and application of the prioritization framework and the rankings in Figure 11 are in many ways the key results representing the recommended priorities between the four land use options included in the analysis. It is important to recognize, however, that these results, and the established priorities amongst the land use options, reflect the chosen decision criteria and the respective measures derived for each of the options, and the weights attached to the criteria. This begs the question, how does the ranking of the land use options change if any of these key inputs changes? To answer this question, sensitivity analysis was applied to the baseline model, the results of which are reported below.

Figure 12; Criteria scores for the *status quo* option

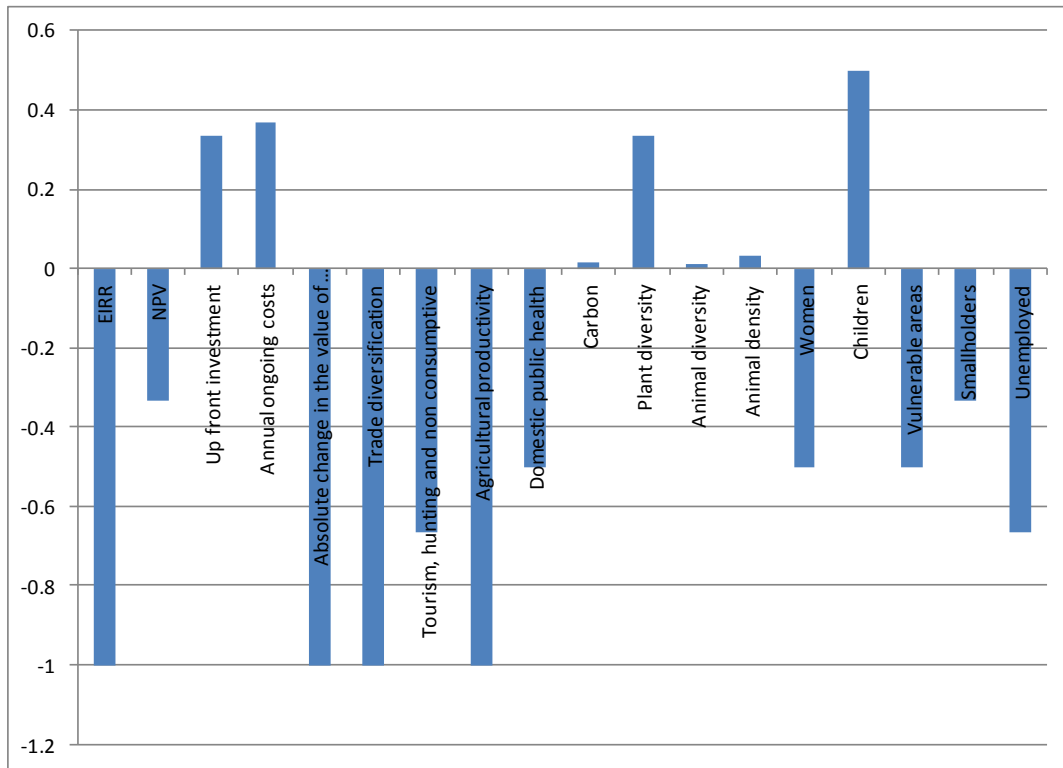


Figure 13; Criteria scores for commodity based trade baseline option

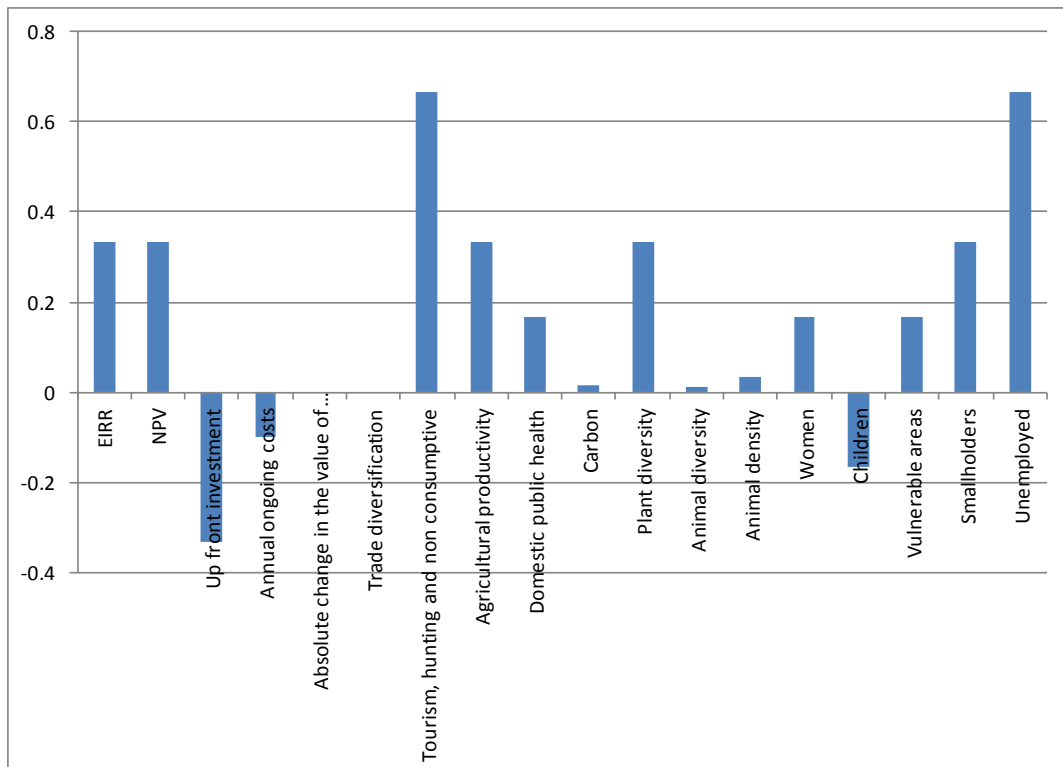


Figure 14; Criteria scores for commodity based trade processing option

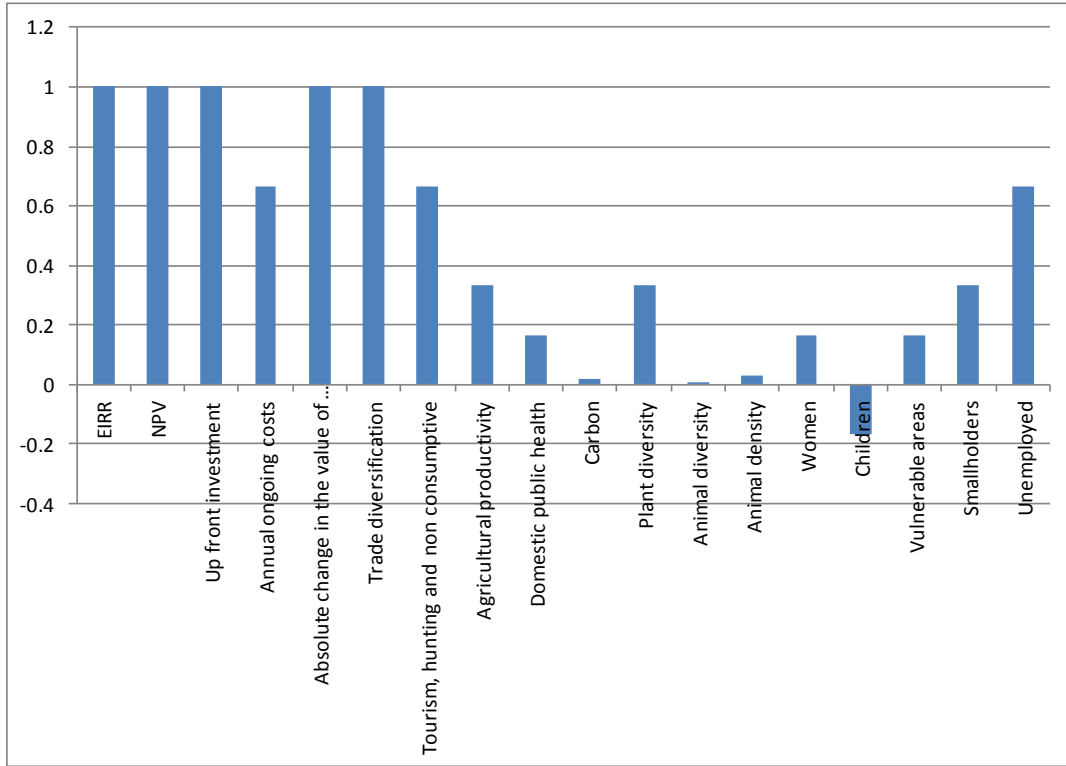
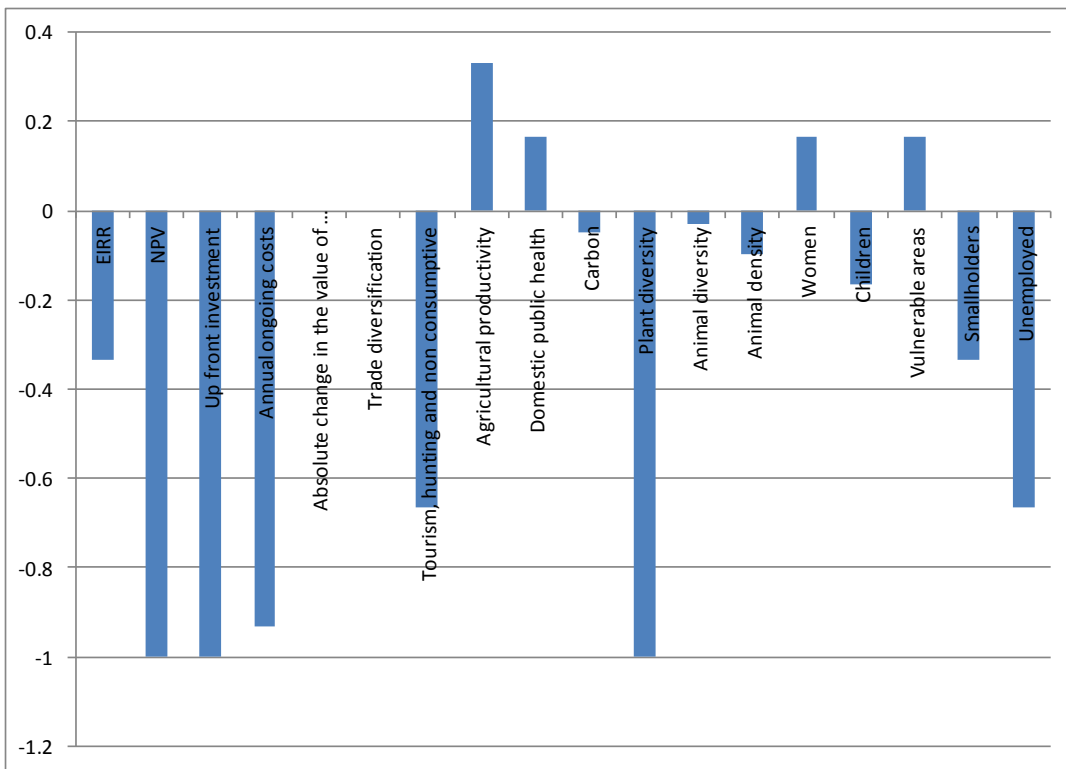


Figure 15; Criteria scores for disease free compartments option



To explore the impact of changing the weights attached to the eight decision criteria, alternative models were investigated and the results are shown in Table 5. These models look at various different alternative models which are; a model ignoring economic impact, a costs and trade impact only model, an equal weights only model and a model with social and environmental impacts only. The results of these models only differ slightly in some respects from those of the baseline model, with the *status quo* and the creation of FMD free compartments changing places between 3rd and 4th position in the Cost and trade impact an Equal weights models. However the top two options of CBT Processing and CBT Base remain one and two respectively. Thus there is a significant amount of commonality in the various models with positive and negative rankings remaining fairly constant regardless of the model applied in that the two top ranked options do not change regardless of the variation in assumptions and weights thus suggesting that the derived priorities are relatively robust to changes in the decision weights with certain qualifications.

Table 5; Sensitivity analysis of the rankings of the capacity building options using models which, exclude economic data, an equal weights, a costs and trade impact model and an analysis using environmental and social data only*

Land use scenario	Baseline model		Model excluding economic data		Cost and trade impact model		Equal weights model		Environmental and social impacts model		CV
	Net flows	Ranking	Net flows	Ranking	Net flows	Ranking	Net flows	Ranking	Net flows	Ranks	
Option 1: <i>Status quo</i>	-0.41	4	-0.38	4	-0.27	3	-0.27	3	-0.10	3	-0.4
Option 2: CBT Base	0.18	2	0.17	2	0.00	2	0.14	2	0.17**	1	0.6
Option 3: CBT Processing	0.54	1	0.49	1	0.86	1	0.56	1	0.17**	2	0.5
Option 4: Disease free compartments	-0.32	3	-0.28	3	-0.59	4	-0.43	4	-0.23	4	-0.4

*ANOVA shows significant (0.1%) differences between options but no significant difference between models

** These options do not differ significantly

5 Conclusions

This report has presented the initial results of a priority-setting exercise for land use options for developing meat and other animal exports from the Caprivi region of Namibia. The priorities are defined using a prioritization framework based on MCDA, which provides a structured and transparent approach to ranking land use options in the Caprivi on the basis of predefined and agreed criteria. Thus, the options to be considered are identified through a process of stakeholder consultation that is informed by a review of prior assessments of SPS capacity. In this case, four distinct land use options were identified. These options are then prioritized on the basis of a series of decision criteria to which equal weights are applied, that are again derived, in part, by consulting stakeholders. The end result is a clear ranking of the four land use options which are, in many cases robust and do not vary with changes in the weights attached to the decision criteria and to scenarios where the sub categories of criteria are examined in isolation. Of four land use options identified, the following are the most consistent rankings:

-
1. investment in *sous vide* processed meat production;
 2. investment for FMD free deboned chilled beef;
 3. *status quo* of conservancies and multispecies land use including formal and informally beef production (no additional investment);
 4. the creation of FMD free compartments.

This prioritization is based not only on the respective costs and predicted trade impacts, but also on the basis of impacts on agricultural productivity, domestic public health, local environmental protection, poverty and vulnerable groups. Given the robustness of the results, this basic ranking would appear to present a coherent basis on which to start defining a national action plan for land use options in Caprivi. It is important to recognize, however, that the results of the analysis presented above represent just the starting point in the use of the priority-setting framework in the context of land use options and SPS capacity-building and the results must be revisited and revised on an ongoing basis in the light of improvements in the availability and/or quality of data, changes in policy priorities that imply shifts in the decision weights and/or the introduction of new decision criteria/land use options, etc. In particular the MCA/Millennium Challenge Corporation project that is investigating the option of chilled beef exports from the Caprivi will generate further information for a refined future analysis.

It is possible that some stakeholders will be concerned about the priorities presented above. It is important to recognize that the aim of the framework is not to make decisions over investments in land use options in the Caprivi, but to provide an input into established systems of decision-making. The framework aims to facilitate a coherent and transparent debate over priorities between land use options. Thus, if a particular stakeholder is unhappy about the priority given to a particular option, they can, and should, present new evidence (in the form of revised data to support measures of particular decision criteria in the capacity-building option information cards/profiles) and/or to suggest how and why distinct decision criteria or differing decision weights should be employed. Such changes can then be employed and the model re-estimated accordingly. The framework is easy to apply and accessible to decision analysts and/or decision makers with little or no prior knowledge of MCDA. Whilst it is not expected that substantive changes will be made to the basic mechanics of the framework, the preliminary prioritization reported above could and should be revisited at any time in the future.

APPENDIXES

Appendix 1; Selected References and Bibliography

Animal production in Namibia

Anonymous, 2009, National Investment Brief, High-Level Conference on: Water for Agriculture and Energy in Africa: the Challenges of Climate Change Sirte, Libyan Arab Jamahiriya, 15-17 December 2008. Mimeo, 9pp.

Bothma, J. du P. van Rooyen N. and van Rooyen M. W., 2004, Using Diet and Plant Resources to Set Wildlife Stocking Densities in African Savannas. *Wildlife Society Bulletin*, Vol. 32, No. 3, pp. 840-851

de Bruyn P., de Bruyn J. N., Vink, N., and Kirsten J. F., 2001, How transaction costs influence cattle marketing decisions in the northern communal areas of Namibia, *Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa*, 40:3, 405-425

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., Courbois, C., 1999, *Livestock to 2020, The next food Revolution - Food, Agriculture, and the Environment*. Discussion Paper 28, International Food Policy Research Institute, Food and agriculture Organization of the United Nations, international Livestock Research Institute, ISBN 0- 89629-632-6. Mimeo 83pp

Government of the Republic of Namibia, 2005, Bankable investment project profile, Livestock Improvement. Support to NEPAD–CAADP implementation TCP/NAM/2903 (I) (NEPAD Ref. 05/38 E) Volume VI of VII July 2005, Mimeo 27pp

Jahnke, H. E., 1982, *Livestock production systems and livestock development in tropical Africa*, Kieler Wissenschaftsverlag Vauk. ISBN 3-922553-12-5, 273pp.

Lesnoff, M., Messad, S., A cross-sectional retrospective method for estimating livestock demographic parameters in tropical small farming systems. (CIRAD Development). <http://livtools.cirad.fr> (1) CIRAD, TA 30/A, Montpellier, Mimeo 52 pp

Meat Board of Namibia, 2009, An Enhanced Animal Identification and Traceability Information System in Namibia, 1st OIE Conference on animal id and traceability –Buenos Aires: 24 March 2009. Powerpoint presentation 20 slides.

Strydom, P. J., 2009, The Role of Livestock for ACP countries: challenges and opportunities ahead, Panel 2. Future policy challenges and opportunities for the ACP livestock sector Responding to the growing demand of livestock products. ACP-EU - 1 July 2009. Powerpoint presentation, 10 slides

Sweet, J., and Burke, A., *Country Pasture/Forage Resource Profiles*, FAO 2006. Mimeo, 16pp.

Verlinden, A., and Kruger, A. S., 2007, Changing grazing systems in central north Namibia. *Land Degrad. Develop.* 18: 179–197 (2007), DOI: 10.1002/ldr.769

Biodiversity

Abensperg-Traun, M., Roe, D., and O’Criodain, C., (editors), 2011, CITES and CBNRM, Proceedings of an international symposium on “The relevance of community-based natural resource management (CBNRM) to the conservation and sustainable use of CITES-listed species in exporting countries”. Vienna, Austria, 18 – 20 May 2011, Mimeo, 176 pp.

Andersson, L., Wilk, J., Todd, M. C., Hughes, D. A., Earle, A., Kniveton, D., Layberry, R., Savenije, H. H. G., 2006, Impact of climate change and development scenarios on flow patterns in the Okavango River *Journal of Hydrology* (2006) 331, 43– 57

Anonymous, 2006, Integrated rural development and nature conservation (IRDNC), WWF/SDC Project Technical Progress Report – Caprivi. Mimeo report for year from July 2006 to June 2007. Mimeo 12 pp.

Anonymous, undated c 2007, Community-based Adaptation (CBA) Country Programme Strategy (CPS) – Namibia. Mimeo 16pp.

Barrow, E., 1996, Who gains? Who loses? – biodiversity in savanna systems. African Wildlife Foundation discussion papers series, community conservation discussion paper No 3, CC-DP-3, Mimeo 18pp

Ashley, C., 1996, Incentives affecting biodiversity conservation and sustainable use: the case of land use options in Namibia. Research discussion paper Number 13, November 1996, Directorate of Environmental Affairs Ministry of Environment and Tourism. Mimeo 24pp.

Blaum, N., Rossmannith, E., Lohmann, D., Meyfarth, S., Schwager, M., Domptail, S., Nuppenau, E., Geßner, U., Keil, M., Petersen, A., Gröngröft, A., Strohbach, M., Jeltsch, F., c2007, From land use to vegetation and biodiversity changes – linking models and data. Undated Power point presentation 32 slides.

Blaum, N., Wasiolka, B., Rossmannith, E., Jeltsch, F., 2008, The effects of grazing-induced shrub encroachment on animal diversity in southern Kalahari rangelands. *Spotlight on Agriculture* no 112, October2008. ISSN 1562-5192, 2pp.

Burke, A., and Strohbach, B. J., 2000, Review: Vegetation Studies in Namibia, *Dinteria* No. 26:1-24 - Windhoek, Namibia

Chase, M., 2007, Aerial wildlife census of the Caprivi river systems; a survey of rivers, wetlands and floodplains. Report prepared for Elephants Without Borders. Mimeo, 33pp.

Cowling, R. M., Proche, O., and Vlok, J. H. J., 2005, On the origin of southern African subtropical thicket vegetation, *South African Journal of Botany* 2005, 71(1): 1–23

Fisher, J. T., Witkowski, E. T. F., Erasmus, B. F. N., Van Aardt, J., Asner G. P., Wessels, K. J., and Mathiew, R., 2011, Human-modified landscapes: patterns of fine-scale woody vegetation structure in communal savannah rangelands. *Environmental Conservation* 39 (1): 72–82 C

Henghali, J. N., 2006, Conservation attitudes and patterns of biodiversity loss in the Ohangwena and Oshikoto regions of Namibia. M.Sc. thesis in Conservation Biology at University of Namibia, 129pp.

Hoffman, M.T., Schmiedel, U., Jürgens, N. (eds.): 2010, Biodiversity in southern Africa 3: Implications for land use and management. Göttingen & Windhoek: Klaus Hess Publishers. ISBN 978-3-933117-47-2 (Germany), 978-99916-57-33-2 (Namibia)

Knowles, T., and Theron, L-J., 2010, A literature review and overview report pertaining to climate change adaptation in Botswana. A report submitted to: Conservation International Southern Africa Wilderness Programme, Gaborone, Botswana. Mimeo, 24 pp.

Namibian Ministry of Environment and Tourism, 2010, Namibia's Draft Fourth National Report to the United Nations Convention on Biological Diversity (UNCBD). Mimeo 168 pp.

OECD, 2002, Handbook of biodiversity valuation, a guide for policymakers. Mimeo, 153pp

Okitsu, S., 2010, Vegetation structure of the biomes in southwestern Africa and their precipitation Patterns. *African Study Monographs, Suppl.40*: 77-89, March 2010

Palmer, R., 2002, Classification and ecological status of aquatic ecosystems in the eastern Caprivi, Namibia. Mimeo 17pp.

Peters, J., Gautier, A., Brink, J. S., Haenen, W., 1994, Late Quaternary Extinction of Ungulates in Sub-Saharan Africa: a Reductionist's Approach. *Journal of Archaeological Science* 21, 17-28

Richardson, J. A., 1998, Wildlife utilization and biodiversity conservation in Namibia: conflicting or complementary objectives? *Biodiversity and Conservation* 7, 549-559

Rodwell, T. C., Tagg, J., and Grobler, M., 1995, Wildlife Resources in the Caprivi, Namibia: The Results of an Aerial Census in 1994 and Comparisons with Past Surveys. Research discussion paper number 9. Directorate of Environmental Affairs, Ministry of Environment and Tourism, Namibia. Mimeo 30pp.

Salles, J-M., 2008, Valuing biodiversity and ecosystem services for practical public decision making: Some preliminary lessons from the Centre d'Analyse Strategique group. EPBRs Meeting, MNHN, Paris, November 19th, 2008. Powerpoint presentation, 12 slides.

Schmiedel, U., Jürgens, N., (eds.): 2010, Biodiversity in southern Africa 2: Patterns and processes at regional scale. BIOTA books, ISBN: 978-3-933117-44-1 (Germany), 978-99916-57-30-1 (Namibia)

Shackleton, C. M., 2000, Comparison of plant diversity in protected and communal lands in the Bushbuckridge lowveld savanna, South Africa, *Biological Conservation* 94 (2000) 273-285

Siljander, M., 2009, Predictive fire occurrence modeling to improve burned area estimation at a regional scale: A case study in East Caprivi, Namibia, *International Journal of Applied Earth Observation and Geoinformation* 11 380–393.

Tews, J., Blaum, N., and Jeltsch, F., 2004, Structural and Animal Species Diversity in Arid and Semi-arid Savannas of the Southern Kalahari, *Annals of Arid Zone* 43(3&4): 413-425

Wasiolka, B., and Blaum, N., The impact of bush encroachment on animal diversity (bird, reptiles, mammals) in Namibia savanna rangelands. *Spotlight on Agriculture* no 114, December 2009. ISSN 1562-5192, 2pp.

Economic and financial studies

Anonymous, Undated - from internal references about 2001. Species Report for Southern Savanna Buffalo, Appendix 2, sourced from www.nnf.org.na

Anonymous, 2012, Livestock Ownership and Livelihood in the Northern Communal Areas: Using a randomised control trial to determine the impact of best practice and joint herding on farmers in Northern Namibia, Findings from the Baseline Household Survey. Prepared by: Innovations for Poverty Action April 5, 2012, Project funded by: The Millennium Challenge Account Namibia & The Millennium Challenge Corporation. Mimeo, 81pp with a 21 page appendix.

Barnes, J. I., 1995, The value of non-agricultural land use in some Namibian communal areas: a data base for planning, Research discussion paper Number 6 May 1995, mimeo 24 pp.

Barnes, J. I., Cannon, J. and MacGregor, J., 2008, Livestock production economics on communal land in Botswana: Effects of tenure, scale and subsidies. *Development Southern Africa* 25(3): 327-345.

Matengu, K. K., 2001, The Quest for Sustainable Community-Based Tourism in Salambala Conservancy, Caprivi Region, Namibia. University of Joensuu, Department of Geography, Human Geography Programme, Master's Thesis, October 2001, 135 pp.

Meatco, 2011, Annual report - 2010, 2011. Mimeo, 84pp.

Rich, K., M., Ross, R. B., Baker, D., Negassa, A., 2011, Quantifying value chain analysis in the context of livestock systems in developing countries. *Food Policy* 36 214–222

Suich, H., Kennedy, E., Bruner, A., Pilgrim, J., and Vynne, S., Transfrontier conservation areas: conservation and socio-economic impact indicators. Paper prepared for the workshop on Transboundary Protected Areas in the Governance Stream of the 5th World Parks Congress, Durban, South Africa, 12-13 September 2003. Mimeo, 10pp

Turpie, J., Barnes, J., Arntzen, J., Nherera, B., Lange, G-M., Buzwani, B., 2006, Economic valuation of the Okavango Delta, Botswana, and implications for management. funded by the IUCN and supported by

the Directorate of Environmental Affairs (DEA) and the Okavango Delta Management Project. Mimeo 139pp.

Food safety

Anonymous, undated (c 2007), Meat inspection training centre, Department of Veterinary Services. Mimeo, 6pp.

Food and Veterinary Office (FVO), 2009, 2010, 2011, 2012, Programme of, Audits and Inspections in Namibia 2009, 2010, 2011, 2012. Series of documents ranging from 18 to 26 pages in length.

Food and Veterinary Office (FVO), 2003, Country; Namibia, Audit number 2003-9203, Title; Animal/Public Health/Bovine Spongiform Encephalopathy/Foot and Mouth Disease, Audit period; Nov 2003, no publishing date given, <http://ec.europa.eu/food/fvo/>

Food and Veterinary Office (FVO), 2005, Country; Namibia, Audit number 2005-7602, Title; Animal/Public Health/Foot and Mouth Disease/Certification, Audit period; Feb-Mar 2005, Published; 06/10/2005, <http://ec.europa.eu/food/fvo/>

Food and Veterinary Office (FVO), 2007, Country; Namibia, Audit number; 2007-7393, Title; Animal/Public Health/Foot and Mouth Disease/Certification, Audit period; Mar 2007, Published; 20/12/2007, <http://ec.europa.eu/food/fvo/>

Food and Veterinary Office (FVO), 2009, Country; Namibia, Audit number; 2009-8216, Title; Public Health - Meat Export, Audit period; Mar 2009, Published; 10/07/2009, <http://ec.europa.eu/food/fvo/>

Food and Veterinary Office (FVO), 2009, Country; Namibia, Audit number; 2009-8326, Title Animal health - foot and mouth disease, certification procedures, Audit period; Mar 2009, Published; 16/10/2009, <http://ec.europa.eu/food/fvo/>

Food and Veterinary Office (FVO), 2011, Country; Namibia, Audit number; 2011-6120, Title; Public Health - Meat Export, Audit period; Jan-Feb 2011, Published; 23/06/2011, <http://ec.europa.eu/food/fvo/>

Kavango-Zambezi Transfrontier Conservation Area - general

Cumming, D. H. M., 2008, Large Scale Conservation Planning and Priorities for the Kavango-Zambezi Transfrontier Conservation Area, A report prepared for Conservation International, Mimeo 124 pp.

The World Bank, 2010, The Zambezi River Basin; A Multi-Sector Investment Opportunities Analysis. Volume 1, Summary Report. Mimeo 52pp.

Kavango-Zambezi Transfrontier Conservation Area - tourism

Anonymous, 2006, Final report, pre-feasibility study of the proposed Kavango-Zambezi Transfrontier Conservation Area, Volume 1, Prepared by the Transfrontier Conservation Consortium for the Peace Parks Foundation on behalf of, the Governments of Angola, Botswana, Namibia, Zambia and Zimbabwe. October 2006. Mimeo 110 pp.

Anonymous, 2006, Final report, pre-feasibility study of the proposed Kavango-Zambezi Transfrontier Conservation Area, Volume 2, Annexes, Prepared by the Transfrontier Conservation Consortium for the Peace Parks Foundation on behalf of, the Governments of Angola, Botswana, Namibia, Zambia and Zimbabwe. October 2006. Mimeo 86 pp.

Barnes, J. I., and Humavindu, M. N., 2003, Economic returns to land use options in Gondwana Cañon Park, Karas, Namibia. Prepared for Nature investments. Mimeo, 73pp.

Kavango-Zambezi Transfrontier Conservation Area wildlife

Cumming, D H M., 2011, Constraints to Conservation and Development Success at the Wildlife-Livestock-Human Interface in Southern African Transfrontier Conservation Areas: A preliminary Review. Technical Report to the Wildlife Conservation Society (WCS). Mimeo 37pp.

Gadd, M. E., 2012, Barriers, the beef industry and unnatural selection: a review of the impacts of veterinary fencing on mammals in southern Africa. Somers, Michael J., and Matthew Hayward, eds. Fencing for conservation: Restriction of evolutionary potential or a riposte to threatening processes? Springer, 2011.

Hanks, J., Mitigation of human-elephant conflict in the Kavango-Zambezi Transfrontier Conservation Area through Community Based Problem Animal Control, with particular reference to the use of chilli peppers. Final Report: December 2006. Prepared for Conservation International. Mimeo 77pp

Harris, G., Thirgood, S., Grant J., Hopcraft, C., Cromsigt, J. P. G. M., Berger, J., Global decline in aggregated migrations of large terrestrial mammals, *Endang. Species Res*, Vol. 7: 55–76, 2009.

Kock, R. A., 2005, What is this Infamous “Wildlife/Livestock Disease Interface?” A Review of Current Knowledge for the African Continent¹, Chapter 1 4 in Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health (ed S. Osofsky), Vol. 30, pp. 27-46. Occasional paper of the IUCN Species Survival Commission

Lamarque, F., Anderson, J., Chardonnet, P., Fergusson, R., Lagrange, M., Osei-Owusu, Y., Bakker, L., Belemsobgo, U., Beytell, B., Boulet, H., Soto, B. and Tabi Tako-Eta, P., 2008, Human-wildlife conflict in Africa; An overview of causes, consequences and management strategies. International Foundation for the Conservation of Wildlife, Food and Agricultural Organization of the United Nations, Rome, February 2008. Mimeo, 81pp.

Martin, R., undated c 2002, Transboundary species project, southern savanna buffalo, in support of the Transboundary Species Project of the Ministry of Environment and Tourism, Namibia. Mimeo 111pp.

Martin, R.B., 2005, The influence of veterinary control fences on certain wild large mammal species in the Caprivi, Namibia. Chapter 4 in Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health (ed S. Osofsky), Vol. 30, pp. 27-46. Occasional paper of the IUCN Species Survival Commission.

Land degradation

Asner, G. P., Levick, S. R., Kennedy-Bowdoin, T., Knapp, D. E., Emerson, R., Jacobson, J., Colgan, M. S., and Martin, R. E., 2009, Large-scale impacts of herbivores on the structural diversity of African savannas. PNAS, March 24, 2009 vol. 106 no. 12 4947–4952

Gibbes, C., Adhikari, S., Rostant, L., Southworth, J., and Qiu, Y., 2010, Application of object based classification and high resolution satellite imagery for savanna ecosystem analysis. Remote Sens. 2010, 2, 2748-2772; doi:10.3390/rs2122748.

Hoffmann, A., and Ulrich Zeller, U., 2005, Influence of variations in land use intensity on species diversity and abundance of small mammals in the Nama Karoo, Namibia, Belg. J. Zool., 135 (supplement): 91-96 December 2005

Jones B., and Barnes, J., undated c2008, Preparing for REDD in dryland forests: Namibia Country Study, Powerpoint presentation, 34 slides.

Jones B., and Barnes, J., 2009, Preparing for REDD in dryland forests: Investigating the options and potential synergy for REDD payments in the miombo eco-region. Namibia country study International institute for Economic Development (IIED) and the World Bank Program on Forests (PROFOR). Mimeo, 51pp.

Kimaru G., and Jama B., 2005, Improving land management in eastern and southern Africa: A review of practices and policies. ICRAF Working Paper no. 18. Nairobi, Kenya. World Agroforestry Centre.

Le Roux, J., 2011, The effect of land use practices on the spatial and temporal characteristics of savanna fires in Namibia, PhD thesis, Naturwissenschaftlichen Fakultät der Friedrich-Alexander-Universität Erlangen-Nürnberg 182pp.

Maitima, J., M., Mugatha, S. M., Reid, R. S., Gachimbi, I. N., Majule, A., Lyaruu, H., Pomery, D., Mathai, S., and Mugisha, S., 2009, The linkages between land use change, land degradation and biodiversity across East Africa. African Journal of Environmental Science and Technology Vol. 3 (10), pp. 310-325, Available online at <http://www.academicjournals.org/AJEST>

Nkonya, E., Gicheru, P., Woelcke, J., Okoba, B., Kilambya, D., and Gachimbi, L. N., 2006, Out of site out of mind: quantifying the long-term off-site economic impacts of land degradation in Kenya. Selected paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, July 23-26, 2006. Mimeo 37 pp.

Reed, M. S., Dougill, A. J., 2009, Linking degradation assessment to sustainable land management: A decision support system for Kalahari pastoralists. *Journal of Arid Environments* 74 (2010) 149–155, [bdoi:10.1016/j.jaridenv.2009.06.016](https://doi.org/10.1016/j.jaridenv.2009.06.016).

Roy, D., Barr, J., and Venema, H. D., 2011, Ecosystem approaches in integrated, water resources management (IWRM); a review of transboundary river basins. International Institute for Sustainable Development (IISD). Mimeo 85pp.

Stringer, L. C., and M. S. Reed. "Land degradation assessment in southern Africa: integrating local and scientific knowledge bases." *Land Degradation & Development* 18, no. 1 (2007): 99-116.

Yayneshet, T., Restoration of degraded semi-arid communal grazing land vegetation using the enclosure model. *International Journal of Water Resources and Arid Environments* 1(5): 382-386, 2011 ISSN 2079-

Land use options – Kwandu, Kwando, Salambala and state land

Anonymous, no date – c. 2003, A Quick Guide to the Human –Animal Conflict Compensation Scheme (HACCS) For Kwandu and Mayuni conservancies; A pilot project sponsored by Integrated Rural Development and Nature Conservation (IRDNC), in partnership with Conservancy Committees, Traditional Authorities and the Ministry of Environment and Tourism. Mimeo 5pp.

De Kock, M., 2007, Exploring the efficacy of community-based natural resource management in Salambala conservancy, Caprivi region, Namibia. MSc thesis, University of Stellenbosch. 157 pp.

Kanapaux III, W., J., 2009, Livelihood activities in a wildlife conservancy on Namibia's Kwando River. MSc Thesis, university of Florida. 79pp

Kasaona, M. K., 2006, An assessment of community understanding of the human animal conservancy self-insurance scheme and the impact of human-wildlife conflicts: a case study from the Kwandu Conservancy, North-East Namibia. M.Sc. thesis in Environment and Development in the Centre for Environment, Agriculture and Development, School of Environmental Sciences, University of KwaZulu-Natal Pietermaritzburg 2006. 76 pp.

Laamanen, R., Otsu, M., 2002, Forest management plan for the Salambala Conservancy core area. Ministry of Environment and Tourism, Directorate of Forestry, Namibia-Finland Forestry Programme. Mimeo 53 pp.

Matengu , K. K., 2001, The Quest for Sustainable Community-Based Tourism in Salambala Conservancy, Caprivi Region, Namibia. MSc thesis, University of Joensuu, Department of Geography, 135pp.

Multiple authors, 2010, State of Protected Areas in Namibia: A review of progress and challenges 2010. Ministry of Environment and Tourism (MET) with funding from the UNDP/GEF supported Strengthening the Protected Area Network (SPAN) Project. Mimeo 88pp.

Murphy, C., Nheta-Manungo, D., and Mwilima, E., undated – around 2006, Case study 1; Who will benefit from tourism and wildlife management? Conflict management in Salambala Conservancy, Namibia. Negotiation and mediation techniques for natural resource management – case studies and lessons learned. Ed. Castro, A.P. Mimeo 18pp

Sweet, J., 1998, Livestock – coping with the drought: Namibia – a case study. Report prepared for the Grassland Group of the Crop and Grassland Service (AGPC) of FAO for the FAO/AGAP electronic conference on “Livestock - Coping with Drought”.

Zimmermann, I., Polytechnic of Namibia joint action research at Kwandu Conservancy between community members and students of the agriculture diploma program. Department of Agriculture, School of Natural Resources and Tourism, Polytechnic of Namibia, Technical Report: NRM/2006/1. Mimeo 85pp.

Zeidler, J., 2010, Namibian national issues report on land use, land-use change and forestry (LULUCF) (adaptation). Document with UNDP logo. Mimeo 32 pp.

Stolton, S., Mansourian, S., and Dudley, N., 2010, Valuing Protected Areas, April 2010 The International Bank for Reconstruction and Development/The World Bank. Mimeo, 75pp.

Turpie, J., Barnes, J., de Longcamp M., and Paxton, M., 2010, Sustainable financing plan for Namibia’s protected area system, February 2010. Ministry of Environment and Tourism. Mimeo, 63pp.

Turpie, J., Barnes, J., Lange, G-M., Martin, R., 2010, The Economic Value of Namibia’s Protected Area System: A Case for Increased Investment, February 2010 Ministry of Environment and Tourism (MET) with funding from the UNDP/GEF supported Strengthening the Protected Area Network (SPAN) Project. Mimeo, 72pp

Land use options - conservancies

Ashley, C., and LaFranchi, C., 1997, Livelihood strategies of rural households in Caprivi: Implications for conservancies and natural resource management. DEA Research discussion paper, Number 20 August 1997. Mimeo, 108pp

Barnes, J. I., 1995, The value of non-agricultural land use in some Namibian communal areas: a data base for planning. Research discussion paper Number 6, May 1995. Directorate of Environmental Affairs Ministry of Environment and Tourism. Mimeo, 24pp.

Barnes, J. I., 2009, REDD in Caprivi - Assessment of competing land uses and woodland conversion. Powerpoint presentation, 14 slides.

Barnes, J. I., MacGregor, J., Nhuleipo, O. & Muteyauli, P.I. 2010. The value of Namibia's forest resources: Preliminary economic asset and flow accounts. *Development Southern Africa* 27(2): (159-176)

Bond, I., Chambwera, M., Jones, B., Chundama, M., Nhantumbo, I., 2010, REDD+ in dryland forests Issues and prospects for pro-poor REDD in the miombo woodlands of southern Africa. International Institute for Environment and Development (UK) ISBN: 978-1-84369-764-0 ISSN: 1605-1017. Mimeo 83pp

Emptaz-Collomb, J-G., Kanapaux, W., Mupeta, P., Barnes, G., Saqui, J., and Child, B., c2007, Assessing the success of community-based natural resources management through the integration of governance livelihood and conservation attitude indicators: case studies from Caprivi, Namibia. Mimeo 30pp.

Emptaz-Collomb, J-G., 2009, Linking tourism, human wellbeing and conservation in the Caprivi strip, (Namibia). PhD thesis, University of Florida, 179pp.

Fuller, B., and Prommer, I., (eds) 2000, Population–Development–Environment in Namibia. IR-00-031 / May 2000 University of Namibia Multidisciplinary Research and Consultancy Centre, IIASA International Institute for Applied Systems Analysis. Background Readings. Mimeo 326 pp.

Gore, Meredith L., and Jessica S. Kahler. "Gendered Risk Perceptions Associated with Human-Wildlife Conflict: Implications for Participatory Conservation." *PloS one* 7, no. 3 (2012): e32901.

Jones, B. T. B., Barnes, J. I., 2006, Human Wildlife Conflict Study: Namibian Case Study. Probably commissioned by the World Wildlife fund. Mimeo, 102pp

Jones, B. T. B., and Barnes, J. I., 2009, Preparing for REDD in dryland forests: Investigating the options and potential synergy for REDD payments in the miombo eco-region Namibia country study. commissioned by the World Bank Program on Forests (PROFOR) and the International Institute for Environment and Development (IIED). Mimeo, 53pp.

Kemp, L., Mendelsohn, J., and Jones, B., 2009, Conservancies in the Mudumu North Complex. Published by the Namibia Nature Foundation on behalf of the Natural Resources Working Group of NACSO, with financial support from WWF Norway. Mimeo 20pp.

Leggett, K., Fennessy, J., and Schneider, S., 2002, Does land use matter in an arid Environment? A case study from the Hoanib River catchment, north-western Namibia. *Journal of Arid Environments* (2003) 53: 529–543, doi:10.1006/jare.2002.1066

Martin, R. B. "The influence of veterinary control fences on certain wild large mammal species in the Caprivi, Namibia." Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health. Collection Occasional papers of the IUCN Species Survival Commission, IUCN, Gland (2005).

Purvis, J., 2002, Fish and livelihoods: Fisheries on the eastern floodplains, Caprivi. Research discussion paper Number 52, October 2002. Directorate of Environmental Affairs Ministry of Environment and Tourism. Mimeo, 49pp.

Schuerholz, G., Baldus, R. D., 2007, Conservation: the Selous-Niassa and Kawango Upper Zambezi challenges. Community Based Wildlife Management in support of Transfrontier Parks, Peace and Partnership Conference September 2007. Mimeo 15pp.

Suich, H., Kennedy, E., Bruner, A., Pilgrim, J., and Vynne, S., 2003, Transfrontier conservation areas: conservation and socio-economic impact indicators. Paper prepared for the workshop on Transboundary Protected Areas in the Governance Stream of the 5th World Parks Congress, Durban, South Africa, 12-13 September 2003. Mimeo, 10pp

Suich, H., Busch, J., and Barbancho, N., 2005, Economic impacts of transfrontier conservation areas: baseline of tourism in the Kavango-Zambezi TFCA, Paper No. 4, Conservation International, South Africa. Mimeo, 69pp.

Suich, H., 2010, "The livelihood impacts of the Namibian community based natural resource management programme: a meta-synthesis." Environmental Conservation 37, no. 1 (2010): 45-53.

Taylor, J. J., 2005, Land, resources and visibility: the origins and implications of land mapping in Namibia's West Caprivi. M.Sc. thesis, St. Anthony's College, Oxford. 83pp.

Weaver, Larrye Chris, and Patricia Skyer. 2003, "Conservancies: integrating wildlife land-use options into the livelihood, development, and conservation strategies of Namibian communities." In The 5th World Parks Congress, pp. 8-17.

Weaver, L. C., and Skyer, P., 2003, Conservancies: integrating wildlife land use-options into the livelihood, development, and conservation strategies of Namibian communities. A Paper Presented At The Vth World Parks Congress To; The Animal Health And Development (AHEAD) Forum Durban, Republic of South Africa September 8-17, 2003

Animal production policy in Namibia

Anonymous, 2009, SADC Draft Record, Livestock Technical Committee, meeting (LTCM), SADC/LTCM/Nov, 09/2. Gaborone, Botswana, 04 - 06 November, 2009. Mimeo 17pp.

Anonymous, 2008, Achieving compatibility between the Trans-frontier Conservation Area (TFCA) concept and international standards for the management of Trans-boundary Animal Diseases (TADs); Report of the workshop held at Chobe Marina Lodge, Kasane, Botswana 11 to 14 November 2008 SADC FMD Project, FANR, SADC Secretariat, Gaborone

Common Market for Eastern and Southern Africa (COMESA), 2008, Commodity based trade in livestock products, new opportunities for livestock trade in the COMESA region, Policy brief Number 1 May 2008, Comprehensive African agriculture Development Programme. Mimeo 3pp

SADC Secretariat, Food, Agriculture and Natural Resources (FANR) Directorate, 2009, Annual Report, April 2009 – March 2010. Mimeo, 73.

Vigne, P., 2005, Reconsidering policies to encourage formal livestock marketing in the northern communal areas, policy analysis and recommendations. National Agricultural Support Services Programme (NASSP), NASSP Report No. 007/2005, Ministry of Agriculture, Water and Rural Development. Mimeo, 50pp.

Social background papers in Namibia

Andersson, J., 2006, Land cover change in the Okavango River basin; historical changes during the Angolan civil war, contributing causes and effects on water quality. M.Sc. thesis Department of Water and Environmental Studies ISRN: LIU-TEMA/V/MPWLS-D-06/003-SE. 60pp.

Ashley, C., and LaFranchi, C., 1997, Livelihood strategies of rural households in Caprivi: Implications for conservancies and natural resource management, DEA research discussion paper Number 20. Directorate of Environmental Affairs Ministry of Environment and Tourism, Mimeo 108pp.

Central Bureau of Statistics, Republic of Namibia, 2008, A review of poverty and inequality in Namibia. October 2008, Central Bureau of Statistics National Planning Commission, Mimeo, 107pp

Gore, M. L., and Kahler, J. S., 2012, Gendered Risk Perceptions Associated with Human-Wildlife Conflict: Implications for Participatory Conservation, PLoS ONE, Vol 7, 3, e32901

Mendelsohn, J., 2007, A digest of information on key aspects of Caprivi's geography. Mimeo 7 pp.

Suich, H., Busch, J., and Barbancho, N., 2005, Economic impacts of transfrontier conservation areas: baseline of tourism in the Kavango-Zambezi TFCA. Paper No. 4, Conservation International, South Africa, Mimeo, 69pp.

UNDP, 2012, Namibia, International Human Development Indicators. Accessed: 10/20/2012,3:04 AM from: <http://hdr.undp.org>

Economic reviews of Commodity Based Trade

Gebru, G., Desta, S., Coppock, D. L., Tezera, S., and Edea, Z., 2009, Can pastoral linkages to livestock markets be sustained in southern Ethiopia? Pastoral Risk Management Project. Research Brief 09-01-PARIMA December 2009. Mimeo 4pp.

Gómez, M. I, Barrett, C. B., Buck, L. E., De Groote, H., Ferris, S., Gao, H. O., McCullough, E., Miller, D. D., Outhred, H., Pell, A. N., Reardon, T., Retnanestri, M., Ruben, R., Struebi, P., Swinnen, J., Touesnard, M. A., Weinberger, K., Keatinge, J. D. H., Milstein, M. B., Yang, R. Y., 2011, Research Principles for Developing Country Food Value Chains. 3 JUNE 2011 VOL 332 SCIENCE www.sciencemag.org

James, A. D., and Rushton, J., 2002, The economics of foot and mouth disease, *Rev. sci. tech. Off. int. Epiz.*, 2002, 21 (3), 637-644

Multiple authors, 2010, Responses and reactions to Scoones et al. to 'Foot-and-mouth disease and market access: challenges for the beef industry in southern Africa'. *Pastoralism* Vol. 1 No. 2 July 2010 13 pp

Naziri, D., Rich, K. M., Bennett, B., 2012, An economic assessment of the potential of commodity-based trade in communal areas of Namibia, DRAFT PAPER 50pp,

OIE, 2012, Terrestrial Animal Health Code, Chapter 8.5. Foot and mouth disease. Mimeo, 26pp.

Perry, B., Pratt, A. N., Sones, K., Stevens, C, undated c 2005, An appropriate level of risk: Balancing the need for safe livestock products with fair market access for the poor, PPLPI Working Paper No 23. Mimeo, 82pp

Perry, B., and Dijkman, J., undated but probably 2009, Livestock market access and poverty reduction in Africa: the trade standards enigma. A discussion paper commissioned by the Pro-Poor Livestock Policy Initiative (PPLPI) Working Paper No. 49. Mimeo 46pp.

Rich, K. M., (2007, July). New methods for integrated models of animal disease control. In Selected paper presented at the annual meeting of the American Agricultural Economics Association held at Portland, Oregon (Vol. 31).

Rich, K. M., 2009, What can Africa contribute to global meat demand? Opportunities and constraints. *Outlook on Agriculture* Vol 38, No 3, 2009, pp 223–233

Rich, K. M., Perry, B. D., 2010, The economic and poverty impacts of animal diseases in developing countries: New roles, new demands for economics and epidemiology *PREVET* (2010), doi:10.1016/j.prevetmed.2010.08.002

Rich, K. M., and Perry, B. D., 2010, Whither Commodity-Based Trade?, NUPI Working Paper 776, Department of International Economics. Mimeo 44pp. also in *Development Policy Review*, 2011, 29 (3): 331-357

Rich, K. M., Perry, B. D., Kaitibie, S., 2009, Commodity-based Trade and Market Access for Developing Country Livestock Products: The Case of Beef Exports from Ethiopia, *International Food and Agribusiness Management Review* Volume 12, Issue 3,

Scoones, I., Bishi, A., Mapitse, N., Moerane, R., Penrith, M-L, Sibanda R., Thompson, G., and Wolmer, W., 2010, Foot-and-mouth disease and market access: challenges for the beef industry in southern Africa. *Pastoralism* Vol. 1 No. 2 July 2010

Scoones, I., and Wolmer, W., 2006, *Livestock, Disease, Trade and Markets: Policy Choices for the Livestock Sector in Africa*, Institute of development Studies, Working Paper 269, Mimeo 55pp.

Vigne, P., 2005, Reconsidering policies to encourage formal livestock marketing in the northern communal areas, *Policy Analysis & Recommendations*, National Agricultural Support Services Programme (NASSP), NASSP Report No. 007/2005.

Technical studies and papers on commodity based trade (CBT)

Anonymous, 2009, Trade and transboundary animal diseases in the horn of Africa, Executive summary and list of participants. Nairobi / Kenya, 30 March—3 April 2009. Mimeo, 12 pp.

Brückner, G. M., 2011, Managing the risks of disease transmission through trade: a commodities-based approach? *Rev. sci. tech. Off. int. Epiz.*, 2011, 30 (1), 289-296

Brückner, G. M., 2011a, Ensuring safe international trade: how are the roles and responsibilities evolving and what will the situation be in ten years' time? *Rev. sci. tech. Off. int. Epiz.*, 2011, 30 (1), 317-324

Cartín-Rojas, A., 2012, *Transboundary Animal Diseases and International Trade*. Chapter 7 "International Trade from Economic and Policy Perspective". Bobek, V., ed. ISBN 978-953-51-0708-8, Published: August 22, 2012

European Food Safety Authority (EFSA), 2006, Risk Assessment on Foot and Mouth Disease, Opinion of the Scientific Panel on Animal Health and Welfare on request from the European Commission related to: Assessing the risk of Foot and Mouth Disease introduction into the European Union (EU) from developing countries, Assessing the reduction of this risk through interventions in developing countries / regions aiming at controlling / eradicating the disease, and Tools for the control of a Foot and Mouth Disease outbreak: update on diagnostics and vaccines (Question N° EFSA-Q-2004-113) Adopted 5 February 2006, *The EFSA Journal* (2006) 313, 1-34

Food and Agriculture Organization (FAO), 2011, A value chain approach to animal diseases risk management; technical foundations and practical framework for field application. *Animal Production and Health Guidelines*. No. 4. Rome. Mimeo 135 pp.

Jori, F., Vosloo W., Du Plessis B., Bengis, R., Brahmhatt D., Gummow B., and Thomson, G. R., 2009, A qualitative risk assessment of factors contributing to foot and mouth disease outbreaks in cattle along the western boundary of the Kruger National Park. *Rev. sci. tech. Off. int. Epiz.*, 2009, 28 (3), 917-931

Kahn, S., 2009, World Organization for Animal Health; The outcome of the discussion OIE ad hoc group on trade in animal products (commodities) [sic], Powerpoint presentation of 9 slides labeled – Paris, 23 May 2009

Metcalf, H. E., Blackwell, J. H., and Acree, J. A., 1996, Application of Risk Assessment to International Trade in Animals and Animal Products. *Annals of the New York Academy of Sciences Volume 791, Vector-borne Pathogens: International Trade and Tropical Animal Diseases* pages 280–295

Morgan, N., and Prakash, A., 2006, International livestock markets and the impact of animal disease, *Rev. sci. tech. Off. int. Epiz.*, 25 (2), 517-528

Musisi, F. L., Dungu B., Thwala R., Mogajane M. E., and Mtei B. J., c2003, The threat of contagious bovine pleuropneumonia and challenges for its control in the SADC region, FAO Document repository, website accessed August 13 2009

OIE, undated probably 2007, Devising import health measures for animal commodities. Mimeo 17pp.

OIE, 2008, Report, regional seminar, “Good Governance for Veterinary Services” 16.01.2008 – 18.01.2008, Gaborone – Botswana. Mimeo, 94 pp.

OIE, 2012, Regional GF-TADs for Africa 5-year Action Plan for the period 2012-2016, Draft version – IV 01 October 2012. Mimeo 26 pp

Paton D.J., Sinclair M., and Rodríguez R., 2010, Qualitative assessment of the commodity risk for spread of foot-and mouth disease associated with international trade in deboned beef. *Transbound. emerg. Dis.*, 57 (3), 115-134.

Paton, D. J., Sinclair, M., Rodríguez, R., 2009, Qualitative assessment of the commodity risk factor for spread of foot-and-mouth disease associated with international trade in deboned beef, OIE ad hoc Group on Trade in Animal Products / October 2009, mimeo, 54 pp. Also published in *Transboundary and Emerging Diseases*. 57 115–134 in 2010.

Pavanello, S., 2010, Livestock marketing in Kenya-Ethiopia border areas: A baseline study. Humanitarian Policy Group (HPG) Working Paper. Mimeo 35pp

Rich, K. M., and Perry, B., 2010, Market access and alternative trading standards for developing countries: An analysis of commodity-based trade for livestock products, Powerpoint Presentation for the OIE, Paris, France, 23 May 2010, Powerpoint 10 slides.

Steps centre / anonymous, 2008, Policy brief; Veterinary science, transboundary animal diseases and markets: pathways for policy in Namibia, www.steps-centre.org/ourresearch/vetscience.html. Mimeo, 2pp.

Steps centre / anonymous, 2008a, Policy brief; Challenges for the beef industry in southern Africa www.steps-centre.org/ourresearch/vetscience.html. Mimeo, 2pp.

Taylor, R. D., 2010, Assessment of the impacts of livestock product preferred market access to the European Union on land-use development options in southern Africa. Beef exports from southern African countries to European markets: Disease management at the livestock-wildlife interface, Mimeo 57pp (Headed DRAFT ONLY NOT FOR CIRCULATION OR CITATION)

Thalwitzer, S., and others, 2012, Development of Export Opportunities for Beef Products from the Caprivi Region, Final Report – Phase 1. Project ID: MCAN/LMEF/2010/02 mimeo, 25pp

Thomson G.R., Leyland T.J., & Donaldson A.I., 2009, Deboned beef – an example of a commodity for which specific standards could be developed to ensure an appropriate level of protection for international trade. *Transbound. emerg. Dis.*, 56 (1-2), 9-17. E-pub.: 29 October 2008.

Thomson, G. R., Perry, B. D., Catley, A., Leyland, T. G., Penrith, M-L., Donaldson, A. I., 2006, Certification for regional and international trade in livestock commodities: the need to balance credibility and enterprise *Veterinary Record* 159, 53-57

Thomson, G. R., Tambi, S. K., Hargreaves, T. J., Leyland, A. P., Catley, G. G., van't Klooster, and M. L. Penrith. "International trade in livestock and livestock products: the need for a commodity-based approach." *The Veterinary Record* 155, no. 14 (2004): 429-433.

Thomson, G., and Penrith, M-L., 2012, Scenario analysis for future integrated livestock production & wildlife conservation in the Caprivi; [produced for] Economic analysis for the WCS-AHEAD, WWF Animal Disease Management Project. Powerpoint presentation, 10 slides

Carbon sequestration and land management

Abberton, M., Conant, R., and Batello, C., (Eds.), 2009, Grassland carbon sequestration: management, policy and economics. Proceedings of the Workshop on the role of grassland carbon sequestration in the mitigation of climate change Rome, April 2009, Prepared for the Plant Production and Protection Division Food and Agriculture Organization of the United Nations (FAO). Mimeo 342pp.

Achard, F., Eva, H. D., Mayaux, P., Stibig, H.-J., and Belward, A., 2004, Improved estimates of net carbon emissions from land cover change in the tropics for the 1990s, *Global Biogeochem. Cycles*, 18, GB2008, doi:10.1029/2003GB002142

- Buringh, P., 1984, Chapter3, Organic Carbon in Soils of the World. In, *The Role of Terrestrial Vegetation in the Global Carbon Cycle: Measurement by Remote Sensing*. Woodwell, G. M., ed 1984, John Wiley & Sons Ltd. Agricultural University of the Netherlands, Wageningen, The Netherlands
- Ciais, P., Bombelli, A., Williams, M., Piao, S. L., Chave, J., Ryan, C. M., Henry, M., Brender, P. and Valentini, R., 2011, The carbon balance of Africa: synthesis of recent research studies. *Phil. Trans. R. Soc.* 369, 1–20
- Conant, R. T., and Paustian, K., and Elliott, E. T., 2001, Grassland management and conversion into grassland: effects on soil carbon. *Ecological Applications*, 11(2), 2001, pp. 343–355.
- Conant, R. T., and Paustian, K., 2002, Potential soil carbon sequestration in overgrazed grassland ecosystems. Potential soil carbon sequestration in overgrazed grassland ecosystems, *Global Biogeochem. Cycles*, 16(4), 1143, doi:10.1029/2001GB001661, 2002.
- Follett, R. F., and Reed, D. A., 2010, Soil carbon sequestration in grazing lands: societal benefits and policy implications. *Rangeland Ecology & Management*, 63(1):4-15. 2010.
- Grace, J., San Jose, J., Meir, P., Miranda, H. S., Monte, R. A., 2006, Productivity and carbon fluxes of tropical savannas, *J. Biogeogr.* 33, 387–400
- Houghton, R. A., 2003, Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850–2000. *Tellus* (2003), 55B, 378–390.
- Houghton, R. A., Melillo, J. M., Moore III, B, Murdiyarso, D., Noble, I., Pacala, S. W., Prentice, I. C., Raupach, M. R., Rayner, P. J., Scholes, R. J., Steffen, W. L., and Wirth, C., 2001, Recent patterns and mechanisms of carbon exchange by terrestrial ecosystems, *Nature* , Vol 414, 169-172.
- IPCC, 1996, Agriculture; Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual. Mimeo 20pp.
- Nouvellon, Y., Epron D., Kinana, A., Hamel, O., Andre´ Mabilia, A., D’Annunzio R., Deleporte, P., Saint-Andre, L., Marsden, C., Rouspard, O., Bouillet, J-P, Laclau, J-P., Soil CO₂ effluxes, soil carbon balance, and early tree growth following savannah afforestation in Congo: Comparison of two site preparation treatments, *Forest Ecology and Management* 255 (2008) 1926–1936
- Rutherford, M. C., 1979, Aboveground biomass subdivisions in woody species of the savanna ecosystem. South African national scientific programmes report No 26, January 1979. Mimeo, 39pp.
- Ryan, C. M. (2009). Carbon cycling, fire and phenology in a tropical savanna woodland in Nhambita, Mozambique. *Earth Observation*. Edinburgh, University of Edinburgh.
- San José, J. J., Rube, A., Montes, R. S., and Rocha, C., 2003, Neotropical savanna converted to food cropping and cattle feeding systems: soil carbon and nitrogen changes over 30 years. *Forest Ecology and Management* 184 17–32 doi: 10.1016/S0378-1127(03)00144-0

Spaninks, F., and van Beukering, P., 1997, Economic Valuation of Mangrove Ecosystems: Potential and Limitations, CREED Working Paper No 14. Mimeo, 62pp.

Van Wilgen, B. W., 2009, The evolution of fire management practices in savanna protected areas in South Africa. *South African Journal of Science*, 105(9-10), 343-349.

Williams, C. A., Hanan, N. P., Neff, J. C., Scholes, R. J., Berry, J. A., Scott Denning, A., and Baker, D. F., 2007, Africa and the global carbon cycle. Review paper in *Carbon Balance and Management*, 2:3. <http://www.cbmjournal.com/content/2/1/3>

Appendix 2; List of persons consulted

Cyprianus Khaiseb
Senior Manager: NCA (Northern Communal Areas)
Meat Corporation of Namibia, MEATCO

Dr. Alec Simukai Bishi,
Ministry of Agriculture Water and Forestry,
Directorate of Veterinary Services

Washington, Elzadia (WINDHOEK/DIR)
Elzadia Washington-Danaux
Mission Director
USAID/Namibia

Kenneth H. K. Uiseb,
Ministry of Environment and Tourism,
Deputy Director, Monitoring, Research and Planning,

Elizabeth Feleke,
Deputy Resident Country Director Namibia,
Department of Compact Operations,

Dustin DeGrande,
Political Officer, Embassy of the United States of America,

Dr Helmke Sartorius von Bach,
Director, Agriculture,
Millennium Challenge Account Namibia

Thomas Brouns
Economic and Commercial Officer,
Embassy of the United States of America,

Titus Kamatuka,
Economic Assistant,
Embassy of the United States of America,

Dr. Susanne Thalwitzer
Manager Meat Standards
MEAT BOARD OF NAMIBIA

Appendix 3; Reviews carried out in the course of the study

Introduction; the Kavango-Zambezi Trans Frontier Conservation Area

The cost benefit study using multi-criteria decision analysis is focused on the Caprivi portion of the Kavango-Zambezi Transfrontier Conservation Area (KAZA-TFCA). The KAZA-TFCA is a trans-frontier multiuse conservation area incorporating parts of Angola, Namibia, Botswana, Zimbabwe and Zambia (Figure A1). As can be seen the park incorporates a variety of land uses including the city of Livingstone as well as a significant number of smaller towns and settlements.

Purpose and establishment of the Conservation Area

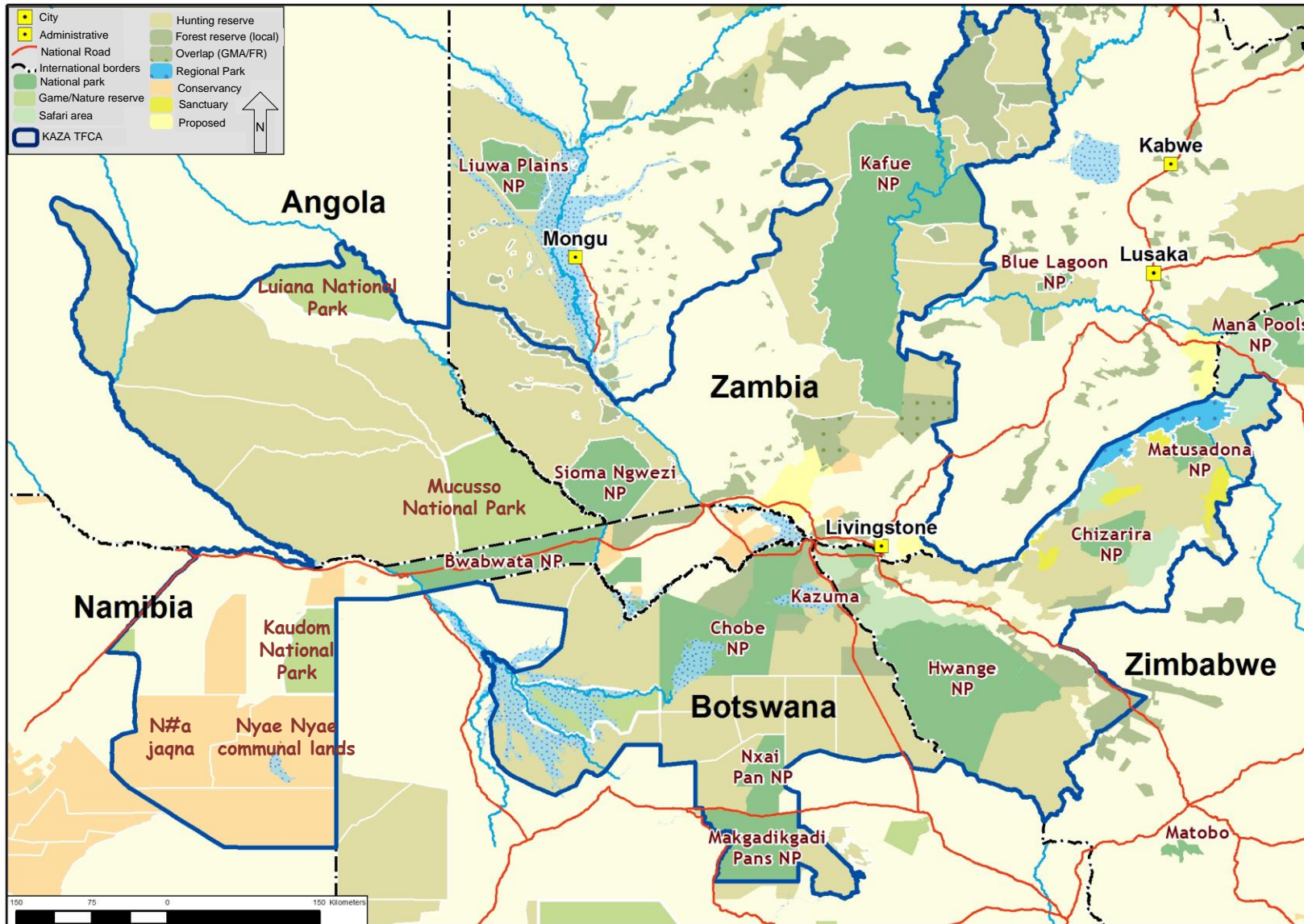
Ministers of the five participating countries, Angola, Botswana, Namibia, Zambia and Zimbabwe, signed a Memorandum of Understanding in December 2006 aiming at establishing the Kavango Zambezi Transfrontier Conservation Area, or KAZA-TFCA centered around the Caprivi-Chobe-Victoria Falls area with the aim “To sustainably manage the Kavango Zambezi ecosystem, its heritage and cultural resources based on best conservation and tourism models for the socio-economic wellbeing of the communities and other stakeholders in and around the eco-region through harmonization of policies, strategies and practices.”³⁵ The park was officially launched on the on the 15th March 2012 at a ceremony in Katima Mulilo in the heart of the area.

The KAZA TFCA program is owned and led by the five partner countries, with a clear focus on community led conservation as the primary form of land use with tourism as the main source of income generation. The entire area is in effect the world’s largest conservation site with over 444,000 square kilometers of natural resources, eco/cultural tourist attractions and includes over thirty national parks, game reserves, forest reserves, game/wildlife management areas as well as a number of conservation and tourism concessions for both consumptive and non-consumptive uses. Consumptive uses include exploitation of forests and hunting in a regulated and sustainable way.

The biological resources of the KAZA TFCA incorporate the largest contiguous elephant population on the African continent, estimated at half the total world population, but other wild and plant life is varied with at least 3,000 plant species and more than 600 species of birds that are characteristic of the southern African savannahs, woodlands and wetlands. Many species are unique to the area. Also incorporated are the Victoria Falls (a World Heritage Site) and the Okavango Delta (a Ramsar Site falling under the International Convention on Wetlands).

The numbers of people living within the park is variously estimated at between 1 million to 2.5 million people. The location of the TFCA, which is remote from national capital cities and in the border areas of all participating countries, has led to the historical marginalization of communities in the area. These individuals already bear the direct opportunity costs covered by the term human-wildlife conflict with limited opportunities for legal access or control over natural resources as well as the overall issues caused by trans-boundary animal diseases. The population of the Caprivi is variously estimated at about 80,000, the majority of whom are Lozi speaking.³⁶

Figure A1; General map of the Kavango Zambezi Transfrontier Conservation Area (KAZA – TFCA) showing major land use types.³⁷



Land use is by no means as homogeneous within the various parks as the designations in Figure A1 would lead one to believe. As an example the Bwabwata National Park in the Caprivi has 4 sub sections as shown in Figure A2 plus communities living within the park itself³⁸. Some maps additional show a ceded block north of the road between Omega and Chetto as being designated for agricultural use.

Figure A2; Bwabwata National Park in the Caprivi showing various land use sub designations within the park³⁹



Livestock farming in the Northern Communal Areas (NCAs) are primarily subsistence with some form of transhumance that involves movement between Namibia and Angola and Caprivi. Reported numbers of cattle in the NCAs is not known with any accuracy and census figures are based on vaccination coverage. On that basis the estimated populations of cattle in east Caprivi are shown in Table A1 (Food and Agriculture Organization, 2009).⁴⁰

Table A1. Summary of Livestock Census, December 2006 (after FAO 2009)

District/Region	Cattle	Sheep	Goats	Horses	Donkeys	Pigs
East Caprivi	156 379	762	92 000	19	28	524

3.1 Carbon balances in savanna under different management regimes

Climate of the Caprivi Strip

The climate of the Caprivi Strip is classified in the Köppen – Trewartha system as BShw. In essence it is a semiarid warm climate zone bordering the tropical (A) dry ‘winter’ (w) climates further north and cooler semiarid zones further poleward. Figure A3.1.1 shows the basic ‘available water’ characteristics of this climate for the Eastern Caprivi Strip which is the main determinant of vegetation patterns in the region. The climate is even though night temperatures in June – July can drop to 3-4°C which coincides with the period of lowest rainfall. The following are the chief characteristics of such a climate;

1. Rainfall is highly variable from year to year
2. Vegetation types are adapted to a single rainy season of less than six months
3. The carrying capacity of the land in terms of livestock units (LSU’s) is low when compared with temperate zones
4. The end of the dry season is a time of high stress on animals, both domestic and wild, and the environment when burning is at a high level and availability of forage is at its lowest

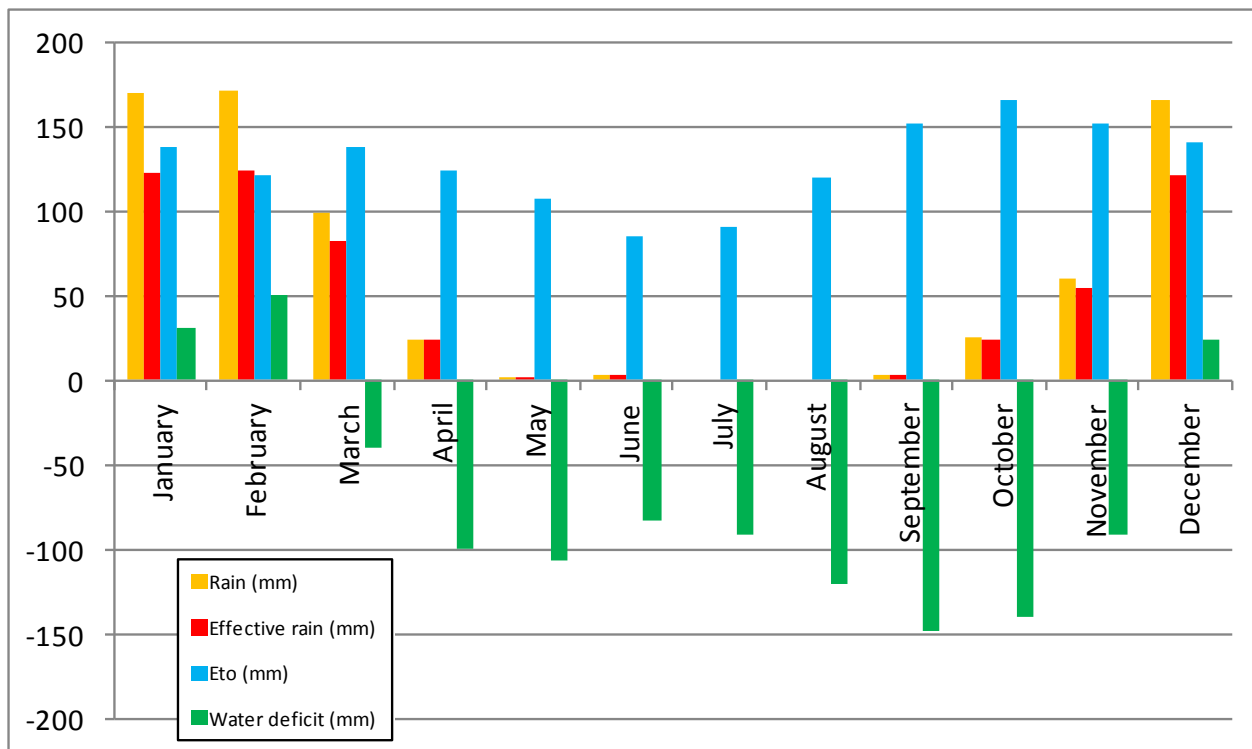


Figure A3.1.1; Rainfall, effective rain, open pan evaporation (Eto) and available water deficits in the eastern portion of the Caprivi Strip (values calculated using Food and Agriculture Organization CROPWAT software⁴¹)

Under natural conditions the content of organic matter in soil is constant with rates of decomposition is equal to the rate of supply of organic matter from plants. The equilibrium is disturbed when forests are

cleared and the land is used for agriculture. There is also a decline in organic matter when grasslands are transformed into cropland, or when savannas are burned. The decline is rapid in the first few years after deforestation and gradually slows over the next 10 to 50 years. Organic matter is also lost through misuse or deterioration of land (soil erosion, salinization, alkalization and soil degradation), and because of the increasing non-agricultural use of land (urbanization and highway construction).

On the other hand, there may be an increase in organic matter when good farm management is practiced and organic manure and compost are used, when arid land is irrigated, or where agricultural land is reforested^{42&43}. While there is a measure of agreement about the general effects of changes in land use on the carbon cycle, a review of the literature of actual field studies shows a number of significant gaps in our knowledge and understanding of the detailed processes going on. Issues such as burning, particularly in an African context, bush encroachment, the effect of large herbivores, grazing patterns of various types of livestock and so on are both controversial and poorly understood. As an example the following quote from Williams et al, 2007 is typical.

“.....much of Africa, particularly in the semi-arid regions, is vulnerable to degradation, that may be the result of periodic drought or caused by agricultural and pastoral activities, releasing presumably large but unknown amounts of CO₂ from cleared and dead vegetation as well as possibly triggering strong biophysical feedbacks to the climate system that may accelerate warming and prolong droughts.”⁴⁴

Therefore when interpreting the data shown in this review it is important to realize that the apparently hard numbers given are no more than rough estimates backed up by little hard data and that qualifying words such as ‘may’, ‘possibly’, ‘presumably’, ‘unknown’ are frequently used in reviews on the topic.

Table A3.1.1 is adapted and partially updated from a table in Grace et al (2006) and provides an illustration of the lack of information on the topic in that there are few studies on the topic of carbon sequestration in savannas, the studies do not offer a complete picture of what amounts of carbon are present and how these are changed by changes in climate, changes in herbivorous species mixes, management/land use and so on. In fact the entire scope of human knowledge on the carbon cycle as it relates to the African savanna has changed little in recent decades.

Table A3.1.1 Carbon stocks in savanna ecosystems of the world, expressed as above ground biomass–carbon per area of land (t C ha⁻¹), obtained from published data by assuming that biomass is 50% carbon (adapted from Grace et al 2006)⁴⁵

	Leaf	Wood	Total above ground biomass	Litter	Total below ground biomass	Soil carbon	Increase /loss in carbon	Authors
Entire South Africa			6.1		4.9			Rutherford (1993) ⁴⁶
Entire South Africa			6.7		5.4			Rutherford (1993)
Nylsvley, South Africa, broad-leaved savanna	1.4	8.1	9.5	6.6	7	23.3		Tothill and Mott (1985) ⁴⁷
Nylsvley, South Africa, broad-leaved savanna, fire every three years	2.6	5.1	7.7	12		33.9	Increase of 10%	Scholes and Walker (1993) ⁴⁸
Carbon loss from African savanna burnt annually							= 6.6 t biomass x 85% +/- 30%	Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories: Reference Manual
Orinoco Llanos protected from burning							+1 t/yr over 20 years	San Jose et al, 1998 a & b
Orinoco Llanos converted to cropping							Loss of half initial C	Scholes and Hall (1996) ⁴⁹
Moderately grazed subtropical savanna (Chaco dry savanna, Argentina)						85.2		Abril and Bucher, (1999) ⁵⁰
Heavily grazed subtropical savanna (Chaco dry savanna, Argentina)						66.5	Loss of just over 20% of soil carbon	Abril and Bucher, (1999)

The clearest set of published figures on carbon levels with grassland type and management are those of Petri et al (2010)⁵¹. The authors have considered four types of grasslands i.e.;

1. herbaceous closed-open cover;
2. evergreen closed-open shrub cover;
3. deciduous closed-open shrub cover; and
4. sparse herbaceous and shrub cover.

The areas under grasslands were also further classified into another three categories based on expected management status so as to define varying scenarios of C sequestration or loss potentials. These scenarios are based on methodologies suggested by the Intergovernmental Panel on Climate Change (IPCC) for estimating relative changes in carbon stock after changes in management. Three management states were identified i.e.;

1. natural grasslands where no management changes are expected to take place;
2. degraded grasslands that are presumably poorly managed and where management improvements are not expected to take place in the short to mid-term; and
3. areas that are potentially susceptible for improvement

Table A3.1.2 shows the distribution worldwide of actual mean soil carbon stocks under different climates and typologies of grassland.

Table A3.1.2: Average stock of organic carbon (0–30 cm) in different grassland types (kg/m²) (After Petri *et. al.*, 2010)

HERBACEOUS	Deciduous shrub	evergreen shrub	Herbaceous	Sparse shrub / herbaceous
Subtropics	3.3	5.1	4.8	5.4

However for more details assessments the IPCC has provided a framework for estimating and simulating emissions resulting from changes in grassland by analyzing data from 49 studies that appeared to isolate the management effect (Ogle, Conant and Paustian, 2004)⁵². Data for the various sub-divisions of sub-tropical grasslands has been extracted from this study and are summarized by, management status and main grassland typology (Table 3 A3.1.3). However the authors add the following reservations in respect of the data in Table A3.1.3;

Where there is no data, and this is particularly true for Africa, soil carbon sequestration factors of similar climates or the IPCC default values were used (details of references used are presented in Table A3.1.5).

1. Some of the experiments were not completely georeferenced, which makes for difficulties in attributing the results to a certain combination of climate, management and vegetation.
2. There is a significant lack of data in developing non-tropical areas, and
3. There is a little data for unmanaged grasslands.

Table A3.1.3: Sequestration factors for organic carbon as a function of grassland typology, management status and climatic zones (After Petri *et. al.*, 2010)

Sub-tropical dryland grassland types	Grassland types	Degraded	Improved
Shrub	1.02	0.56	1.07
Grasses	1.02	0.8	1.1
Sparse grasses	1.02	0.7	1.1

Total and mean carbon sequestration is presented in Table A3.1.4.

Table A3.1.4: Mean (kg C/m²) carbon sequestration (0–30 cm) as a function of grassland typology and management level (After Petri *et. al.*, 2010)

Typology of grasslands	Natural	Degraded	Potentially improved
Deciduous	0.06	−0.02	0.03
Evergreen	0.13	−0.05	0.07
Herbaceous	0.03	−0.02	0.02
Sparse	0.02	−0.02	0.02

Table A3.1.5: Sequestration factors for organic carbon as a function of grassland typology, management status and climatic zones (Chapter II)

Land cover class	without management (natural)		Managed		Degraded	
	Stock change factor	Authors	Stock change factor	Authors	Stock change factor	Authors
Shrub cover, closed-open, evergreen	1.02	Solomon et al, 2007 ⁵³	1.05-1.1 1.07	Batjes, 2004, ⁵⁴ Derived	'0.39 0.56	Puerto et al., 1990 Derived from Bonet, 2004
Shrub cover, closed-open, deciduous	1.02	Solomon et al, 2007	1.05-1.1 1.07	Batjes, 2004, Derived	'0.39 0.56	Puerto et al., 1990 Derived from Bonet, 2004
Herbaceous cover, closed-open	1.02	Solomon et al, 2007	1.05-1.1 1.1	Batjes, 2004	0.8	Derived
Sparse herbaceous or sparse shrub cover	1.02	Solomon et al, 2007	1.05-1.1 1.1	Batjes, 2004	0.7	Derived

3.2; Literature review and discussion document; Ecological values attributed to land use patterns in the Kavango-Zambezi Transfrontier Conservation Area

Introduction

There has been a considerable amount of discussion in conservation literature of the importance of including ecological and species conservation dimensions into economic cost benefit analyses.^{55, 56 & 57} However these proposals have not led to any formal cost benefit studies that have successfully incorporated these to date. This review is aimed at summarizing the existing data on the ecological implications of land management in terms of species diversity, carbon, as well as soil and water conservation. The intention is to inform the corresponding economic and social dimensions of any such analysis. As a starting point Table A3.2.1 was been constructed determine what data could be gathered from existing literature

Table A3.2.1; Proposed matrix for ecological data in multi -criteria decision analysis of various management systems in the Caprivi Strip

Land use	Land use	Species diversity or occurrence	
	Carbon sequestration	Plant	Animal
Livestock	carbon wildlife refuges and corridors water recharge and purification	Scalar or number	Scalar or number
Wildlife	carbon wildlife refuges and corridors water recharge and purification	Scalar or number	Scalar or number
Mixed/multi species systems	carbon wildlife refuges and corridors water recharge and purification	Scalar or number	Scalar or number

The following were the proposed sub divisions within the Ecology sub-matrix of the multi-criteria decision analysis (MCDA) analysis. The section is tentative in the following respects;

1. **Land use** subdivisions
2. The **Criteria** used
3. The **Data** values

Carbon sequestration

There is general agreement that climax biomes are generally carbon neutral in that fixing of carbon dioxide by photosynthesis is matched by its production. Greenhouse gas negative systems, such as peat bogs, do not occur in the Caprivi Strip though some areas of permanent wetland may qualify as being carbon negative. Due to the current lack of literature specific to the Caprivi an estimate is made based on the global review of Neely et al, 2009.⁵⁸ In this review the following broad conclusions can be drawn

on changes in the carbon cycle in relation to livestock production in sub humid regions as compared with 'virgin' or pre historic⁷ habitats;

1. Overgrazed with domestic livestock; initially large carbon positive and then carbon neutral
2. Managed and mixed species; initially medium carbon positive if converted from wildlife use or carbon negative if changed from purely domestic livestock management system and then becoming carbon neutral
3. Managed wildlife; carbon neutral (virgin) or carbon negative if converted from grazing by domestic animals

Plant species diversity

There is no data available on plant species diversity under different management systems in the Caprivi Strip so data from Jeltsch et al 2010 is used instead.⁵⁹ The authors present data of vegetative diversity in Thornbush Savannah from various sheep farms with adjacent game management areas for the north central area of Namibia. An interpretation of vegetative diversity in three management systems could be that shown in Table A3.2.2.

Table A3.2.2; Plant species diversity in various land uses in the Thornbush Savannah of North Central Namibia (after Jeltsch et al 2010)

Land management	Intensive livestock	Extensive domestic livestock management	Game farming
Number of species	-10 to +10	0 to +10	+30 to +40

Animal diversity

There is very little specific information on animal species diversity and density under different land use systems. The following table (Table A3.2.3) has been constructed on the raw data presented in the survey carried out by Elephants without Borders (Chase, 2007).⁶⁰

Table A3.2.3; Data on species diversity in Protected Areas and Conservancies in the Caprivi strip interpreted in terms of proposed land use classifications for the multi-criteria decision analysis study (after Chase, 2007).

Land use	Number of wildlife species (based on presence/absence and weighted by area)	Density of wildlife species (woodland species only)
Livestock	0	0
Wildlife	0.099	15.42
Mixed/multi species systems	0.031	2.23

⁷ Pre human settlement

3.3 Land use systems in the Caprivi area of Namibia

Introduction

This review looks at the patterns of land ownership and management in Namibia with particular reference to the Caprivi area. The aim is to generate a list of 'land use options/alternatives' to populate a model for economic, social and environmental analysis using MCDA. As such the review is far from comprehensive as the aim is to generate relatively broad categories of land use that are currently practiced in the Caprivi.

Prior to independence Namibia had broadly three main land use systems being, commercial privately owned land south of the Veterinary Cordon Fence (VCF), a communal land system primarily north of the VCF and a network of national parks. Respective areas in the three systems amounted to 44%, 42% and 17% of Namibia's land area. At independence on 21 March 1990 Namibia adopted a constitution that specifically addresses habitat conservation and protection of natural resources (Anon 2012⁶¹ and Barnard 1998⁶²). The country has taken this provision seriously and in the post-independence era new land uses have developed and now comprise a significant proportion of the total. More specifically the concept of conservancies in the communal areas has developed apace and now account for 19% of the total land area of the country.

Table A3.3.1 summarizes the various types of land use currently practiced in Namibia. As can be seen each type of land ownership can now be subdivided into various land use sub-divisions. In essence the communal areas have begun to mirror the land uses seen in the private sector where three uses (livestock, wildlife and mixed multispecies) are seen. Commercial wildlife hunting and ecotourism have expanded into the communal areas from both private lands and protected areas. The uses and development of each type of area is described in more detail below.

Protected areas

Essentially National Parks concentrated along the more arid western parts of Namibia though a significant portion of the western part of the Caprivi is protected. The majority of the protected estate takes in almost the entire coastline of the country with some associated protected marine areas mainly in the south central coast. Protected areas fall into four broad categories;

- desert parks, such as Namib-Naukluft Park and /Ai-/Ais Hot Springs
- developed wildlife parks – Etosha and Waterberg Plateau
- less developed wildlife parks, all of which are found in the north-eastern parts of the country, such as Mamili National Park and Caprivi Game Park
- numerous small reserves, resorts and recreational sites, such as Popa Game Park and Hardap Recreation Resort.

Trophy/safari hunting in state protected areas in 1996 was estimated at US\$215,000 in 1996 versus US\$ 681,000 spent in Communal Conservation areas (Turpie et al 2010)⁶³

Traditional communal lands

The legal status of communal land has been confused with a combination of laws and precedents from before 1990 that originated in South Africa, Namibia and the 'homelands,' as well as the guiding principles of the Constitution, customary law and post-1990 sectoral legislation. The relationship of post-1990 sectoral legislation to the Communal Land Act is unclear. This causes problems for residents of these areas since they are not sure that they will have continued access to their land and there is no indication that the situation has been fully resolved (Blackie, 2000)⁶⁴

For the purposes of this review traditional communal lands are subdivided into two broad categories, i.e. those that are primarily managed for domestic livestock with limited or no wildlife, and those belonging to the new conservancies that have domestic livestock with wildlife (mixed multispecies) or consist of wildlife only. An example of what is essentially a wildlife only conservancy is that of the Nyae Nyae communal lands but in practice it appears that land use in the communal lands in the Caprivi itself is either primarily domestic livestock oriented or mixed multispecies.

In communal areas agro-pastoral systems are still the norm, combining extensive livestock management with small-scale cropping, and a diverse use of trees and other wild resources. Wildlife populations have been generally rich in the northeast and northwest. Residents of communal lands have use-rights over arable land, rangeland, and some trees, but no individual ownership of the land or resources (Ashley, 1996).⁶⁵

In the Caprivi the communal areas are of two kinds namely; traditional communal lands and the Registered and Emerging Conservancies. As of 2011 there were 11 registered conservancies in the Caprivi (Table A3.3.2). The seven Conservancies declared prior to 2006 are shown in Figure A.3.3.1. Communities wishing to register as conservancies must elect a representative committee negotiate and agree boundaries with neighboring communities and draw up a constitution and management plan which is then submitted to the Ministry of Environment and Tourism for consideration.

Community forests, a comparatively new development in conservancies follow the same basic principles of community based natural resource management (CBNRM) of wildlife oriented conservancies to benefit the local community by providing an opportunity to develop a forest management plan in which explicit extraction and use quotas are set out. Income generated from the use of these resources is intended to benefit the community directly (Dusenberry 2012)⁶⁶.

Table A.3.3.1; Land uses in Namibia based on a review of various sources

Land use type	Sub divided into-	Notes
Protected areas	Hunting permitted (concessions in State Protected Areas?) and others where no hunting is permitted	Namibia has an extensive State Protected Area arrangement, covering about 17% of the country.
Namibia Conservancy Program	Registered conservancies	Namibia's CBNRM Programme includes extending protected areas in the form of conservancies are multiple use zones where residents are given partial rights to manage and benefit from wildlife to 19% of the country, i.e., over 130,000 square kilometers is covered by 64 registered conservancies with over 230,000 members. ⁶⁷
	Emerging conservancies	Circa 25 new conservancies in development
Concession	Hunting concessions in areas which could be wildlife only, multiple use and various types of land ownership from communal to private (e.g. Weaver and Skyer 2005 ⁶⁸).	As game numbers increase in registered conservancies, concessions are available via auction through the Ministry of Environment and Tourism for trophy hunting, own use and shoot and sell. Prices in 2005 ranged from US\$150 for a duiker to US\$ 15,000 for an elephant (2005 prices quoted by Weaver and Skyer 2005). The assumption is that the bulk of the fees collected are paid to the community in the conservancy. These areas are within both the State Protected Areas, commercial wildlife farms and Conservancies in the traditional communal lands
Traditional communal lands	Livestock – no wildlife	Communal lands encompass an additional 42%, mainly in the area to the north of the Veterinary Fence. Rainfall is relatively plentiful in the eastern portion of this area including the Caprivi. The assumption is that the Caprivi area is de-facto mixed multispecies but not all declared as conservancies
	Livestock with wildlife (mixed multispecies)	
	Without livestock – wildlife only	For example the Nyae Nyae communal lands, now a conservancy, belonging to the Ju/'hoansi San are part of the 42% of communal lands in Namibia and it appears that livestock rearing has never been a significant economic activity in this and similar groups. Prior to the declaration of the Conservancy the Ju/'hoansi San appear to have been primarily hunter gatherers (outside the Caprivi area proper)
Private land	Livestock	Private farms occupy 44% of Namibia and are mainly in the area to the south of the Veterinary Fence.
	Livestock with wildlife (mixed multispecies)	
	Wildlife only	

Private land

Privately owned land in Namibia is primarily to the south of the Livestock Veterinary Fence (popularly known as the 'red line') and appears not to be a significant feature in the Caprivi. A particular feature of private land ownership is the ability of owners to invest in longer term management measures and one feature has been the growth of wildlife farming at the expense of domestic animals. Studies indicate that the conversion to wildlife farming is driven, in part by the increased income that such activities generate. However from a larger conservation perspective the gains are limited by continued confinement of game to a limited range in what are effectively a series of compartments. In the era immediately preceding the development of conservancies private landowners registered increases in both wildlife numbers (80%) and species (40%) based on the following factors identified by Ashley (Ashley 1996).

- Land tenure plus use rights over wildlife.
- Market value of wildlife with well developed links with trophy hunting and sport hunting markets, and increasingly with tourism
- No positive environmental externalities leading to any incentives
- Comparative returns to alternative land use distorted by livestock subsidies -

The first two were positive incentives, the third neutral and the fourth negative though by then, 1996, livestock production subsidies/incentives were being phased out.⁸

Table A3.3.2; conservancies in the Caprivi to 2011 and date of registration (source; Republic of Namibia, Ministry of Environment and Tourism)

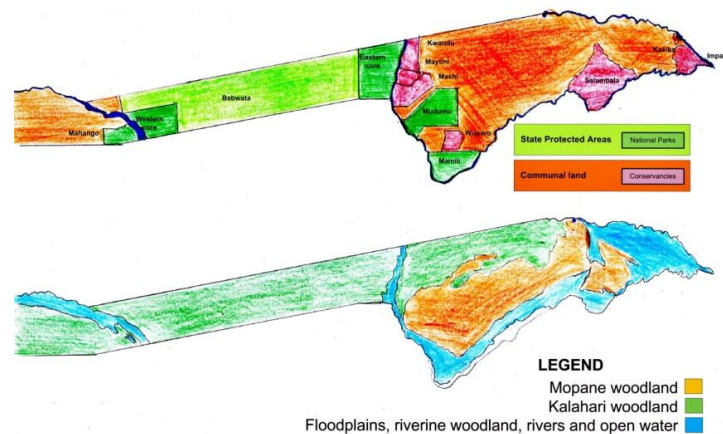
Conservancy	Date registered
02. Salambala	1998, Jan
16. Kwandu	1999, Dec
17. Mayuni	1999, Dec
18. Mashi	2003, Mar
19. Wuparu	1999, Dec
43. Kasika	2005, Dec
44. Impalila	2005, Dec
49. Balyerwa	2006, Oct
50. Sobbe	2006, Oct
56. Sikunga	2009, Jul
58. Dzoti	2009, Oct
64. Bamunu	2011, Mar

⁸ Agricultural support was focused on commercial farmers through livestock subsidies, loans, extension and veterinary services, drought relief, and protected markets (source, Ashley, 1996).

Concessions

The concept of a concession is that of a limited use hunting or tourism permit for an area of land. In essence it is a limited lease that allows private operators to use land belonging to the private, public or communal sectors for private profit. Since the concessionaire is bound by both the terms of the permit and time the environmental and other impacts of such activities can be managed by both the land owners and the State. In addition the benefits can be easily gauged as they translate into both money and job creation. Tourism to Namibia is primarily nature based and therefore the value of any given piece of land to a concessionaire is the game viewing and/or hunting opportunities it offers. This limits choice to the State Protected Areas and commercial farms managed for wildlife and conservancies.

Figure A.3.3.1; Land use and vegetation map for the Caprivi and conservancies declared before 2006 (after Mendelsohn and Roberts 1997: 'Land Types', page 20⁶⁹)



Populating an Alternatives list for multi criteria decision analysis

The following is a proposed list of land use alternatives for populating the 'Alternative Land Uses' in an analysis using MCDA.

1. State Protected Areas with hunting concessions permitted
2. State Protected Areas no hunting permitted
3. Registered Conservancies with domestic livestock and wildlife - hunting concessions permitted
4. Registered conservancies with wildlife only with hunting concessions permitted (not sure that there is an example in the Caprivi)
5. Registered conservancies for forest conservation and use
6. Emerging conservancies
7. Traditional communal lands with livestock – no more than residual wildlife
8. Private land with livestock only
9. Private land with livestock with wildlife (mixed multispecies)
10. Private land with wildlife only

There is no indication that Alternatives 5, 8, 9 and 10 exist in the Caprivi. There may also be no real distinction between Alternatives 3 and 4 for that geographic area though there is an example of Alternative 4 elsewhere in Namibia.

3.4 Possible social impacts of land use options and commodity based trade in beef in the Caprivi

Introduction

This mini review is of existing studies and reviews of the potential social and poverty alleviation [economic impact at the household and vulnerable group level] impacts of the creation of the KAZA TFCA and the development of commodity based trade in beef from Caprivi. The study focuses on the potential impacts on vulnerable groups/areas [women, children, vulnerable areas, smallholders and unemployed] and the potential number of households involved. In late 2009 something in excess of 200 studies relating in some way to CBNRM programs were identified (Suich, 2010)⁷⁰. The current study has collected in excess of 700 documents of which 8 (i.e. c. 1%) might be regarded as exclusively focusing on the social and socio economic impacts of conservancies. Most of the studies described are qualitative in nature with some limited attempts at some statistical rigor (for example see Table A3.4.1). The primary meta study of Suich quotes no statistics at all other than the numbers of studies with negative and/or positive findings. The data, such as it is, has been collected into two tables representing the two land use methodologies adopted in this study. Table A3.4.3 represents the 'land use classification' and Table A3.4.4 follows the alternative 'scenarios for beef exports from Caprivi.' Also included in the tables is the criteria 'agricultural productivity' as this item is closely bound with many of the social criteria. Each criterion is reviewed separately below.

Agricultural productivity

The Caprivi region has sufficient rainfall for the inhabitants to engage in some dryland, i.e. unirrigated, cropping. The definition of agriculture as used here is extended to the keeping of livestock as the land use and scenario impacts are broadly similar to both planted crops and domestic animals. In the meta study (Suich, 2010) the agricultural impacts are in three broad categories; access to food, access to land, and human wildlife conflict. Indications in the first two categories are that the development of conservancies have lead to real or perceived reduced land access and food availability. Linked to these indicators are the more quantified rise in incidences of human wildlife conflict which are primarily, though not exclusively, in the form of damage/depredations to crops and livestock.⁹ There is no data for livestock losses in Caprivi but what data there is indicates that somewhat above 60% of crops are damaged in some way by wildlife. The actual losses might be somewhat less but these are not quantified in any of the studies reviewed. Losses of livestock and family members, but not crops, to wildlife have been valued for compensation purposes by the Ministry of Environment and Tourism (anonymous, undated)⁷¹. One study has provided some quantitative data on the impact of wildlife on communal farmers but it is not easy to interpret the study in terms of hard data particularly as the study looks at smallholder households only. A figure of US\$37 per household per year is given on lost agricultural productivity but there are several qualifications to this number and all one can really say is

⁹ An 8 km transect of maize and millet crops was undertaken by the senior author on 20 February 2013 about 50 km east of Katima Mulilo. Considerable crop damage was visible but appeared to be entirely caused by domestic cattle

that crop damage exists and it impacts negatively on household income, (Jones and Barnes, 2006)⁷². For purposes of the analysis the following arbitrary values have been put in; there is no crop production in state protected land therefore agricultural productivity is set at zero, for mixed multi species situations the number is set at 40% (i.e. undamaged gardens) and for private land productivity is set at 100 on the assumption that fencing is in place to exclude wildlife from domestic animals and planted crops.

Poverty impacts

There are two counterbalancing effects of the creation of conservancies in poverty. The first is some measure of reduced access to resources for personal use which is counterbalanced by increased income and services through a variety of options including employment and other work opportunities – such as handicrafts. Some hard data on incomes and spending at the level of conservancies is quoted by Jones and Barnes, (2006) but is not in a format than can be used in the tables. There are few studies that examine household incomes in the Caprivi in detail and many of these tend to be limited in scope covering one land use option only (e.g. Kanapaux, 2009)⁷³ or present data that is only really translatable to a Likert type scale in terms of data entry (Emptaz-Collomb, 2009⁷⁴).

A systematic attempt has been made to quantify the non agricultural benefits of conservancies though the study is from the mid 1990's and predate their establishment by some years (Barnes, 1995 as shown in Table A3.4.1)⁷⁵. However it does provide some basis for assigning incomes in terms of numbers for conservancies though direct comparison with [state] protected areas and private land remain elusive. Thus the poverty impact is set at 'some' while that for protected, traditional and private land is set at 'none or limited' given that a number of studies point out that these reflect the current *status quo* and that poverty and that today's income inequalities in Namibia are high.

Impact on vulnerable groups/areas

There is general agreement in the literature that impacts of conservancies and hunting concessions in these areas have a generally positive impact on the community. While the financial benefits are relatively easy to quantify the impact on vulnerable areas is also simple to determine since by definition the entire Caprivi region is a vulnerable area. Vulnerable groups include, women, children, [smaller] smallholders and [landless] unemployed. The definition of vulnerable group can, in the case of Namibia, be extended to people living with HIV/AIDS. Namibia's Gini coefficient of 68.3 makes it one of the most unequal countries in the world (UNDP, 2012).¹⁰ In practice the poorest groups in Namibia are female-headed households, based in rural areas with have one or more children (Central Bureau of Statistics, Republic of Namibia, 2008⁷⁶) which places the entire project in one of the centers of vulnerability in Namibia. However there are two issues to consider which are;

¹⁰ The Gini coefficient measures the inequality among values of a frequency distribution – in this case levels of income). A country Gini coefficient of zero expresses perfect equality, and of one a hypothetical situation where a single person has all the income of the country.

- whether the outcomes of implementing various land use options or commodity based trade (CBT) scenarios impacts on vulnerable areas

and

- whether there is a trickledown effect to vulnerable groups within those areas

These questions are considered in a little more detail below.

Table A3.4.1: The current contribution to National Income of non-agricultural natural resource use in four areas of communal land (with associated protected areas) (N\$, adjusted for inflation from 1994 value to estimated currency value in 2017) (after Barnes 1995)

Area	Caprivi Region	Tsumkwe District, eastern Otjozondjupa region, north of latitude 22
Extent (sq.km.)	18800	17877
Resource use		
Non-consumptive tourism		
Community run	155015	82485
Private sector run	8995629	0
Government run	373791	0
Safari hunting	7338909	0
Angling tourism	1995289	0
Community activities		
Hunting	42309	226678
Fishery	2774988	0
Timber	99551	37332
Thatch grass sales	111995	0
Other veld products	367097	440514
Craft production	393080	128554
Craft marketing	421822	153930
Commercial timber	616174	0
SUBTOTAL	23685645	1069492
LESS Wildlife damage costs	521207	67420
TOTAL	23164438	1002072
TOTAL per sq. km.	1233	57

Number of households involved

As discussed in a little more detail in the section describing the land use and scenarios - Caprivi has an estimated 12,000 farm households of whom 6,840, almost 60%, are believed to own cattle. The total herd is estimated at 145,000 head.

Women

The participation of women in economic activities in the Caprivi region is relatively little studied though there are some studies (e.g. Gore and Kahler, 2012⁷⁷). However the data that has been uncovered do not really provide much data for a study such as this one. It appears that there are differences in perceptions of conservancies between men and women that would appear reflect the oft repeated clichés relating to the gender division of economic activities and participation in child raising that obtain in rural Africa.⁷⁸ For example in the instance of Caprivi the women appear to be more concerned about crops and children whereas men have greater concerns about livestock related issues including TAD's.

Children

There are no studies that can be found that look at the impacts of land use and SBT scenarios on children. Anecdotally it can be assumed that with increasing wealth in the region increasing investments in nutrition, clothing, housing and education will be available to children though this is not easy to quantify in the context of this analysis. It also appears to be true that children are often involved in cattle herding, perhaps to the detriment of schooling, but this appears to be a little studied topic.

Vulnerable areas

As noted above the entire region is a vulnerable area so it is not really possible to disaggregate impact effects of various land use options or scenarios by their relative impact on areas, vulnerable or otherwise.

Smallholders

Using data extracted from a graph in Anonymous, (2012) Table 3.4.2 has been constructed which gives an idea of the size and ownership distributions in Northern Namibia.⁷⁹ The text in the source document is unclear but the pattern seems to be similar to that in the Caprivi region mentorship program participants (Meatco, 2012).⁸⁰

Table 3.4.2; Cattle herd sizes and distribution in the Northern Communal Areas (after Anonymous, 2012).

Number of cattle owned	% of owners
1-4	16
5-15	35
16-51	33
52+	16

The Meatco mentorship program has managed to move significant numbers of smallholders from the median range (5 to 51 cattle) into the large herd category – primarily through improved management practices of which direct sanitary and phytosanitary (SPS) related activities have been of marginal effect at best. The evidence is that the primary effect on smallholders would be to increase market access and that more direct productivity gains would come from other interventions – primarily in the form of the introduction of improved husbandry practices. Overall the effect is deemed to be negative because the application of a mixed multispecies system (the conservancy and the various CBT scenarios) introduce

livestock–wildlife interactions which in the short to medium term introduce production and marketing uncertainties in the form of increased problems such as increased possibilities for foot and mouth disease (FMD) outbreaks.

Unemployed

There is not much in the way of hard data on the various opportunities for employment represented by the various land use options. While increased income per unit area from various types of tourism is possible and indeed has been quantified there is no [easily accessible] source of information on the corresponding work opportunities for unemployed people in the Caprivi. Many such people have relatively few skills and opportunities would be in unskilled work, crafts, outsourcing of inputs for hunting and ecotourist operators. While these have been enumerated in some reports it is not possible to use this data to insert hard numbers in Tables A3.4.3 and A3.4.4 so these have been left as Likert scales (Suich et al, 2005).⁸¹

Table A3.4.3; Land use options for Caprivi and imputed values for agricultural and social effects¹¹

Land use type		A	B	C	D	E
		Protected areas	Namibia Conservancy Program	Concession	Traditional communal lands	Private land
Domestic agri-food effects	Agricultural /fisheries productivity	0	40	40	100	100
Social effects	Poverty effects	None or very limited	Positive but no firm data	Positive but no firm data	None or very limited	None or very limited
	Effect on vulnerable groups/areas	0	Some positive effect	Some positive effect	0	0
	Number of households involved	0	several hundred	several hundred	0	0
	Women	No data	No data	No data	No data	No data
	Children	No data	No data	No data	No data	No data
	Smallholders	0	some negative effect	some negative effect	0	0
	Unemployed	0	Some positive effect	Some positive effect	0	0

¹¹ For the purposes of the two tables on agricultural and social impacts a five point Likert scale is used as follows

1. Large positive effect
2. Small positive effect
3. No effect
4. Small negative effect
5. Large negative effect

Table A3.4.4; Cattle production and marketing scenarios for Caprivi and imputed values for agricultural and social effects

Scenario description		1	2	3	4	5	5.1	5.2	5.3	5.4	5.5	6	7	8
		<i>Statu s quo</i>	Have FMD treated as most other transboundary animal diseases (TADs)	Caprivi recognized as a zone free from FMD with vaccination	Apply Article 8.5.25 of the TAHC as it currently stands ¹²	Modifications of 8.5.25 that achieve equivalence(ALOP)	Include quarantine in the process	Combine the quarantine system with feedlotting	Exclude need for motorized transport	Introduce heating standard associated with processing	Exclude the requirement for 10km FMD-freedom in last 30 days	Develop exclusively CBT/ hazard analysis and critical control points (HACCP)-based system	Creation of one or more FMD-free compartments within the Caprivi	Develop beef processing systems for poor quality beef
Domestic agri-food effects	Agricultural /fisheries productivity	100	40	40	40	40	40	40	40	40	40	40	40	40
Social effects	Poverty effects	0	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data
	Effect on vulnerable groups/areas	0	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data	Positive but no firm data
	Number of households involved	0	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred		
	Women	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
	Children	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
	Smallholders	0	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect	some negative effect
	Unemployed	0	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred	Several hundred

¹² i.e. dispense with requirement for quarantine of animals & meat but introduce requirement for motorized transport of cattle to QS/abattoir

3.5 Scenarios for beef cattle production and beef exports from the Caprivi area of Namibia

Introduction

The following review looks at the various options (henceforth 'scenarios') for development of beef exports from the Caprivi area. These are based on a presentation made by Gavin Thomson to a working group led by Jon Barnes which is carrying out a cost benefit analysis on the subject (Thomson and Penrith, 2012).⁸² The presentation suggests eight scenarios or variants of scenarios for beef export initiatives from the Caprivi in the context of balanced rural development, including a *status quo* option. The various scenarios are outlined in Table A3.5.1 and described in more detail below. Table A3.5.1 includes a column briefly describing, where appropriate, the political, logistical, financial and technical considerations for each scenario. For purposes of the current analysis some scenarios have been included though they may be unworkable based on the current wording of the Terrestrial Animal Health Code (TAHC) or land use options in the Caprivi. However, the relevant chapter of the TAHC is currently under revision and so some articles are likely to change. They have been included both for completeness and to complement discussions on possible options.

There are about 12000 smallholder farmers in the Caprivi of whom approximately 60% are owners of 156,000 head of cattle, the major production system being a form of agropastoralism with pastoralists cultivating some of their food needs from their fields (van Rooyen, personal communication [2012] and Schoeman, 1989). While livestock are valued property, herds are on average smaller than in other pastoral systems. Cattle in the Caprivi are Sanga types evolved from crosses between Zebu and humpless Hamitic longhorn cattle (Schoeman, 1989).⁸³ The area is prone to recurrent outbreaks of FMD which conventionally results in a series of reactions including the closure of the single abattoir in Katima Mulilo with attendant restrictions on the movement of animals, heightened additional FMD surveillance and re-vaccination as well as a ban on movement of beef south of the VCF. Livestock is an important component of rural livelihoods in Caprivi and contribute to virtually all household needs. Direct production of food and cash is usually small, but the value of cattle for plowing, transport, and as a reserve and cultural asset is considerable. Households without livestock have lower crop production, greater dependence on off-farm cash income, and generally greater economic insecurity. Crop production, an activity undertaken by virtually all households, provides food but rarely cash. Variability, in harvests between households and between years is high and indications are that most households in most years cannot produce food sufficient for their needs so that the deficit must be met through other means such as formal and informal employment and pensions. These are estimated as being important for 15-20% of rural households, with most regular jobs being in government, NGOs, and with tourism the main source of private sector employment in rural areas (Ashley et al, 1997).⁸⁴

Option 1; Status quo

Livestock are sold on local informal markets and to MeatCo to earn cash. Between 1992-96 annual cattle sales to MeatCo generally ranged between 4,000 and 5,000 animals according to MeatCo Katima Mulilo Office and these numbers have not changed substantially to date in the current millennium.⁸⁵ The scale of informal sales is unknown but may amount to 50% of total sales. Informal sales compared

with formal sales to Meatco are a function of distance from the quarantine station with 55 km to being the threshold. In other words the closer a producer is to the quarantine station the more likely they are to sell to Meatco and consequently the less likely to sell locally or to traders (van Rooyen, personal communication, 2012). Meatco effectively cross subsidizes its activities in the Northern Communal Areas with operating surpluses in its other abattoirs. Challenges include the high proportion of C grade cattle with low average weights, which have a significant negative impact on carcass returns and recurrent outbreaks of FMD in the area. The two abattoirs in the NCA are subsidized by about N\$ 10 million annually. Furthermore, producers in the northern areas are paid the same price per kilo as producers south of the Veterinary Cordon Fence for cattle carcasses according to the carcass grade. This is despite the perception by producers in Caprivi that producers south of the VCF are paid a higher rate.

Option 2; Initiative to have foot and mouth disease treated like some transboundary animal diseases with a wildlife component, i.e. where wildlife are essentially ignored when it comes to management of trade risk

Currently the OIE's TAHC adopts two different approaches to standard- setting in respect of TADs associated with wildlife:

1. For some diseases it is assumed that all susceptible species are important in the maintenance and generation of trade risks associated with infections/diseases that potentially affect multiple species, e.g. FMD and African swine fever (ASF).
2. For other multi-host infections/diseases only the trade risks associated with domestic animal species/commodities derived from them are taken into consideration, e.g. highly pathogenic avian influenza (HPAI), Newcastle disease and classical swine fever (CSF).

Approach 2 provides a convenient mechanism for maintenance of countries, zones or compartments as 'free' from the infection/disease concerned because any occurrence in wildlife is essentially irrelevant as far as trade risk is concerned.

The question therefore arises as to why FMD should be treated differently from HPAI or Newcastle disease in this respect? Various technical arguments could be presented to support either side of the argument but the point nevertheless remains as to why this dichotomy exists in the first place (there is no available explanation). A strong argument could be made for adoption by the OIE of a unified system.

Table A3.5.1; Summary of scenarios for beef cattle production and beef exports from the Caprivi area of Namibia

No	Description	Advantages	Disadvantages	Critical Success Factors
1	<i>Status quo</i>	·Well established system – but confusion regarding what happens in advent of FMD outbreak	<ul style="list-style-type: none"> - Lacks long-term viability - Cattle owners are disadvantaged by the system - Not appropriate 	<p>Political</p> <ul style="list-style-type: none"> - Does not fully address needs of KAZA livestock owners <p>Logistical</p> <ul style="list-style-type: none"> - No considerations <p>Financial</p> <ul style="list-style-type: none"> - No additional costs <p>Technical</p> <ul style="list-style-type: none"> - Existing controls in place - Additional Directorate of Veterinary Services (DVS) field staff needed
2	Initiative to have FMD treated as most other TADs with wildlife component by World Organization for Animal Health (OIE), viz. disease is only recognized in livestock (occurrence in wildlife essentially ignored)	·Perhaps the most favorable long-term option – importance of FMD reduced, including in relation to trade	<ul style="list-style-type: none"> - Not a short-term solution - Requires at least regional agreement & collaboration 	<p>Political</p> <ul style="list-style-type: none"> - Requires AU-IBAR (African Union Inter-African Bureau for Animal Resources) or Southern African Development Community (SADC) to take up cause. Needs support of affected stakeholders <p>Logistical</p> <ul style="list-style-type: none"> - Co-ordination with time tables of relevant OIE meetings <p>Financial</p> <ul style="list-style-type: none"> - Funding for lobbying of relevant organizations (OIE, AU, SADC, COMESA etc)

No	Description	Advantages	Disadvantages	Critical Success Factors
				Technical - The same required for some other TAD's such as ASF

3	Have the Caprivi recognized as a zone free from FMD with vaccination	From a practical perspective probably the most obvious solution	<ul style="list-style-type: none"> - Current Southern African Territories (SAT) serotype vaccines suboptimal - Caprivi could not comply with sub-article 8.5.5.2b - Could be even more disruptive than currently (can take up to 18 months to regain status after an outbreak) 	<p>Political</p> <ul style="list-style-type: none"> - Would require a policy/ political decision that this will be the route to adopt <hr/> <p>Logistical</p> <ul style="list-style-type: none"> - The logistical requirements would need careful consideration <hr/> <p>Financial</p> <ul style="list-style-type: none"> - Dedicated costing of this option will be necessary because the long-term constraints are likely to be considerable even if technical difficulties can be overcome <hr/> <p>Technical</p> <ul style="list-style-type: none"> - Criteria for evaluating herd immunity require development - Improving efficacy of vaccination against SAT serotypes - Establishment of more realistic recovery periods & methods in the event of outbreaks
---	--	---	---	--

4	Creation of one or more FMD-free compartments within the Caprivi	<ul style="list-style-type: none"> - Provides an alternative that would be favored by some stakeholders because fencing would be required to separate wildlife from cattle within the compartment & so indirectly address their 'problem animal' concerns - Would likely appeal to DVS 	<ul style="list-style-type: none"> - There is no independent accreditation system available for compartments - It would be difficult to maintain fencing systems in the Caprivi for various reasons - There would likely be opposition from the environmental lobby if compartments cover large tracts of land - Article 8.5.5 of the TAHC precludes the use of vaccination in compartments or the introduction of animals into the compartment that have been vaccinated 	<p>Political</p> <ul style="list-style-type: none"> - The decision to follow this route would require strong central government support <p>Logistical</p> <ul style="list-style-type: none"> - Would require extensive consultation & planning with private sector players <p>Financial</p> <ul style="list-style-type: none"> - Dedicated financial support because the cost is likely to be very high <p>Technical</p> <ul style="list-style-type: none"> - Requirement for a dedicated feasibility study
---	--	--	---	---

5	Apply Article 8.5.25 of the TAHC as it currently stands , i.e. dispense with requirement for quarantine of animals & meat but introduce requirement for motorized transport of cattle to QS/abattoir	<ul style="list-style-type: none"> - ·International standard recognized by WTO/OIE - ·Solves some practical problems but not all 	<ul style="list-style-type: none"> - International standard not accepted by SADC countries or trading partners - Some provisions of the article impractical/ scientifically unsound 	<p>Political</p> <ul style="list-style-type: none"> - Central government decision to pursue this route - Extensive consultation & achievement of bilateral agreement with trading partners <p>Logistical</p> <ul style="list-style-type: none"> - Ensure that remains profitable <p>Financial</p> <ul style="list-style-type: none"> - Dedicated financial planning essential although the cost would not be high <p>Technical</p> <ul style="list-style-type: none"> - Development of an implementation plan - Conduct of a dedicated risk assessment
---	--	--	---	--

6	Modifications of 8.5.25 that achieve equivalence(ALOP)	- Will likely satisfy DVS	- Practical & financial problems	<p>Political</p> <ul style="list-style-type: none"> - Government-led consultation & agreement on how to address the issue <hr/> <p>Logistical</p> <ul style="list-style-type: none"> - Can only be assessed when the basic plan is in place <hr/> <p>Financial</p> <ul style="list-style-type: none"> - Same as for logistical <hr/> <p>Technical</p> <ul style="list-style-type: none"> - Detailed feasibility study
---	--	---------------------------	----------------------------------	---

6.1	·Include quarantine in the process	- Possible financial benefit	- Increases FMD risk	Political - Government decision Logistical Financial Technical
6.2	- Combine the quarantine system with feedlotting	- Would address the need to improve the quality of beef produced in the Caprivi - Such a system is already being assessed by the MB/Meatco	- The logistical & financial costs/benefits are uncertain - Animal health control would be complicated	Political Logistical - The location & management of the QS/feedlots will require planning Financial - Meatco/MB need to devise a financially sustainable plan Technical - Detailed feasibility study required
6.3	· Exclude need for motorized transport	-Introduces additional CBT benefits	- No existing infrastructure (investment required)	Political Logistical Financial Technical - Dedicated risk assessment

6.4	· Depending on product, introduce heating standard associated with processing	-Makes 8.5.25 entirely commodity-based though move to lower priced products	- Departs from the requirements of an international standard	Political
				Logistical - Plan for establishment of the required facilities
				Financial - Financial plan
				Technical - Dedicated risk assessment
6.5	· Exclude the requirement for 10km FMD-freedom from the locality of origin in last 30 days			Political - Government-led consultation & decision-making process
				Logistical
				Financial
				Technical - Alternative plan based on risk analysis
7	Develop exclusively CBT/HACCP-based system founded on dedicated risk assessment/management for specific processed products (value chain risk management)	-ALOP achieved on the basis of proven equivalence for processed meat products	- Likely resistance from some stakeholders	Political - Government-led consultation process & decision making - Requires lobbying of OIE at political level
				Logistical - Comprehensive management plan

				<p>Financial</p> <ul style="list-style-type: none"> - Dedicated financial analysis <p>Technical</p> <ul style="list-style-type: none"> - Risk management plan based on assessment of the value chain(s)
8	<p>Give up the idea of export from the Caprivi & rather develop beef processing systems for poor quality beef aimed at producing beef-based products for local consumption & sale in rural areas north of the VCF</p>	<p>- SPS standards more manageable in the Namibian context & foreign acceptance would be unnecessary</p>	<p>- The business model would require extensive research to determine practical feasibility</p>	<p>Political</p> <ul style="list-style-type: none"> - Government-led consultation & decision-making process <p>Logistical</p> <ul style="list-style-type: none"> - Development of the detailed plan <p>Financial</p> <ul style="list-style-type: none"> - Dedicated financial analysis <p>Technical</p> <ul style="list-style-type: none"> - Dedicated risk management plan

Option 3; Have the Caprivi recognized as a zone free from foot and mouth disease with vaccination

The option is based on the requirements of Article 8.5.5 of the Terrestrial Animal Health Code, i.e. the article which defines the requirements of a *FMD free zone where vaccination is practiced*.

There are three fundamental requirements for the establishment and maintenance of a FMD-free zone with vaccination:

- There must have been no outbreak of FMD within the zone for the last two years (criteria for assessing whether a 'case' has occurred in that two-year period is provided in Article 8.5.1; where the World Organization for Animal Health (OIE) defines an outbreak as occurrence of one or more cases of FMD, i.e. there is no technical distinction between a 'case' and an 'outbreak');
- No evidence of foot and mouth disease virus (FMDV) circulation has been found during the last 12 months (this applies to all susceptible species within the zone) using surveillance systems based on Articles 8.5.42-47);
- Routine vaccination for the prevention of FMD is carried out (but neither the species that need to be vaccinated nor the requirements/guidelines to prove the efficacy of the preventative vaccination are provided).

While the first and third bullet points could potentially be complied with in the Caprivi, the second is unattainable because there are large herds of buffalo in and around the Caprivi within which FMD viruses circulate continuously without resulting in obvious disease (the implication is that circulation of FMDV in any species would serve as a disqualification).

For that basic reason the Caprivi could not qualify as a FMD-free zone where vaccination is practiced even if the vaccination program applied to the cattle population were shown to be effective & there was no outbreak of FMD for a period of two years. Furthermore, should a FMD outbreak occur in a FMD-free zone where vaccination is practiced, it would take 18 months to recover the status unless all affected and in-contact animals were 'stamped out' (Article 8.5.9.2b). Even if 'stamping out' were to be conducted recovery of recognition for the free zone would require a minimum of 6 months (Article 8.5.9.2a).

This option is therefore precluded by the current provisions of the TAHC. However, if amendments were made to some provisions of Chapter 8.5 it could become a scenario worth consideration.

A peculiarity of Article 8.5.5 alluded to above is that although it is implicitly based on the presumption that vaccination against FMD in the zone concerned will be effective (i.e. will generate an effective level of herd immunity), no criteria for ensuring that the vaccination program is, in fact, effective are provided. All that is required is that routine vaccination is carried out for the purpose of prevention of FMD using a vaccine or vaccines that comply with the requirements of the Terrestrial Manual. Put simply, there is no set of standards provided by the OIE upon which the efficacy of a preventative vaccination program could be assessed as being satisfactory other than through the non-occurrence of outbreaks of FMD or virus circulation (which non-event would not be entirely dependent upon the efficacy of a vaccination program). This is perhaps fortunate because it has been shown in the recent

past that preventative vaccination against Southern African Territories (SAT) serotypes in southern Africa is only marginally effective for a variety of reasons (SADC, 2010; University of Pretoria, 2011).

Option 4. Creation of one or more foot and mouth disease -free compartments within the Caprivi

Chapter 8.5 of the TAHC makes provision for the creation of FMD-free compartments in otherwise 'infected' countries or zones (Article 8.5.6), i.e. creation of production enterprises – which can be physically separated – that are managed on the basis of integrated bio-security systems targeting FMD. Theoretically therefore, it would be possible for compartments to be established in the Caprivi which contain livestock but exclude wildlife, particularly buffalo. To achieve that in practical terms would require that the compartments be separated by physical barriers (e.g. game-proof fences) from areas where wildlife occur. In other words, domestic livestock in specific locations could be fenced off from FMD-infected wildlife populations. It is known from previous interaction with some communities in the Caprivi that a significant number of livestock owners favor this approach although they do not understand all the implications.

There are potential advantages for beef production associated with such an approach but equally there are a number of constraints which are environmental, financial & technical in nature:

- Environmental (to some extent also political): The main issue here is that there is very little privately-owned land in the Caprivi with a large proportion of land utilized one way or another for wildlife conservation. Most land is controlled either by government or communally. Establishment of beef production compartments in such a land-ownership system is clearly complicated. Moreover, the environmental lobby is strongly opposed to fences that constrain the movement of wildlife.
- Financial: Establishment and management of compartments which are financially viable in arid environments, where grazing and water supply is frequently limited, implies a high element of risk. Construction & especially maintenance of game-proof fences in the Caprivi would also be expensive & logistically challenging.
- Technical: Sub-articles 8.5.6.2c & 8.5.6.2d of the TAHC clearly state that vaccination against FMD within compartments should be prohibited and entry of animals vaccinated against FMD within the last 12 months should not be permitted. It needs to be remembered that it is Government policy to vaccinate all cattle in the Caprivi at least twice a year & in some locations more frequently. This implies that sourcing cattle for compartments in the Caprivi would essentially be impossible in present circumstances.

From the above summary it is obvious that establishment of FMD-free compartments in the Caprivi, while potentially feasible, faces a variety of complicated constraints.

Option 5; Apply Article 8.5.25 of the Terrestrial Animal Health Code as it currently stands, i.e. dispense with requirement for quarantine of animals & meat but introduce requirement for motorized transport of cattle to QS/abattoir

Article 8.5.25 contains provisions with respect to FMD that represent the nearest the OIE has come to developing guidelines for commodity-based trade in beef. The title of the Article is: ‘Recommendations for importation from FMD infected countries or zones, where an official control programme for FMD, involving compulsory systematic vaccination of cattle, exists’

The problem with Article 8.5.25 is that sub-article 1d requires that “The entire consignment of meat comes from animals which were kept for the last 30 days (i.e. prior to slaughter) in an *establishment* & that FMD has not occurred within a 10 km radius of the *establishment* during this period”. In locations such as the Caprivi where large numbers of healthy buffalo infected with SAT serotypes are present (the vast majority of such buffalo do not show signs of infection), it would be impossible for anyone to certify that such buffalo did not come within 10 km of the origin of all animals in a consignment. The reason is that the intensity of laboratory-based surveillance required to detect subclinical infection on a 30-day rotational basis is not conducted currently anywhere in the world at present; such surveillance would be logistically too complicated and expensive to institute as a routine. Presumably those drafting this article meant by ‘occurrence of FMD within a 10 km radius’ were referring to clinical disease. The problem is that a ‘occurrence’ of FMD is explicitly addressed in the introduction to chapter 8.5 of the TAHC refers not only to clinical disease but also to the ‘presence of infection with FMDV in the absence of clinical signs’. In effect therefore the certification required by Article 8.5.25 could not be provided by DVS.

Option 6; Modifications of 8.5.25 that achieve equivalence (Appropriate Level of Protection)

Article 4 of the SPS Agreement recognizes that different SPS measure may be equally effective in satisfying an importing country’s appropriate level of protection (ALOP). In theory, importing Members [of the WTO] are obliged to accept as equivalent the SPS measures of an exporting Member (even if the measures are different from the importers) if the exporter objectively demonstrates that its SPS measures match the importer’s appropriate level of protection.⁸⁶

The concept of ‘acceptable risk’ is an underlying principle of the WTO SPS Agreement and is sometimes referred to as the ‘appropriate level of protection’ (ALOP). For some commodities – for example, beef from which the bones and lymph nodes have been removed – the risk of transmission of TADs is low, because viruses that cause diseases such as FMD, Rift Valley fever and rinderpest are unable to withstand the low pH associated with postmortem maturation of beef (Thomson et al 2004; Thomson et al 2009; Paton et al 2010).⁸⁷

The accepted basis for demonstrating equivalence is through risk analysis and guidelines for conduct of risk analyses are provided by the OIE as well as the other international standard-setting bodies concerned with the SPS Agreement. It is assumed that the five sub-scenarios proposed within this option (5) can be proven to be equivalent to Article 8.5.25 on the basis of formal risk assessment:

- 6.1 Include quarantine in the process i.e. a pre-slaughter quarantine period because the DVS of Namibia is insistent upon application of quarantine.
- 6.2 Combination between an extended quarantine period and feeding of the animals in quarantine to improve carcass/beef quality. However, the logistics and financial viability of this option require detailed investigation. This may be facilitated by the fact that the MB is investigating a similar option elsewhere in the western part of the NCA.
- 6.3 Exclude the need for motorized transport, i.e. maintain trekking of animals along roads with contact enabled between resident cattle and those being trekked. This will likely reduce costs but trekking in the context of FMD is a high-risk practice and also results in loss of condition if the distances involved are long. This is arguably a high risk option but is no worse than current practice.
- 6.4 Depending on product, introduce heating standards associated with processing of animal products, i.e. essentially reaching an internal temperature of 70°C for 30 minutes (Article 8.5.34).
- 6.5 Exclude the requirement for 10km FMD-freedom from the locality of origin in last 30 days based on a dedicated risk analysis which demonstrates the inappropriateness of this provision in the Caprivi context.

Option 7; Develop exclusively commodity based trade (CBT)/hazard analysis and critical control point (HACCP)-based system founded on dedicated risk assessment/management for specific processed products (value chain risk management)

Option 6 proposes that the procedures for, rearing, slaughter and processing of cattle should be approached holistically with full account being taken of pre-requisite programs that reduce the level of exposure of cattle to potential sources of FMDV infection. When combined with other risk mitigation measures applied along the value chain (e.g. quarantine, deboning & maturation) the level of risk mitigation could be shown by risk analysis to be equivalent to standards based on zoning or compartmentalization. However, quantification of risk does present a problem but that too could be addressed.

Option 8. Give up the idea of export from the Caprivi & rather develop beef processing systems for poor quality beef aimed at producing beef-based products with extended shelf-life for local consumption & sale in rural areas south of the Veterinary Cordon Fence

This option is based on the observation that currently beef produced in the Caprivi as well as most of the rest of the NCA is of poor quality and not suited to most export markets other than those for processing beef. On the other hand, the population of the NCAs is overwhelmingly young and poor with consequent limited access to diets containing sufficient high quality protein. It is therefore logical that locally available meat that is processed to make it more palatable and to increase its shelf-life in an environment where refrigeration is not widely available may constitute a national investment worth making. This is being undertaken in some African countries on a commercial scale (e.g. Kenya).

While this idea is simple it would take considerable organization & investment to make it viable. It is suggested that such a feasibility study based on this or perhaps similar ideas would be worth consideration.

3.6 Analysis of Namibia's trade data

Trade in sanitary and phytosanitary sensitive agri-food products

Table A3.6.1 provides an overview of the key SPS requirements associated with Namibia's traditional and non-traditional agri-food exports. Agricultural and agri-food exports from Namibia have averaged 4428 million US\$ annually in the period between 2009 and 2011. Exports are largely dominated by seafood which is responsible for nearly 50% of agri-food exports during this period. Exports of, beverages, unprocessed animal products and live animals account for much of the remainder of SPS sensitive exports.

SPS requirements as illustrated in Table A3.6.1 show that private sector standards are particularly an issue for beverage exports and animal health, environmental compliance and food safety is important for seafood exports, that food safety and animal health is important for terrestrial animal products and finally that animal health is important in the case of trade in live animals.¹³ It is important to recognise, however, that there are wide differences in the application and enforcement of SPS requirements across markets and segments within markets. Namibia's agri-food trade is predominantly with Europe, neighbouring countries including South Africa and other African countries with widely varying SPS standards and level of enforcement. The EU Rapid Alert System for Food and Feed (RASFF) Portal lists 104 Notifications for Namibian imports between 1999 and 2011 which indicate that heavy metal and microbiological contamination for seafood and microbiological contamination in animal products are the most common issues (Table A3.6.2).

¹³ Key to sensitivity of SPS issues on trade

- XXX high influence
- XX some influence
- X little influence
- Blank no influence

Table A3.6.1. Namibian agri-food exports and attendant sanitary and phytosanitary requirements (average annual exports between 2009 and 2011)*

Category (Harmonized System 1992 2 Digit)	Average Annual Exports (US\$,000,000)	Proportion of Total SPS Sensitive Exports (%)	Sensitivity				
			Plant Health	Animal Health	Food Safety	Environmental standards	Private standards
01 Live animals	359	8.1		XXX		X	
02 Meat and edible meat offal	587	13.3		XXX		X	
03 Fish, crustaceans, molluscs, aquatic invertebrates, nes	2081	47.0		XXX	XXX	XXX	XX
04 Dairy products, eggs, honey, edible animal product, nes	17	0.4		XX	XX	X	XXX
05 Products of animal origin, nes	4	0.1		X		XX	
06 Live trees, plants, bulbs, roots, cut flowers etc	3	0.1	XX			XX	
07 Edible vegetables and certain roots and tubers	53	1.2	XX				XXX
08 Edible fruit, nuts, peel of citrus fruit, melons	141	3.2	XXX				XXX
09 Coffee, tea, mate and spices	2	0.1	X		X	X	XXX
10 Cereals	3	0.1	XX		XX	X	
11 Milling products, malt, starches, inulin, wheat gluten	12	0.3	X		XX		
12 Oil seed, oleagic fruits, grain, seed, fruit, etc, nes	13	0.3	XXX		XX		XXX
13 Lac, gums, resins, vegetable saps and extracts nes	0	0.0			XXX		XXX
14 Vegetable plaiting materials, vegetable products, nes	0	0.0	X			X	
15 Animal, vegetable fats and oils, cleavage products, etc	23	0.5			XX		
16 Meat, fish and seafood food preparations, nes	156	3.5		X	XXX	X	XXX
17 Sugars and sugar confectionery	34	0.8			X	X	
18 Cocoa and cocoa preparations	17	0.4			X	X	
19 Cereal, flour, starch, milk preparations and products	18	0.4			X		
20 Vegetable, fruit, nut, etc. food preparations	8	0.2			XX		XX
21 Miscellaneous edible preparations	7	0.1			X		
22 Beverages, spirits and vinegar	644	14.6			X		
23 Residues, wastes of food industry, animal fodder	85	1.9	XX	XX		X	
24 Tobacco and manufactured tobacco substitutes	38	0.9			X		
44 Wood and articles of wood, wood charcoal	105	2.4	X				X
46 Manufactures of plaiting material, basketwork, etc.	0	0.0	X				
48 Paper & paperboard, articles of pulp, paper and board	18	0.4			X	XX	X
50 Silk	0	0.0			X	XX	
51 Wool, animal hair, horsehair yarn and fabric thereof	0	0.0		X			
52 Cotton	0	0.0		X			
TOTAL	17,620						

*Source: COMTRADE

Table A3.6.2; Rapid Alert System for Food and Feed (RASFF) alerts for Namibian imports 2004 to June 2012

Product	Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Fish	Microbiology	18	1		6						2	3			1
	Manufacturing		1										6	2	4
	Heavy metal					1	1	5	3	11	2	7			
Prepared food	Microbiology				1										
Meat	Microbiology		1		9	4	5	6				3			
Vegetables	MRL														1
TOTAL		18	3	0	16	5	6	11	3	11	4	13	6	2	6

Source, Rapid Alert System for Food and Feed (RASFF) Portal

Given the overall composition of Namibia’s agri-food exports and experiences to date, SPS requirements are a particularly major issue with seafood and meat exports (which are classified under Harmonized System (HS) 02 and 03 and account for 60% of SPS sensitive exports) and other exports where microbiology is a concern. The overall trend of RASFF alerts is downward. Other competitiveness factors, such as primary producer and processor productivity, continuity/reliability of supply, logistical costs, macroeconomic factors and international commodity price trends have arguably assisted Namibia’s agri-food trade performance providing good access to regional and overseas markets (Figure A3.6.1).

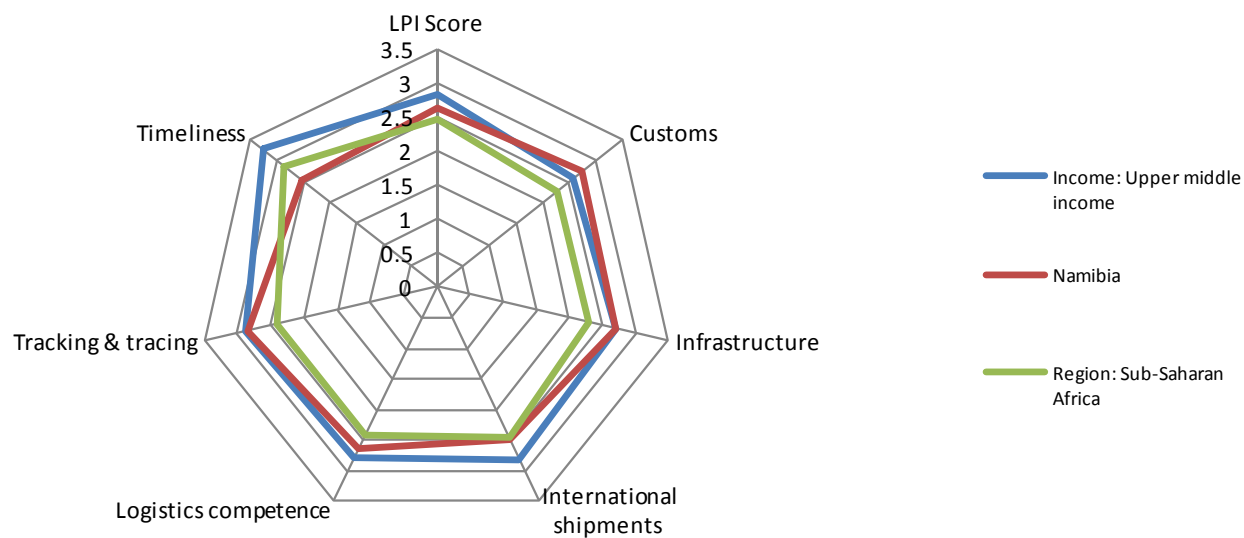


Figure A3.6.1; Spider diagram showing Namibia’s (blue) relative Logistics Performance Index scores against sub-Saharan Africa (maroon), and South Africa (green). (Source; World Bank, January 2013)

Namibia’s net trade performance in terms of SPS sensitive exports of 02 (Meat and edible meat offal exports) at the HS two and four figure level is shown in Table A3.6.3 which shows that Namibia’s meat

exports, peaked in 2009 and have been in decline since then. Nevertheless overall export growth over the decade has been remarkable with continued growth in mutton, offals, and dried/smoked meat.

Terrestrial animal product exports

Namibia exports about 90 percent of its animal production. A significant number of weaner calves, principally to South Africa form the bulk of cattle exports. Slaughtered cattle declined in the period 1994-2006, from about 149,833 to just fewer than 114,150 in 2011. Lower throughputs are ascribed to the increase in live cattle exports to South Africa, Angola and the Democratic Republic of the Congo, as well as to the reduced producer price and increased local slaughter competition. Exports from 2001 to 2004 averaged over 24,000 metric tons annually. About half of this has been for South Africa (Meat Board of Namibia 2009)^{88&89}. EU members are also major destinations for Namibian beef importing fresh, chilled, and frozen boneless cuts. The United Kingdom (UK) is by far Namibia's largest European customer, followed by Germany. In contrast, the number of small stock has dramatically increased in the same period more than doubling from 318,713 in 2002. Exports to the EU are subject to an annual beef export quota of 13,000 metric tons but this quota appears to be unfilled. Export values vary with markets and product type with lowest returns paid for live cattle at N\$ 18/kg. Meat products marketed to the EU fetch the highest returns at N\$ 44/Kg. Returns for meat sales to Africa and canned meat are about half this at N\$ 23 and N\$ 20 respectively.⁹⁰ In part this reflects the types of cuts marketed regionally which include offals (HS code 206).

Terrestrial animal disease control services

The features of Namibia's disease control services that have led to the development of overseas developed and local emerging markets are (1) disease zoning, facilitated by the use of a VCF, an animal traceability system and the strong commercial sector. Veterinary and traceability services are administered by the Directorate of Veterinary Services (DVS), within the Ministry of Agriculture, Water, and Rural Development (MoAWD) which is the designated EU Competent Authority. The DVS is responsible for coordinating and supervising overall animal health programs as well as regulating and controlling international commerce in live animals and animal products. Part of this entails maintaining surveillance programs for high-priority diseases including FMD, contagious bovine pleuropneumonia (CBPP), rabies, and exotic Newcastle disease. There is also ongoing surveillance for Bovine Spongiform Encephalopathy (BSE) which is a specific EU requirement. Of primary concern to developed countries when importing from developing countries is FMD and this activity consumes most of Namibia's veterinary attention and resources.

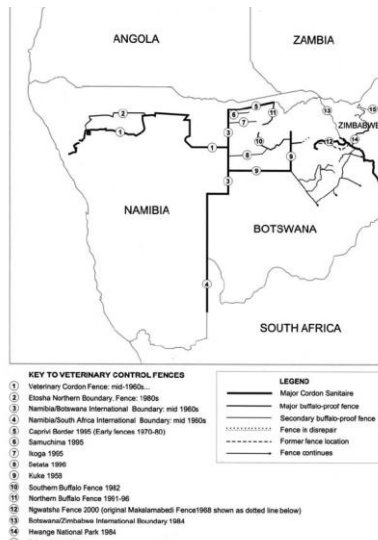


Figure A3.6.2: Location of the veterinary cordon fence (VCF) and game fences in Botswana and Namibia (source Martin 2005 & IRAS, 2009)^{91,92}

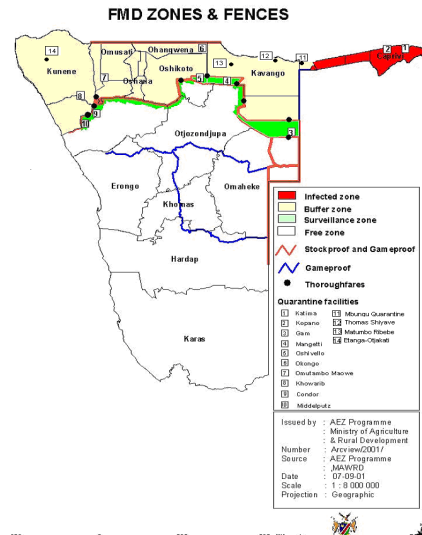


Figure A3.6.3: Veterinary zones of Namibia, (Source Meatco)

Figures A3.6.2 and A3.6.3 illustrate the scale of this effort and the accompanying problem. In simple terms the VCF system is a trans-national game control fence to control migration and movement of buffalo from the Caprivi and northern regions of Namibia, and Botswana as well as neighboring Angola and Zambia into the main central farming regions of Namibia/Botswana.

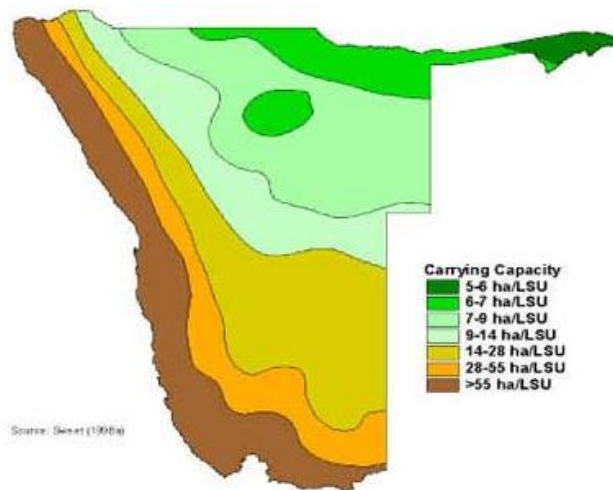


Figure A3.6.4: Carrying capacity map for commercial animal production in Namibia (Source, Sweet and Bourke, 2000)⁹³

Consequences of the ‘zoning’ is the double problem of putting the most productive areas in Namibia on the ‘wrong’ side of the VCF (Figure A3.6.4) but also that a significant portion of the northern lands are, in fact, grazed communally by some of the poorest people in Namibia. The free zone south of the surveillance area (which is part of the VCF) is entirely free of FMD and has been so since 1965. DVS also

manages the control of animal movement throughout Namibia which requires permits for any animal movement and is backed up by the police. Inspection and quarantine is required for animals moving from the infected zone to the buffer zone. Live cattle are not allowed to move from the buffer zone to the free zone, though slaughtered beef, after inspection, processing, and freezing, is permitted to move from the buffer zone to the free zone.

The DVS is major role player in the Farm Assured Namibian Meat Scheme (FAN Meat), the cornerstone of Namibia's animal traceability system which has its legal basis in the 2009 Traceability; Animal Identification Regulations (Government of Namibia, 2009)⁹⁴. The regulations were initially a response to EU requirements in terms of the BSE outbreak in Europe in the 1990's.

Marketing

Two parastatals in Namibia are responsible for meat exports. These are the Meat Corporation of Namibia (Meatco) jointly owned by the government with private sector participation which runs the abattoirs and the Meat Board of Namibia which is a lobbying and marketing organization with a wide membership by government and the private sector.⁹⁵ Two Meatco abattoirs in Windhoek and in Okahandja are the only EU certified abattoirs in Namibia. Meatco is currently the only exporter but it is technically not a state monopoly - there are no restrictions on others being set up. Given the existing levels of investment, it seems possible that necessary upgrades to serve other lucrative markets with high safety standards such as the US, South Korea and Japan might be easy.

Table A3.6.3; Harmonized System 02 Meat and edible meat offal exports at HS two and four figure level – 2002 to 2009* (US\$000,000).

Period	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CV
Meat and edible meat offal [HS code 02]	24.4	45.9	93.9	139.0	126.5	144.5	159.1	205.7	193.0	188.1	0.5
Meat of bovine animals, fresh or chilled. [HS code 0201]	5.3	16.4	36.3	43.3	35.6	39.4	51.0	62.6	62.1	46.5	0.5
Meat of bovine animals, frozen. [HS code 0202]	12.0	18.8	31.3	37.5	39.8	39.9	44.2	58.5	47.1	54.7	0.4
Meat of swine, fresh, chilled or frozen. [HS code 0203]	0.3	0.1	0.5	1.5	3.3	0.7	0.7	0.5	0.5	0.2	1.2
Meat of sheep or goats, fresh, chilled or frozen. [HS code 0204]	5.6	7.9	18.8	43.1	37.5	50.2	43.3	61.5	67.4	69.5	0.6
Meat of horses, asses, mules or hinnies, fresh, chilled or frozen. [HS code 0205]	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2
Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules [HS code 0206]	0.0	0.4	2.5	4.4	3.4	3.6	5.3	8.2	8.1	9.8	0.7
Meat and edible offal, of the poultry of heading 01.05 (domestic poultry) [HS code 0207]	0.1	0.3	0.7	4.8	2.4	3.0	7.3	8.0	1.4	0.9	1.0
Other meat and edible meat offal, fresh, chilled or frozen. [HS code 0208]	0.8	1.4	2.1	2.4	2.0	4.5	3.8	1.8	1.3	1.3	0.5
Pig fat, free of lean meat, and poultry fat [HS code 0209]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.6
Meat and edible meat offal, salted, in brine, dried or smoked [HS code 0210]	0.3	0.5	1.2	1.3	1.5	3.1	3.4	4.4	5.1	5.3	0.7

*Source COMTRADE

Table A3.6.4; Revealed Comparative advantage of exports of 02 Meat and edible meat offal exports at HS two and four figure level – 2002 to 2009*

Product code	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	CV
Meat and edible meat offal [HS code 02]	2.94	5.48	6.16	8.77	6.50	6.16	5.35	4.87	5.12	4.66	0.27
Meat of bovine animals, fresh or chilled. [HS code 0201]	3.07	9.26	11.78	13.47	8.49	7.91	8.70	7.44	8.77	6.23	0.33
Meat of bovine animals, frozen. [HS code 0202]	0.12	0.04	0.13	0.33	0.60	0.12	0.08	0.04	0.05	0.01	1.18
Meat of swine, fresh, chilled or frozen. [HS code 0203]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Meat of sheep or goats, fresh, chilled or frozen. [HS code 0204]	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.16
Meat of horses, asses, mules or hinnies, fresh, chilled or frozen. [HS code 0205]	0.06	1.10	3.83	6.41	4.15	3.44	3.27	3.37	3.78	4.13	0.52
Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules [HS code 0206]	0.06	0.15	0.25	1.49	0.70	0.60	1.15	0.88	0.16	0.09	0.90
Meat and edible offal, of the poultry of heading 01.05 [HS code 0207]	6.78	14.25	10.92	13.04	8.61	15.92	11.83	4.34	3.74	3.98	0.48
Other meat and edible meat offal, fresh, chilled or frozen. [HS code 0208]	0.52	0.00	0.01	0.01	0.04	0.00	0.04	0.21	0.06	0.03	1.75
Pig fat, free of lean meat, and poultry fat [HS code 0209]	0.69	1.25	1.71	2.13	1.73	2.63	2.40	2.25	3.02	3.00	0.36

Source; The World Integrated Trade Solution (WITS) software and database - World Bank,

Cross referencing Revealed Comparative Advantage data with other studies for Namibia

Revealed Comparative Advantage (RCA) only reflects comparative advantage for a given industry and time period across countries. Where, trade costs are higher, the smaller the country and the lower the national average technological position, the less reliable the RCA as a measure.⁹⁶ The analysis in this review is limited to HS02 - Meat and edible meat offal, and the HS 4 figure sub groups within that group i.e.;

1. Meat of bovine animals, fresh or chilled.
2. Meat of bovine animals, frozen.
3. Meat of swine, fresh, chilled or frozen.
4. Meat of sheep or goats, fresh, chilled or frozen.
5. Meat of horses, asses, mules or hinnies, fresh, chilled or frozen.
6. Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules
7. Meat and edible offal, of the poultry of heading 01.05
8. Other meat and edible meat offal, fresh, chilled or frozen.
9. Pig fat, free of lean meat, and poultry fat

The RCA data for the period between 2002 and 2011 is shown in Table A3.6.4.

Revealed Comparative Advantage in Namibia's agri-food exports¹⁴

Data for the 'RCA for Namibia's live animal, cut flower/vegetable and coffee/tea/spice exports have been extracted from World Bank World Integrated Trade Solution (WITS) Database⁹⁷ at the HS2 and HS4 level (statistical data and results are shown in the final column of Table A3.6.4). The following observations are the conclusions of an analysis of the extracted data for the period 2002-2011. Technically a positive RCA is any value above 1. Because of the variability of year to year trade data the Coefficient of Variation (CV) is included to reflect the stability or otherwise of exports (last column Table A3.6.4).

- i. Sectors which have revealed comparative advantages (RCA) at the HS4 level are the following;*
- Meat of bovine animals, fresh or chilled.
 - Meat of horses, asses, mules or hinnies, fresh, chilled or frozen.
 - Meat and edible offal, of the poultry of heading 01.05
 - Pig fat, free of lean meat, and poultry fat

¹⁴ For an explanation of Revealed Comparative Advantage see Appendix 4; Revealed Comparative Advantage

- ii. *Sectors at the HS4 level which have “increasing” revealed comparative advantages in the time period under review;*
 - Meat of bovine animals, fresh or chilled.
 - Meat of horses, asses, mules or hinnies, fresh, chilled or frozen
 - Pig fat, free of lean meat, and poultry fat

- iii. *Sectors at the HS4 level which have “decreasing” revealed comparative advantages in the time period*
 - Meat of bovine animals, frozen.
 - Meat of sheep or goats, fresh, chilled or frozen

- iv. *Sectors at the HS4 level which have revealed comparative advantages at present and had revealed comparative disadvantages in 2002*
 - Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules
 - Pig fat, free of lean meat, and poultry fat

Stability of the revealed comparative advantage indices

Mean and coefficient of variation (CV) have been calculated for each commodity group at the HS4 level for the years 2002 to 2011 for RCA and trade values as expressed in US\$

- v. *Coefficients of Variation for both RCA and export volumes at the HS 4 level are all <1 for the following;*
 - Meat of bovine animals, fresh or chilled
 - Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules
 - Meat and edible offal, of the poultry of heading 01.05
 - Pig fat, free of lean meat, and poultry fat

Appendix 4; Land use option cards

Table A4.1 Scenario 1; Land use type; conservancy

Land use type; Status quo			
Decision Criterion	Value / Cost	Details and references	Confidence
Economic indicators			
Economic Internal Rate of Return (EIRR) of contribution to net national income	-9%	Source J. I. Barnes (20 year cash flow model)	High
Net Present Value (NPV) of contribution to net national income	-33	Source J. I. Barnes, Figure is for 20 years discounted at 8%	High
Cost of implementation			
Up-front investment	55 million N\$	Costs of establishing a conservancy have not been captured in any publications that we can access. Most costs seem to be integral parts of Ministry of Environment and Tourism running expenditure and in the communal lands people are donating their time and other resources <i>pro-bono</i> . Source J. I. Barnes economic models	High
Annual on-going costs	14.9 million N\$	No upfront costs therefore no provisions for depreciation. Returns from tourism are net of costs. Source J. I. Barnes economic models	High
Trade impact			
Absolute change in value of exports	0	No direct impact outside of tourism which is captured elsewhere	High
Trade diversification	0	No direct impact outside of tourism which is captured elsewhere	High
Domestic tourism and agri-food impacts			
Tourism (hunting and non consumptive)	N\$ 23.6 million	Source J. I. Barnes	Medium
Agricultural / fisheries productivity	N\$ 30.3 million	Source J. I. Barnes	Medium
Domestic public health	Neutral	Some investments have been made using conservancy income in clinics and community health projects such as water. Higher individual incomes could translate into some nutritional and other health gains but default is set at zero	Medium

Environmental protection	Carbon = 0.03 Plant diversity +5 # wildlife spp = 0.031 Diversity of wildlife = 0.099	<ul style="list-style-type: none"> - The scenario will be carbon negative (capturing 0.03 kg carbon per square meter (kg C/m²)) - See Table A3,1.4 of carbon and environmental review = 0.03 - Number of plant species (Table A3.2.2 review on species diversity) = between 0 and 10 (mean 5) as wildlife / domestic animal mix is not expected to change plant species mix appreciably - Number of wildlife species will increase (based on presence/absence and weighted by area) see Table A.3.2.3 review on species diversity) = 0.099 - Density of wildlife estimated as increasing E23 (Table A.3.2.3 review on species diversity) = 0.099 	Medium
Social impacts			
Impact on vulnerable groups/areas	• Women 0	<ul style="list-style-type: none"> - Some employment opportunities for women? - No direct impact on children - Conservancies are also vulnerable areas - Smallholders have no export or value added opportunities - Unemployed are unaffected 	Medium
	• Children 0		Medium
	• Vulnerable areas 0		Medium
	• Smallholders 0		Medium
	• Unemployed 0		Medium

Table A4.2 Scenario 2; Land use type; conservancy with commodity based trade (CBT)

Land use type; conservancy with CBT			
Decision Criterion	Value / Cost	Details and references	Confidence
Economic indicators			
Economic Internal Rate of Return (EIRR) of contribution to net national income	51%	Source J. I. Barnes (20 year cash flow model)	High
Net Present Value (NPV) of contribution to net national income	128 million N\$	Source J. I. Barnes, Figure is for 20 years discounted at 8%	High
Cost of implementation			
Up-front investment	55 million N\$	Based on a detailed budget, Source J. I. Barnes economic models	Medium
Annual on-going costs	14.9 million N\$	Based on a detailed budget, Source J. I. Barnes economic models	Medium
Trade impact			
Absolute change in value of exports	30.9 million N\$	Based on analysis of COMTRADE data	Medium
Trade diversification	9.7 million N\$	Based on analysis of COMTRADE data	Medium
Domestic tourism and agri-food impacts			
Tourism (hunting and non consumptive)	N\$ 40 million	Source J. I. Barnes	Medium
Agricultural / fisheries productivity	N\$ 39.4 million	Source J. I. Barnes	Medium
Domestic public health	Small positive	Some additional investments anticipated using additional income in clinics and community health projects such as water. Higher individual incomes could translate into some nutritional and other health gains	Medium

Environmental protection	Carbon = 0.03 Plant diversity +5 # wildlife spp = 0.031 Diversity of wildlife = 0.099	<ul style="list-style-type: none"> - The scenario will be carbon negative (capturing 0.03 kg carbon per square meter (kg C/m²)) - See Table A3,1.4 of carbon and environmental review = 0.03 - Number of plant species (Table A3.2.2 review on species diversity) = between 0 and 10 (mean 5) as wildlife / domestic animal mix is not expected to change plant species mix appreciably - Number of wildlife species will increase (based on presence/absence and weighted by area) see Table A.3.2.3 review on species diversity) = 0.099 - Density of wildlife estimated as increasing E23 (Table A.3.2.3 review on species diversity) = 0.099 	Medium
Social impacts			
Impact on vulnerable groups/areas	• Women 1	<ul style="list-style-type: none"> - Some employment opportunities for women - negative impact on children (herders) - Attention and investment to/in a vulnerable area - Smallholders have export or value added opportunities - Unemployed are affected significantly 	Medium
	• Children -1		Medium
	• Vulnerable areas 1		Medium
	• Smallholders 1		Medium
	• Unemployed 2		Medium

Table A4.3 Scenario 3; Land use type; conservancy with meat processing facility

Land use type; conservancy with meat processing facility			
Decision Criterion	Value / Cost	Details and references	Confidence
Economic indicators			
Economic Internal Rate of Return (EIRR) of contribution to net national income	53%	Source J. I. Barnes (20 year cash flow model)	High
Net Present Value (NPV) of contribution to net national income	252 million N\$	Source J. I. Barnes, Figure is for 20 years discounted at 8%	High
Cost of implementation			
Up-front investment	47 million N\$	Based on a detailed budget, Source J. I. Barnes economic models	Medium
Annual on-going costs	14.6 million N\$	Based on a detailed budget, Source J. I. Barnes economic models	Medium
Trade impact			
Absolute change in value of exports	35.6 million N\$	Based on analysis of COMTRADE data	Medium
Trade diversification	35.6 million N\$	Based on analysis of COMTRADE data	Medium
Domestic tourism and agri-food impacts			
Tourism (hunting and non consumptive)	N\$ 40 million	Source J. I. Barnes	Medium
Agricultural / fisheries productivity	N\$ 39.4 million	Source J. I. Barnes	Medium
Domestic public health	Small positive	Some additional investments anticipated using additional income in clinics and community health projects such as water. Higher individual incomes could translate into some nutritional and other health gains	Medium
Environmental protection	Carbon = 0.03 Plant diversity +5 # wildlife spp = 0.031 Diversity of wildlife = 0.099	- The scenario will be carbon negative (capturing 0.03 kg carbon per square meter (kg C/m ²)) - See Table A3,1.4 of carbon and environmental review = 0.03 - Number of plant species (Table A3.2.2 review on species diversity) = between 0 and 10 (mean 5) as wildlife / domestic animal mix is not expected to change plant species mix appreciably - Number of wildlife species will increase (based on presence/absence and weighted by area) see Table A.3.2.3 review on species diversity) = 0.099 - Density of wildlife estimated as increasing E23 (Table A.3.2.3 review on species diversity) = 0.099	Medium

Social impacts			
Impact on vulnerable groups/areas	• Women 1	<ul style="list-style-type: none"> - Some employment opportunities for women - negative impact on children (herders) - Attention and investment to/in a vulnerable area - Smallholders have export or value added opportunities - Unemployed are affected significantly 	Medium
	• Children -1		Medium
	• Vulnerable areas 1		Medium
	• Smallholders 1		Medium
	• Unemployed 2		Medium

Table A4.4 Scenario 4; Land use type; conservancy with FMD free compartments

Land use type; conservancy with FMD free compartments			
Decision Criterion	Value / Cost	Details and references	Confidence
Economic indicators			
Economic Internal Rate of Return (EIRR) of contribution to net national income	-2%	Source J. I. Barnes (20 year cash flow model)	High
Net Present Value (NPV) of contribution to net national income	-36 million N\$	Source J. I. Barnes, Figure is for 20 years discounted at 8%	High
Cost of implementation			
Up-front investment	79 million N\$	Source J. I. Barnes	High
Annual on-going costs	16.1 million N\$	Source J. I. Barnes	High
Trade impact			
Absolute change in value of exports	30.9 million N\$	Based on analysis of COMTRADE data	Medium
Trade diversification	9.7 million N\$	Based on analysis of COMTRADE data	Medium
Domestic tourism and agri-food impacts			
Tourism (hunting and non consumptive)	N\$ 24 million	Source J. I. Barnes	Medium
Agricultural / fisheries productivity	N\$ 40 million	Source J. I. Barnes	Medium
Domestic public health	Small positive	Some additional investments anticipated using additional income in clinics and community health projects such as water. Higher individual incomes could translate into some nutritional and other health gains	Medium
Environmental protection	Carbon = -0.02 Plant diversity 0 # wildlife spp = 0 Diversity of wildlife = 0	- The scenario will be carbon generating (releasing 0.02 kg carbon per square meter (kg C/m ²)) - See Table A3.1.4 of carbon and environmental review = 0.03 - Number of plant species (Table A3.2.2 review on species diversity) = 0 based on default domestic animal use only - Number of wildlife species will decrease (based on presence/absence and weighted by area) see Table A.3.2.3 review on species diversity) = 0 - Density of wildlife estimated as zero as they will be excluded - see Table A.3.2.3 review on species diversity) = 0.	Medium

Social impacts			
Impact on vulnerable groups/areas	• Women 0	<ul style="list-style-type: none"> - Some employment opportunities for women - negative impact on children (herders) - Attention and investment to/in a vulnerable area - Smallholders have some access to opportunities - Unemployment opportunities enhanced 	Medium
	• Children -1		Medium
	• Vulnerable areas 1		Medium
	• Smallholders 1		Medium
	• Unemployed +2		Medium

Endnotes and selected references

¹ Thomson, G., R., Leyland, T. J., and Donaldson, A. I., 2008, De-Boned Beef – An Example of a Commodity for which Specific Standards could be Developed to Ensure an Appropriate Level of Protection for International Trade. Transboundary and Emerging Diseases, Journal compilation © 2008 Blackwell Verlag

² Thompson, G. R., 2009, Currently important animal disease management issues in sub-Saharan Africa, Onderstepoort Journal of Veterinary Research, 76:129-134

³ Southern African Development Community (SADC) Sanitary and Phytosanitary (SPS) Annex to the SADC Protocol on Trade which was signed in Lusaka in November 2008

⁴ SADC, 2013, The Phakalane Declaration On Adoption of Non-Geographic Approaches for Management of Foot and Mouth Disease Resolution by the Southern African Development Community (SADC) Calling for Adoption of Commodity-Based Trade and Other Non-Geographic Approaches for Foot and Mouth Disease Management as Additional Regional Standards for Trade in Animal Products

⁵ See Annex 9 of the Tripartite Agreement between SADC, COMESA and the EAC; Annex on SPS Measures Under Article 29(3) of the Agreement Article 1, General Provisions,

⁶ Thalwitzer, S, 2012, Development of Export Opportunities for Beef Products from the Caprivi Region, Project ID: MCAN/LMEF/2010/02, Commissioned by the Millennium Challenge Account Namibia with funding from the Millennium Challenge Corporation. Mimeo, 25pp.

⁷ An unpublished study on the business case for commodity based trade from the Caprivi region by Naziri, D., Rich, K. M., Bennett, B.

⁸ Henson and Masakure, 2011, Guidelines on the Use of Economic Analysis to Inform SPS-related Decision-Making. Standards and Trade Development Facility, Geneva.

⁹ Sweet, J., and Antje Burke, 2000. "Namibia." Country Pasture/Forage Resource Profiles, FAO.

<[http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPC/doc/Counprof/Namibia/namibia.htm#3.%20LIVES TOCK%20PRODUCTION](http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPC/doc/Counprof/Namibia/namibia.htm#3.%20LIVES%20TOCK%20PRODUCTION)>.

¹⁰ This section is based to some extent on the paper; African capacity building for meat exports, lessons from the Namibian and Botswana beef industries, Cabrera, R., Cochran, M., Dangelmayr, L., D'Aguilar, G., Gawande, K., Lee, J., Speir, I., Weigand, C. George H. W. Bush School of Government and Public Service, Texas A&M University, Version: September 2007

¹¹ Bayer, C-T. H., 2010, CAADP Process: Namibia status report, 2010 FANRPAN Regional Food Security Policy Dialogue, 2 September 2010, Windhoek. Powerpoint presentation, 12 slides

¹² Regional Strategic Analysis and Knowledge Support System, (ReSAKSS) 2013, Namibia CAADP Implementation <http://www.resakss.org/>. Website accessed 08 January 2013

¹³ Agricultural Science and Technology indicators (ASTI), 2013, Namibia. <http://www.asti.cgiar.org/namibia>. Website accessed 08 January 2013

¹⁴ Government of Namibia, 2012, Welcome to the NDP4; Executive Summary! Mimeo, 24pp.

¹⁵ WTO, 2009, Trade Policy Review, SACU-Namibia. Annex 3, Namibia, WT/TPR/S/222/NAM. Mimeo 73 pp.

-
- ¹⁶ OIE, 2008, OIE Mission report, evaluation of the veterinary services of the Republic of Namibia, Mission report, August 11 - 22, 2008, Evaluation Team: Thiermann, A., Hutter, S. Mimeo 121 pp
- ¹⁷ Mosoti, V., Rautenbach, J. W., Kirk-Spriggs, A., 2007, Review and drafting of plant health legislation, Technical Cooperation Programme, Republic of Namibia. TCP/NAM/3002, Food and Agriculture Organization of the United Nations. Mimeo 51 pp.
- ¹⁸ World Trade Organization, 2012, SPS Information Management System, 13 June 2012, National Enquiry Points List of national enquiry points foreseen in Paragraph 3 of Annex B of the SPS Agreement
- ¹⁹ Namibia was an original signatory of the Convention on Biological Diversity (CBD) in June 1992 and ratified the convention in March 1997
- ²⁰ The Convention on Biological Diversity was finalized in Nairobi in May 1992 and the Cartagena Protocol was finalized and adopted in January 2000
- ²¹ Anon 2012, Namibia's national report on the implementation of the Cartagena Protocol on Biosafety (undated), www.cbd.int/doc/world/de/de-nr-cpb-01-en.doc , website accessed 08 January 2012
- ²² Ministry of Environment and Tourism, Government of Namibia, 2010, Namibia's Draft Fourth National Report to the United Nations, Convention on Biological Diversity (UNCBD) August 2010 Compiled by the Namibian Ministry of Environment and Tourism
- ²³ <http://spsims.wto.org/> website accessed 08 January 2013.
- ²⁴ [http://www.codexalimentarius.org/members-observers/members/detail/ru/?dyna_fef\[uid\]=15699](http://www.codexalimentarius.org/members-observers/members/detail/ru/?dyna_fef[uid]=15699) website accessed 08 January 2013.
- ²⁵ https://www.ippc.int/index.php?id=npponam&no_cache=1&L=0 website accessed 09 January 2013
- ²⁶ <http://www.oie.int/en/about-us/our-members/delegates/> website accessed 09 January 2013
- ²⁷ For example see Hamukwaya, P. N., 2007, Environmental criteria analysis can contribute to sustainable local level land use planning – Linyati/Katima Mulilo rural/Kabbe constituencies, Caprivi region, Namibia, M.Sc. thesis, Faculty of Economic Management.
- ²⁸ Barnes, J. I. (2013) Economic Analysis of Land Use Policies for Livestock, Wildlife and Disease Management in Caprivi, Namibia, with Potential Wider Implications for Regional Transfrontier Conservation Areas. Technical Report to the Wildlife Conservation Society's AHEAD Program and the World Wildlife Fund. 84pp
- ²⁹ Henson and Masakure (2011) op cit.
- ³⁰ Barnes, J. I. (2013) op cit.
- ³¹ Ashley, C., 1996, Incentives affecting biodiversity conservation and sustainable use: the case of land use options in Namibia in Research Discussion Paper Number 13, Directorate of Environmental Affairs, Ministry of Environment and Tourism
- ³² Dusenbery, K., 2012, Namibia Case Study, <http://natureneedshalf.org/namibia/> Website accessed 21 October 2012
- ³³ Meatco, 2011, Annual report - 2010, 2011. Mimeo, 84pp.

-
- ³⁴ Thalwitzer, S, 2012, op cit.
- ³⁵ Anonymous, 2012, About KAZA http://www.kavangozambezi.org/about_kaza.php Website accessed 28 October 2012.
- ³⁶ Source http://www.parliament.gov.na/constituencies_show.php?const_id=1 , Website accessed 1 November 2012.
- ³⁷ Map used with permission from the Elephants without Borders website, some typo's corrected and some details updated. <http://elephantswithoutborders.org> on 27 October 2012.
- ³⁸ Bwabwata National Park <http://www.namibiatourism.org/place/bwabwata-national-park>, website accessed 29 October 2012 (will draw a bespoke map in December)
- ³⁹ Downloaded from <http://www.met.gov.na/Park%20Maps/Bwabwata%20National%20Park%20map.jpg> on 29 October 2012
- ⁴⁰ FAO, 2009, FAO Global information and early warning system on Food and Agriculture World Food Program, Special Report, FAO/WFP CROP, Livestock and Food Security Assessment Mission to Namibia, 14 July 2009 <http://www.fao.org/docrep/012/ak334e/ak334e00.htm>. Website accessed 30 October 2012
- ⁴¹ Data generated using CROPWAT 8.0 software and climate databases; http://www.fao.org/nr/water/infores_databases_cropwat.html. Water deficits (Eto) are not corrected for actual water use by grasses and trees which are adapted to the dry season in various ways and have much lower water requirements than the Eto figure as calculated.
- ⁴² Rutherford, M. C., Powrie, L. W., Husted L. B., 2012, Herbivore driven land degradation: Consequences for plant diversity and soil in arid subtropical thicket in South-Eastern Africa. *Land Degrad. Dev.* doi: 10.1002/ldr.2181
- ⁴³ Buringh, P. "Organic carbon in soils of the world." *The Role of Terrestrial Vegetation in the Global Carbon Cycle. Measurement by Remote Sensing, Vol. SCOPE 23* (1984).
- ⁴⁴ Williams, C. A., Hanan, N. P., Neff, J. C., Scholes, R. J., 2007, Berry, J. A., Denning, A. S., Baker, D. F., 2007, Africa and the global carbon cycle Carbon Balance and Management 2007, 2:3 <http://www.cbmjournal.com/content/2/1/3>
- ⁴⁵ Grace, J., San Jose, J., Meir, P., Miranda, H. S., Montes, R. A., (2006), Productivity and carbon fluxes of tropical savannas, *J. Biogeogr.* 33, 387–400
- ⁴⁶ Rutherford, Michael C. "Empiricism and the prediction of primary production at the mesoscale: a savanna example." *Ecological modeling* 67, no. 2 (1993): 129-146.
- ⁴⁷ Tohill, J.C. & Mott, J.C. (eds) (1985) Second International Savannah Symposium, CSIRO, Brisbane, Queensland, Australia. Published in *The World's Savannah: Ecology and Management*, Australian Academy of Science, University of Queensland Press. In Grace, J., San Jose, J., Meir, P., Miranda, H. S., Montes, R. A., (2006).
- ⁴⁸ Scholes, R. J. & Walker, B.H. (1993) An African savannas: synthesis of the Nylsvley study. Cambridge University Press, Cambridge, UK. In Grace, J., San Jose, J., Meir, P., Miranda, H. S., Montes, R. A., (2006).
- ⁴⁹ Scholes, R.J. & Hall, D. (1996) The carbon budget of tropical savannas, woodlands and grasslands. *Global change, effects on coniferous forest and grasslands. SCOPE* (ed. by A.I. Breymer, I.D. Hall, J.M. Melillo and G.I. Agren), pp. 69–100. John Wiley, New York.

-
- ⁵⁰ Abril, A., and Bucher, E. H., 1999, The effects of overgrazing on soil microbial community and fertility in the Chaco dry savannas of Argentina, *Appl. Soil Ecol.*, 12, 159–167, 1999.
- ⁵¹ Petri, M., Batello, C., Villani R., and Nachtergaele, F., 2010, CHAPTER II, Carbon status and carbon sequestration potential in the world's grasslands, in, *Grassland carbon sequestration: management, policy and economics Proceedings of the Workshop on the role of grassland carbon sequestration in the mitigation of climate change*, Edited by Abberton, M., Conant, R., and Batello C., Food and Agriculture Organization of the United Nations (FAO) Rome, April 2009, *Integrated Crop Management Vol. 11–2010*,
- ⁵² Ogle, S.M., Conant, R.T. & Paustian, K. 2004. Deriving grassland management factors for a carbon accounting method developed by the Intergovernmental Panel on Climate Change. *Environ. Manage.*, 33(4): 474–484. In Petri, M., Batello, C., Villani R., and Nachtergaele, F., 2010,
- ⁵³ Solomon, D., Lehmann, J., Kinyangi, J., Amelung, W., Lobe, I., Ngoze, S., Riha, S., Pell, A., Verchot, L., Mbugua, D., Skjemstad, J. & Schäfer, T. 2007. Longterm impacts of anthropogenic perturbations on the dynamics and molecular speciation of organic carbon in tropical forest and subtropical grassland ecosystems. *Global Change Biol.*, 13: 511–530.
- ⁵⁴ Batjes, N.H. 2004. Estimation of soil carbon gains upon improved management within croplands and grasslands of Africa. *Environ, Devel. Sust.*, 6: 133–143.
- ⁵⁵ Scoones, I., Bishi, A., Mapitse, N., Moerane, R., Penrith, M. L., Sibanda R., Thompson, G., and Wolmer, W. 2010, Foot-and-mouth disease and market access: challenges for the beef industry in southern Africa. *Pastoralism Vol. 1 No. 2*
- ⁵⁶ Cassidy, D., 2011, Regional trade in SPS sensitive products - Pillar II of the Comprehensive African Agriculture Development Plan (CADDP), Powerpoint presentation at 11th AHEAD-GLTFCA Working Group Meeting, 2nd to 4th March, 2011, Mopane Camp, Kruger National Park
- ⁵⁷ OECD, c2001, *Handbook of Biodiversity Valuation, A guide for policymakers*. Mimeo, 153pp
- ⁵⁸ Neely, C., Bunning, S., and Wilkes, A., 2009, Review of evidence on drylands (sic) pastoral systems and climate change, Implications and opportunities for mitigation and adaptation Land Tenure and Management Unit (NRLA), Land and Water Division, LAND AND WATER DISCUSSION PAPER 8, Food and Agriculture Organization of the United Nations, Rome, 2009
- ⁵⁹ Jeltsch, F., et al. "Impacts of landuse and climate change on the dynamics and biodiversity in the Thornbush Savanna Biome." (2010).
- ⁶⁰ Chase, M., 2007, Aerial Wildlife Census of the Caprivi River Systems, A Survey of Rivers, Wetlands and Floodplains, September 2007, Elephants Without Borders, PO Box 682, Kasane, Botswana, October 2007
- ⁶¹ Wikipedia, 2012, Communal Wildlife Conservancies in Namibia, http://en.wikipedia.org/wiki/Communal_Wildlife_Conservancies_in_Namibia, Website accessed 21 October 2012
- ⁶² Barnard P (ed). *Biological diversity in Namibia: a country study*. Namibian National Biodiversity Task Force. Windhoek, Namibia. 1998. 323pp.
- ⁶³ Turpie, J., Barnes, J., Lange, G-M., Martin, R., 2010, *The Economic Value of Namibia's Protected Area System: A Case for Increased Investment*, Ministry of Environment and Tourism, Directorate of Parks & Wildlife Management, Mimeo, 72 pp

-
- ⁶⁴ Blackie, R., 2000, Government policies on sustainable development in Namibia, in Population–Development–Environment in Namibia, University of Namibia, Multidisciplinary Research and Consultancy Centre, Background Readings, Eds., Fuller, B., and Prommer, I., IR-00-031 , pp 137 – 152
- ⁶⁵ Ashley, C., 1996, Incentives affecting biodiversity conservation and sustainable use: the case of land use options in Namibia in Research Discussion Paper Number 13, Directorate of Environmental Affairs, Ministry of Environment and Tourism
- ⁶⁶ Dusenbery, K., 2012, Namibia Case Study, <http://natureneedshalf.org/namibia/> Website accessed 21 October 2012
- ⁶⁷ Republic of Namibia, Ministry of Environment and Tourism, 2012, <http://www.met.gov.na/Pages/Protectedareas.aspx>. Website accessed 21 October 2012
- ⁶⁸ Weaver, L. C., and Skyer, P., 2005, Conservancies: Integrating Wildlife Land-Use Options into the Livelihood, Development and Conservation Strategies of Namibian Communities, Conservation and Development Interventions at the Wildlife/Livestock Interface Chapter 13 in Implications for Wildlife, Livestock and Human Health, Edited and compiled by Osofsky, S. A., Associate Editors: Cleaveland, S., Karesh, W. B., Kock, M. D., Nyhus, P. J., Starr L., and Yang, A., Occasional Paper of the IUCN Species Survival Commission No. 30
- ⁶⁹ Mendelsohn, J and Roberts, C. 1997. An environmental profile and atlas of Caprivi. Windhoek: MET.
- ⁷⁰ Suich, H., 2010, Community-based natural resource management (CBNRM): designing the next generation (Part 1) The livelihood impacts of the Namibian community based natural resource management programme: a meta-synthesis. *Environmental Conservation* 37 (1): 45–53
- ⁷¹ Anonymous, no date - sometime after 2003, A Quick Guide to the Human –Animal Conflict Compensation Scheme (HACCS) For Kwandu and Mayuni conservancies; A pilot project sponsored by Integrated Rural Development and Nature Conservation (IRDNC), in partnership with Conservancy Committees, Traditional Authorities and the Ministry of Environment and Tourism. Mimeo 5pp.
- ⁷² Jones, B. T. B., Barnes, J. I., 2006, Human Wildlife Conflict Study: Namibian Case Study. Probably commissioned by the World Wildlife fund. Mimeo, 102pp
- ⁷³ Kanapaux III, W., J., 2009, Livelihood activities in a wildlife conservancy on Namibia’s Kwando River. MSc Thesis, university of Florida. 79pp
- ⁷⁴ Emptaz-Collomb, J-G,. 2009, Linking tourism, human wellbeing and conservation in the Caprivi strip, (Namibia). PhD thesis, University of Florida, 179pp.
- ⁷⁵ Barnes, J. I., 1995, The value of non-agricultural land use in some Namibian communal areas: a data base for planning, Research discussion paper Number 6 May 1995
- ⁷⁶ Central Bureau of Statistics, Republic of Namibia, 2008, A review of poverty and inequality in Namibia. October 2008, Central Bureau of Statistics National Planning Commission, Mimeo, 107pp
- ⁷⁷ Gore, M. L., and Kahler, J. S., 2012, Gendered Risk Perceptions Associated with Human-Wildlife Conflict: Implications for Participatory Conservation, *PLoS ONE*, Vol 7, 3, e32901
- ⁷⁸ Anonymous, 2012, Livestock Ownership and Livelihood in the Northern Communal Areas: Using a randomised control trial to determine the impact of best practice and joint herding on farmers in Northern Namibia, Findings from the Baseline Household Survey. Prepared by: Innovations for Poverty Action April 5, 2012, Project funded by:

The Millennium Challenge Account Namibia & The Millennium Challenge Corporation. Mimeo, 81pp with a 21 page appendix.

⁷⁹ Anonymous, 2012, op cit

⁸⁰ Meatco, 2012, Livestock producer's forum; Northern Communal Areas in Caprivi Region, undated mimeo 6pp.

⁸¹ Suich, H., Busch, J., and Barbancho, N., 2005, Economic impacts of transfrontier conservation areas: baseline of tourism in the Kavango-Zambezi TFCA. Paper No. 4, Conservation International, South Africa, Mimeo, 69pp.

⁸² Thomson, G., and Penrith, M-L, 2012, Economic analysis for the WCS-AHEAD, WWF Animal Disease Management Project; Scenario analysis for future integrated livestock production & wildlife conservation in the Caprivi. Powerpoint presentation, 10 slides.

⁸³ Schoeman, S. J., 1989, Recent research into the production potential of indigenous cattle with special reference to the Sanga, S. Afr. J. Anim Sci, 19 (2), 55-61

⁸⁴ Ashley, C., and LaFranchi, C., 1997, Livelihood strategies of rural households in Caprivi: Implications for conservancies and natural resource management. DEA RESEARCH DISCUSSION PAPER Number 20 August 1997. Mimeo, 108pp

⁸⁵ Meatco, 2011, Annual report - 2010, 2011. Mimeo, 84pp.

⁸⁶ World Trade Organization, 2012, The Sanitary and Phytosanitary Agreement, http://www.wto.org/english/tratop_e/sps_e/sps_agreement_cbt_e, website accessed, 18 December, 2012

⁸⁷ Thomson, G.R., Tambi, E.N. Hargreaves, S.K. Leyland, T.J. Catley, A.P. van't Klooster, G.G.M. and Penrith., M.-L., 2004. International trade in livestock and livestock products: the need for a commodity- based approach. Veterinary Record 155: 429–433.

⁸⁸ Meat Board of Namibia, 2009, <http://www.nammic.com.na/meat.php>. accessed 13 August 2009

⁸⁹ Meat Board of Namibia, Annual report 2010-2011, <http://www.nammic.com.na/meat.php>. accessed 09 January 2013

⁹⁰ Meat Board of Namibia 2011, Cattle review: production and marketing trends. Mimeo 10pp.

⁹¹ Martin, R.B., 2005, The influence of veterinary control fences on certain wild large mammal species in the Caprivi, Namibia. Chapter 4 in Conservation and development interventions at the wildlife/livestock interface: implications for wildlife, livestock and human health (ed S. Osofsky), Vol. 30, pp. 27-46. Occasional paper of the IUCN Species Survival Commission. available at http://www.wcs-ahead.org/wpc_launch.html

⁹² IRAS, 2009, Information system for Rare Species Management (IRAS), 2009, website <http://www.nnf.org.na/RARESPECIES/InfoSys/wildlifeLanduse/vetFence.htm> accessed 12 August 2009

⁹³ Sweet, J., and Burke, A., 2000, Country Pasture/Forage Resource Profiles, Namibia, <http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPC/doc/Counprof/Namibia/namibia.htm#3.%20LIVESTOCK%20PRODUCTION> accessed 13 August 2009

⁹⁴ Government of Namibia, 2009, Animal Identification Regulations GN29/2009 in terms of the Animal Diseases and Parasites Act 13 of 1956 as amended

⁹⁵ These have websites as follows; <http://www.meatco.com.na> for Meatco and <http://www.nammic.com.na> for the Meat Board

⁹⁶ Moenius, J., 2006, Measuring Comparative Advantage: A Ricardian Approach. Mimeo 33pp

⁹⁷ Accessed from <http://wits.worldbank.org>