Sustainability of smallholder cattle production and its vertical integration into the formal beef market value chain in South Africa

by

Tawanda Marandure

Thesis is presented in partial fulfillment of the requirements for the degree of Master of Science in Sustainable Agriculture at Stellenbosch University

Department of Animal Sciences
Faculty of AgriSciences
Supervisor: Dr. C. Mapiye
Co-supervisor: Prof. K. Dzama

December 2015

Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2015

Abstract

A survey to assess the sustainability and marketing opportunities for smallholder cattle production systems was conducted by consulting with a total of 95 smallholder cattle producers in Ncorha and Gxwalibomvu communities in the Eastern Cape Province (ECP) of South Africa. In addition, a total of 18 surrounding beef retailers, 5 abattoirs that supplied beef to these retailers and 155 beef consumers who bought beef from these retailers between February 2013 and February 2014 were also interviewed using pretested structured questionnaires. The surveys established the perception of beef traders and consumers on the development of a Natural beef (NB) brand and indicated the willingness of participants to support the development of a NB brand. The results indicated that a smallholder beef cattle production system was socially and environmentally conditionally sustainable but economically not sustainable. Overall, the system was conditionally sustainable. Cattle herd size was bigger in Ncorha than in Gxwalibomvu (13.7±1.9 vs. 11.3 ± 1.9 heads of cattle, respectively). Smallholder producers from both sites sold an average of two cattle per year. Young farmers (<40 years old), Christians and small households (<5 members) had a greater potential to sell cattle than adults (>40 years old), traditionalists and larger households (>5 members). Similarly, households with access to extension services, owners of smaller cattle herds (<10 cattle) and from a lower income bracket (<R3000) had a bigger potential to sell cattle. More than 70% of consumers were willing to buy a NB brand once it is available on the market but were not willing to pay a premium for the beef brand. Consumers' willingness to buy and pay a premium for a NB product was influenced by gender, age, income source, with meat preference and meat consumption frequency playing the biggest role in decision making. On the other hand, retailers were not willing to participate in the development of a NB brand. Beef traders, however, suggested that communal feedlotting, group marketing and characterization of beef from cattle fed natural pasture-based diets to identify unique quality attributes of such beef, can potentially improve offtake and economic sustainability of smallholder cattle production systems. The study concluded that smallholder cattle production systems in the ECP is conditionally sustainable, and opportunities for the integration of smallholder cattle producers into the formal beef market value chain lies in the characterization of natural pasture-fed beef, feedlotting and group marketing.

Keywords: sustainability, natural pasture-fed beef brand, marketing opportunity, group marketing, feedlot

Opsomming

'n Opname om die volhoubaarheid en bemarkingsgeleenthede vir kleinboer vleisbeesproduksiestelsels te evalueer, is deur middel van konsultasie met 'n totaal van 95 kleinboere vee produsente in Ncorha en Gxwalibomvu gemeenskappe in die Oos-Kaap Provinsie van Suid-Afrika, uitgevoer. Daarbenewens is altesame 18 omliggende vleis kleinhandelaars, 5 abattoirs wat beesvleis verskaf aan hierdie kleinhandelaars en 155 beesvleis verbruikers wat vleis gekoop het van die kleinhandelaars tussen Februarie 2013 en Februarie 2014, met behulp van vooraf-getoetste gestruktureerde vraelyste ondervra. Die opnames het die mening van beesvleis handelaars en -verbruikers oor die ontwikkeling van 'n natuurlike weiding-geproduseerde beesvleis (NPB) handelsmerk ingewin en ook die bereidwilligheid van die deelnemers om die ontwikkeling van 'n NPB handelsmerk te ondersteun, aangedui. Die bevindinge dui daarop dat 'n kleinskaalse vleisbees produksiestelsel sosiaal en omgewingsvriendelik voorwaardelik volhoubaar is, maar nie ekonomies volhoubaar is nie. In geheel is hierdie tipe produksiestelsel as voorwaardelik volhoubaar beskou. Beestrop grootte was groter in die Ncorha as in die Gxwalibomvu gemeenskappe (13.7 ± 1.9 beeste vs. 11.3 ± 1.9 beeste, onderskeidelik). Kleinboer produsente van beide areas het 'n gemiddeld van twee beeste per jaar verkoop. Jong boere (<40 jaar oud), Christene en klein huishoudings (<5 lede) het 'n beter potensiaal gehad om beeste te verkoop as volwassenes (> 40 jaar oud), tradisionele boere en groter huishoudings (> 5 lede). Net so het huishoudings met toegang tot voorligtingsdienste, eienaars van klein troppe (<10 beeste) en boere wat aan die laer inkomstegroep behoort het (<R3000), ’n groter potensiaal gehad om vee te verkoop. Meer as 70% van verbruikers was bereid om vir 'n NPB produk te betaal sodra dit beskikbaar is op die mark, maar was nie bereid om 'n premie vir die NPB handelsmerk te betaal nie. Verbruikers se bereidwilligheid om NPB produkte te koop en ’n premie te betaal vir die handelsmerk was deels beïnvloed deur geslag, ouderdom, bron van inkomste en die meeste deur vleis voorkeur en frekwensie van vleis verbruik. Kleinhandelaars was nie bereid om

deel te neem aan die ontwikkeling van ’n NPB handelsmerk nie. Bees handelaars het egter voorgestel dat kommunale voerkrale, groepsbemarking en karakterisering van vleis van beeste gevoer op natuurlike weiding om die unieke kwaliteitseienskappe van die tipe vleis vas te stel, potensieel afsette en ekonomiese volhoubaarheid van kleinboere produksie beeste stelsels kan verbeter. Die studie het bevind dat kleinboer veeproduksiestelsels in die Oos-Kaap Provinsie voorwaardelik volhoubaar is en dat geleenthede vir die integrasie van kleinboer beesprodusente in die formele vleisbeesmark waardeketting in die karakterisering van beesvleis geproduseer op natuurlike weiding, voerkrale en groepsbemarking, vervat is.

Sleutelwoorde: volhoubaarheid, natuurlike weiding geproduseerde beesvleis handelsmerk, bemarkingsgeleentheid, groep bemarking, voerkraal

Acknowledgements

I wish to express my sincerest appreciation to my supervisors Dr. C. Mapiye and Prof. K. Dzama for their dedicated guidance, motivation and constructive criticism throughout the course of the project. I will always cherish the unique skills they imparted on me. I am also grateful to the Sustainable Agriculture South Africa (SASA) team at Stellenbosch University for their contribution to the dynamic nature of this program which laid a firm foundation for this study. The financial assistance of the Department of Science and Technology-National Research Fund (DST-NRF) Centre of Excellence in Food Security towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at are those of the author and are not necessarily to be attributed to the DST-NRF Centre of Excellence in Food Security.

I wish to express my appreciation to Ncorha and Gxwalibomvu farmers, beef retailers, abattoirs and consumers for being patient with me during data collection and their willingness to share experiences. My greatest appreciation also goes to Amanda Chulayo, Zikhona Rani, Thuthuzelwa Stempa, Zuko Mpisana, Sinethemba Mngqi and Bulelani Mazizi for assisting me with data collection. I would also want to acknowledge the assistance provided by Dr. Ngethu and Inga from the National Agricultural Marketing Council (NAMC).

My colleagues Busi Mahlobo, Tshepo Morokong, Sakeus Kafula and Zander Venter have also been very supportive with their advises and criticism for the whole duration of the programme. I further convey my gratitude towards my mum, dad, brothers and sisters whose moral support and motivation has kept me going.

Table of Contents

List of Acronyms

ASI	Agriculture Sustainability Index
BFAP	Bureau for Food and Agricultural Policy
BMGF	Bill and Melinda Gates Foundation
CHDM	Chris Hani District Municipality
CI	Confidence Interval
CSIR	Centre for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DST	Department of Science and Technology
DWA	Department of Water Affairs
ECP	Eastern Cape Province
ECDC	Eastern Cape Development Corporation
FAO	Food and Agriculture Organisation
FPL	Food Poverty Line
FSI	Farmer Sustainability Index
IDP	Integrated Development Plan
IDT	Independent Development Trust
ISAP	Indicators of Sustainable Agricultural Practice
ISRD	Integrated Sustainable Agriculture and Rural Development
LBPL	Lower Boundary Poverty Line
Ls	Least square
MAHFP	Months of Adequate Household Food Provision
MESMIS	Indicator Based Sustainability Assessment Framework
NAMC	National Agricultural Marketing Council
NDA	National Department of Agriculture
NB	Natural beef
NRC	National Research Council
NRF	National Research Fund
PRA	Participatory Rural Appraisal
RDP	Reconstruction Development Program
SAS	Statistical Analysis System
SE	Standard Error
SSA	Statistics South Africa
USAID	United States Agency for International Development
WCED	World Commission on Environment and Development
NERPO	National Emergent Red Meat Producers Organisation

List of Figures

List of Tables

Chapter 1: General introduction

1.1 Introduction

South Africa has a cattle population of 14.1 million constituting about 6.0% of the cattle on the African continent (Department of Agriculture Fisheries and Forestry (DAFF), 2012). It is estimated that 40% of that total cattle population belong to the smallholder sector, which is composed of emerging and communal farmers (DAFF, 2012; World Bank, 2014). The Eastern Cape Province (ECP) is estimated to have a quarter of the total national herd. It is an undeniable fact that smallholder cattle producers have a significant cattle population which if well managed have a potential to improve their livelihoods and play a major role in the national economies (Randolph et al., 2007). Unfortunately that is far from the prevailing situation, a number of authors have often expressed concern over little contributions by smallholder livestock production, particularly cattle, to their households and national economies (Herrero et al., 2010; Altman et al., 2009; Ainslie et al., 2002).

Cattle in the smallholder areas of South Africa are managed under extensive systems where they entirely depend on natural pastures as their major source of feed (Mapiye et al., 2010). The sustainability of smallholder natural beef (NB) cattle production systems is, however, under threat from increasing global human population, urbanisation, land degradation and climate change (Nardone et al., 2010; Nelson et al., 2009; Thornton et al., 2009). Nevertheless, there are major concerns regarding conventional beef production which include issues of animal welfare, food safety, severe negative environmental impacts, and degradation of some social aspects of smallholder farmer families (Shisana et al., 2013; Pickup & Stafford, 1993). In that regard, modern consumers are increasingly demanding high quality and healthy beef from extensively farmed cattle with minimum use of external chemical inputs and high animal welfare standards (Labuschagne, 2007). To maintain or improve sustainability,

smallholder cattle production systems should ethically and profitably produce safe beef of high quality as per consumers' preferences with little or no negative impacts on economic, social and environmental aspects (Chaudhry, 2008; Mueller 1997).

Smallholder cattle producers can make a recognisable impression on the formal beef market by developing a unique NB brand to improve their access to high value formal beef markets. NB is beef from cattle fed the whole range of natural pastures including grass, tree/shrub leaves, legumes and pods. Muchenje at al. (2008) and Mapiye et al (2011) have already demonstrated smallholder farmers' ability to produce high quality and healthy beef from natural pasture based feed resources using high animal welfare standards and little or no use of antibiotics. In addition, Daley et al. (2010) reported that beef from cattle fed natural pasture based feed resources are not only an excellent source of protein, energy and minerals, but also contain omega-3 fatty acids, vaccenic and rumenic acids which seem to have positive effects on human health, and vitamins (beta-carotene and alpha-tocopherol) that reduce risk of heart disease, diabetes and cancer in humans. These attributes can be used to market a NB brand as unique healthy beef brand. Previous research has identified branding as a single, most important source of competitive advantage, particularly at a retail level (Froehlich et al., 2009). Keller (2003) indicated other important attributes of beef branding which include; accountability, traceability, earning consumer trust as well as signalling to consumers the level of quality inherent in a product. More importantly, Bredahl (2004) expressed that brands are of particular importance to food items because of the frequency with which food is purchased, often under time pressure. The current study proposes that the development of a NB brand has the potential to create demand in niche markets resulting in the payment of a premium to smallholder cattle producers. However, in order to consistently support the NB brand smallholder sustainability of the cattle production system should be improved.

A key long-standing challenge of the smallholder cattle production system in South Africa and sub-Saharan Africa in general is low offtake which is mainly attributed to low productivity (Musemwa et al., 2010). Scholtz & Bester (2010) reported that when compared with commercial beef production, communal cattle production in South Africa reflects a high level of mortality of up to 30.7%, due to diseases and parasites, low reproduction rates (± 48%), low weaning rates (± 45%) and relatively poor body conditions of cattle (Nowers et al., 2013). The combined effects of all these factors are a very low offtake (± 5%) (Scholtz et al., 2008). Other authors attributed low offtake in smallholder cattle production systems to shortage of feed resources and lack of access to stable and reliable markets (Salami et al., 2010; Mapiye et al., 2009).

Smallholder farmers in South Africa desire to sell their cattle through the formal markets but individually they lack sufficient cattle numbers (Musemwa et al., 2010) to offset pre-slaughter transaction costs and satisfy the formal market demand. Moreover, they often produce beef that fail to meet the quality standards required by formal markets (Altman et al., 2009). However, smallholder cattle producers indicate lack of transparency among some agents and/or middlemen who buy their cattle at very low prices. In addition, the current system used by formal markets which favours young well-conditioned animals work to their disadvantage as they often market old and emaciated animals (Coetzee et al., 2005). Other hindrances to formal cattle marketing are poor market infrastructure, lack of adequate marketing information as well as absence of institutional support services (Herrero et al., 2010). To this end, improving animal performance and access to formal markets might increase cattle offtake and subsequently, income for the resource-poor smallholder cattle producers (Salami et al., 2010). Lahif & Cousins (2005) indicated that increased cattle offtake may also have the added benefit of taking pressure off the fast deteriorating natural pastures, which may improve environmental sustainability of the smallholder beef cattle production system.

1.2 Justification

The scientific community currently face the challenge of sustaining extensive livestock production systems to improve smallholder resource poor farmers' livelihoods while preserving the natural resource base of vegetation, soil, water, air and biodiversity (FAO, 2004). Livestock production impacts the; environment (e.g., overgrazing, deforestation and fertilization), climate; (e.g., temperature and rainfall; Nelson et al., 2009) and have multiple effects on the social well-being of communities (e.g., wealth levels, household income, gender balance; Musemwa et al., 2010). Efficient cattle management entails considering utilization of the above mentioned resources at optimum levels. Efficient use of resources ensures enhanced productivity which may sustainably increase cattle offtake. In South Africa there are no studies aimed specifically at assessing sustainability of the smallholder livestock production system. It is therefore, vital to assess the sustainability of smallholder cattle production system, the potential of improving access to formal markets and its suitability in future to supply safe and high quality beef for human consumption without impacting on pseudo-climatic and social conditions.

Developing a NB brand has the potential to improve smallholder beef producers' access to formal beef markets through creating a niche market for healthy beef. It is therefore, imperative to assess the potential and willingness of smallholder beef producers to participate in the development such a brand. In addition, beef traders' and consumers' general perceptions on the development of the brand must be ascertained as well as consumers' willingness to buy and pay a premium for such beef. Knowledge of farmers' perceptions on the development of a NB are crucial in determining factors influencing farmers' potential to sell. Perceptions are also important in formulating locally applicable strategies aimed at improving offtake of cattle in the smallholder areas and their contribution to household food security and income for resource-poor smallholder farmers.

1.3 Objectives

The main objective of this research was to assess sustainability of smallholder beef cattle production system in the Eastern Cape Province of South Africa and identify strategies for its vertical integration into the formal beef market value chain.

The specific objectives were to;

1. Assess the sustainability of the smallholder cattle production system;
2. Determine the potential and willingness of smallholder cattle producers to develop a NB brand;
3. Assess the perceptions of beef traders on the development of a NB brand and their willingness to support its development;
4. Assess the perceptions of consumers on the development of a NB brand and their willingness to support its development.

1.4 Hypotheses

1. The smallholder cattle production system in the ECP is not sustainable
2. Smallholder cattle producers in the ECP do not have the potential and are not willing to develop a NB brand
3. Beef traders in the ECP do not have positive perceptions about NB and are not willing to support its development by smallholder cattle producers
4. Beef consumers in the ECP do not have positive perceptions about NB and are not willing to support its development by smallholder cattle producers.

References

Ainslie, A., Kepe, T., Ntsebeza, L., Ntshona, Z. & Turner, S. (2002). Cattle ownership and production in the communal areas of the Eastern Cape, South Africa. Research Report no. 10. University of the Western Cape.

Altman, M. Hart, T. & Jacobs, P. (2009). Household food security status in South Africa. *Agrekon*, **48**(4): *345-361*.

Bredahl, L. (2004). Cue utilisation and quality perception with regard to branded beef. *Food Quality and Preference*, **15** (1): *65–75*.

Chaudhry, A.S. (2008). Forage based animal production systems and sustainability, an invited keynote. *Revista Brasileira De Zootecnia*, **37**: *78-84*.

Coetzee, L., Montshwe, B.D. & Jooste, A. (2005). The marketing of livestock on communal lands in the Eastern Cape Province: Constraints, Challenges and Implications for the extension services. *South African Journal of Agricultural Extention*, **34**(1): *81-103*.

Daley, C.A., Abbott, A., Doyle, P., Nader, G. & Larson, S. (2010). A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef. *Nutrition Journal,* **9:** *10*.

Department of Agriculture Fisheries & Forestry (DAFF) (2012). Accessed on 15.11. 2014) at http://www.nda.agric.za/docs/AMCP/Beef2012-13.pdf

FAO (2004). Policy issues in livestock development and poverty reduction. Pro-poor livestock policy initiative. Working paper No. 27. Ugo Pica-ciamarra.

Froehlich, J.E., Carlberg, G.J. & Clement E.W. (2009). Willingness-to-pay for fresh brand name beef. *Canadian Journal of Agricultural Economics,* **57***: 119–137*

Herrero, M., Gerber, P., Lecomte, P., Ayantunde, A., Van Der Zijpp, J., Notenbaert, M., Van Steeg, J., Thornton, P.K., Lecomte, P., Tarawali, S. & Grace, D. (2010). The way forward for livestock and the environment In: The role of livestock in developing communities: Enhancing multi-functionality edited by Swanepoel, F.J.C., Stroebel, A. and Moyo, S. (Eds). Wageningen, The Netherlands: CTA.

Keller, K.L. (2003). Strategic Brand Management: Building, Measuring, and Managing Brand Equity. Upper Saddle River, NJ: Prentice Hall.

Labuschagne, A. (2007). A consumer orientated study of the South African beef supply chain. Unpublished MBA thesis, University of Pretoria. South Africa.

Lahiff, E. & Cousins, B. (2005). Smallholder Agriculture and Land Reform in South Africa. *Institute of Development Studies (IDS) Bulletin*, **36** (2): *127-128*.

Mapiye, C., Chimonyo, M., Dzama, K., Hugo, A., Strydom, P.E. & Muchenje, V. (2011). Fatty acid composition of beef from Nguni steers supplemented with *Acacia karroo* leafmeal. *Journal of Food Composition and Analysis,* **24**(4-5): *523-528*.

Mapiye, C., Chimonyo, M., Dzama, K., Strydom, P.E. & Muchenje, V. (2010). Meat quality attributes of Nguni steers supplemented with Acacia karroo leaf-meal. *Meat Science,* **8**(4): *621-627*.

Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. & Mapekula, M. (2009). Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. *Livestock Science* **124**: *196-204*.

Muchenje, V., Dzama, K., Chimonyo, M., Raats, J.G. & Strydom, P.E. (2008). Meat quality of Nguni, Bosmara and Aberdeen Angus steers raised on natural pasture in the Eastern Cape, South Africa. *Meat Science* **79**: *20-28*.

Mueller, S. (1997). Evaluating the Sustainability of Agriculture: The Case of the Reventado River Watershed in Costa Rica. In *European University Studies Series 5*; Peter Lang GmbH: Frankfurt, Germany; *223pp*.

Musemwa, L., Mushunje, A., Chimonyo, M., & Mapiye C. (2010). Low cattle market offtake rates in communal production systems of South Africa: Causes and migration strategies. *Journal of Sustainable Development in Africa*, **12**: *209-226*.

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S. & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science* **130:** *57-69*.

Nelson, G.C., Rosegrant, M.W., Koo, J., Robertson, R., Sulser, T., Zhu, T., Ringler, C., Msangi, S., Palazzo, A., Batka, M., Magalhaes, M., Valmonte-Santos, R., Ewing, M. & Lee. D. (2009). Climate Change: Impact on Agriculture and Costs of Adaptation. IFPRI Food Policy Report, Washington DC.

Nowers, C.B., Nobumba, L.M. & Welgemoed, J. (2013). Reproduction and production potential of communal cattle on sour rangeland in the Eastern Cape Province, South Africa. *Applied Animal Husbandry & Rural Development* **6**:*48-54:* Accessed on 16.12.2014 at *www.sasas.co.za/aahrd/*

Pickup, G. & Stafford, D. M. (1993). Problems, Prospects and Procedures for Assessing the Sustainability of Pastoral Land Management in Arid Australia. *Journal of Biogeography*, **20**(5): 471-487. Accessed on 19 November 2014, at http://www.jstor.org/stable/2845721

Salami, A., Kamara, A., B. & Brixiova, Z. (2010). Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities, *Working Papers Series No. 105.* African Development Bank, Tunis, Tunisia.

Scholtz, M.M. & Bester, J. (2010). Offtake and production statistics in the different South African cattle sectors: results of a structured survey. *Applied Animal Husbandry & Rural Development* **3**(1): *19-23*.

Shisana, O., Labadarios, D., Rehle, T., Simbayi, L., Zuma, K., Dhansay, A., Reddy, P., Parker, W., Hoosain, E., Naidoo, P., Hongoro, C., Mchiza, Z., Steyn, N.P., Dwane, N., Makoae, M., Maluleke, T., Ramlagan, S., Zungu, N., Evans, M.G.,

Jacobs ,L., Faber, M. & SANHANES-1 Team. (2013). South African National Health and Nutrition Examination Survey (SANHANES-1). Cape Town: HSRC Press.

Thornton, P.K., van de Steeg, J., Notenbaert, A. & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: a review of what we know and what we need to know. *Agricultural Systems* **101**: *113-127*.

Chapter 2: Literature review

2.1 Introduction

Smallholder farmers are becoming increasingly significant for their tremendous contribution to the global agricultural value chains (FAO, 2009). Managing an estimated 85% of the world's farms, smallholder farmers' agricultural outputs are thought to support approximately 2.2 billion people (Calcattera, 2013). The World Bank (2008) report revealed that about 1.3 billion people in the world are poor and constantly faced with inadequate food supplies. The majority of these poor people live in developing countries where more than 30% is estimated to be living in extreme poverty (World Bank, 2008) and depend directly or indirectly on livestock for their livelihoods (FAO, 2009). It is further anticipated that the livestock sector will play an even greater significant role in value addition and land use in future (Van der Zijpp et al., 2010).

Cattle production is considered the most important livestock sub-sector in South Africa, contributing about 25 to 30% to the total agricultural output per annum (Musemwa et al., 2008; Herrero et al., 2010). The Eastern Cape Province (ECP) has the largest cattle herd in South Africa. About 90% of the province is used for communal grazing, commercial livestock production, nature conservation and game ranching (CSIR, 2004). The combination of climatic, topographic and geological features limits crop production in this province (Ainslie et al., 2002). More efficient livestock production is not yet evident among the majority of the smallholder cattle producers in South Africa, particularly in the ECP. Altman et al. (2009) expressed that the contribution of cattle to smallholder cattle producers' household food security and income, and consequently to the national economy is very insignificant. Low cattle productivity is regarded as the major hindrance to significant contribution of smallholder cattle to household and national economy. Despite that smallholder farmers own about 40% of the total

national herd, total beef production per annum (600 000 to 800 000 tonnes) over the past 10 years was ~5% less than the annual total beef consumption in South Africa (DAFF, 2012). As a result, the country has been importing up to 20 000 tonnes of beef per annum, which is 2.5% of its total beef consumption per annum, to meet the consumer demand (DAFF, 2012).

Most smallholder cattle producers do not consider cash from cattle sales as their major reason for cattle production (Monsthwe, 2006). They are mainly concerned about the other roles played by cattle like, provision of draught power, sign of household wealth, assets of inheritance and many other socio-cultural roles. This is reflected by non-participation of a large number of smallholder cattle producers in mainstream cattle marketing. Consequently, their cattle stay much longer on the farm and they often prefer to sell older emaciated cattle (Randolph et al., 2007). Creating opportunities for improved smallholder cattle producers' access into the formal beef markets can go a long way in increasing their household food security and income (Coetzee et al., 2005). It may also assist the country to consistently meet its local beef consumption level.

Increasing cattle productivity appears to be the logical intervention that might lead to higher cattle market offtake (Musemwa et al., 2008). However, increasing cattle productivity might strain the ecological and social capacity of the system to continuously support this intervention. This merits an investigation on the current sustainability level of the smallholder cattle production system. Sustainability of smallholder cattle production system is still largely vague, dynamic and not universal. It is therefore important to investigate it on a case specific basis and update existing knowledge on the matter. This chapter explores literature on sustainability of smallholder cattle production system and opportunities for vertical integration of the system into the formal beef market value chain.

2.2 Smallholder cattle production in South Africa

The term 'smallholder cattle production' is often used interchangeably with small-scale cattle production, subsistence or family farming, low income farming, resource poor farming or low technology farming (Calcattera, 2013). According to the author, there is no consensus on the definition of smallholder cattle production. Similar sentiments were also expressed by Nagayates (2005) who analysed different smallholders' definitions and concluded that their sole consensus is the lack of a sole definition for smallholder cattle producers. In South Africa, Oettle et al. (2005) admitted that smallholder farming in the country is too diverse and difficult to define. However, smallholder farmers include, small-scale, communal and emerging farmers Palmer and Ainslie, 2006). An analysis from various institutions revealed common criteria and indicators for smallholders' definitions. The common criteria used include; market orientation, landholding size, labour input, on-farm income, management level, level of technology of farming system, capacity, land tenure and level of organization (Calcattera, 2013).

In the context of this research, smallholder cattle farmers are considered as those who hold small farms (< 12 ha) where individuals have open access to natural resources, including rangelands (Moyo et al., 2008). The farmers own between one and 10 cattle, and have limited use of technology and external inputs (Palmer and Ainslie, 2006). Otherwise, some common characteristics of smallholder livestock keepers as listed by FAO (2009) are as follows:

1. They tend to operate with limited resources relative to other producers in the sector.
2. They have low levels of formal education and training and they keep their animals on communal, rather than private, land or they may be landless.
3. Smallholder livestock keeping is usually a family enterprise that practises either subsistence production or a mix of subsistence and commercial production.

The family is the major source of labour, and livestock production is often the main source of income.

4. They have limited access to input and output to markets and to services and credit with most of their market interaction taking place in informal local markets, for which they produce local or traditional products.
5. They routinely face high transaction costs in respect of securing quality inputs and gaining market recognition for quality outputs.

Emerging farmers is a relatively new term in South Africa used to refer to previously underprivileged farmers that are determined and have the capacity to expand and develop into commercial farmers (National Department of Agriculture (NDA), 2006). In South Africa the term comprises of black farmers who were previously denied the opportunity to farm profitably by the Apartheid system. Now with much improved opportunities, the same farmers operate above subsistence levels and are more market oriented (Calcaterra, 2013). However, smallholders including emerging farmers lack adequate resources for optimum production and marketing and therefore, are facing challenges of penetrating into the already established formal markets. Kistern & van Zyl (1998) added that smallholder and emerging farmers have very limited policy support and predicted that their challenges will persist if this is not addressed.

2.3 Contribution of smallholder beef cattle to food, economic, ecological and social security

FAO (2009) defined food security as a situation that exist when all the people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preference for an active and healthy life. The Wikipedia definition of economic sustainability is a condition of having stable income or resources to support a standard of living now and in the future. Cattle have the

potential to serve smallholder farmers with a regular supply of animal source protein that provides a critical supplement and diversity to staple plant-based diets (Murphy & Allen, 2003). A study conducted by Rendani (2003) revealed an average farming family milk consumption of 2 to 4 litres/day in Limpopo Province. Steinfield et al. (2006) stated that livestock products account for 30% of protein consumed by humans. However, Randolph et al. (2007) revealed that slaughtering cattle for meat is infrequent and usually occurs to sick or unproductive animals, or for exceptional occasions such as ceremonies and other family gatherings.

Cattle are also integrated within household production and consumption decisions, making the role played by cattle to minimize risk in household well-being, much more complex (Vandamme et al., 2010). Resource poor smallholder farmers and their communities consider cattle production as a diversification strategy that provides a means of reducing risks associated with crop failure (Freeman et al., 2007, Thornton et al., 2007; Vandamme et al., 2010). In mixed farming systems cattle are used to support crop production and vice-versa. Stroebel et al. (2010) estimated that cattle constitute about two thirds of large ruminant livestock used to provide draft power and manure in farming systems in developing countries. Specifically, cattle provide traction power for draught and transportation to almost a quarter of the total area under crop production in developing countries (Devendra, 2010). It is important that smallholder cattle producers maintain cattle that fullfill the roles mentioned above but also consider reserving part of their cattle herds for breeding market cattle.

With no access to formal financial institutions in smallholder areas, cattle provide resource poor farmers with opportunities to save or accumulate capital, guarantee financial security and to help finance their planned and unplanned expenditure (Hoddinott, 2006). This was supported by various other authors who also stated the importance of cattle as a ready source of cash when need arises (Freeman et al., 2007;

Mapiye et al., 2009; Musemwa et al., 2010). Cattle production also contributes to employment creation thereby, providing income and consequently, contributing to overall economic sustainability of smallholder farmer livelihoods (Karakok, 2007).

Ecologically cattle play an important role in nutrient cyclic by enhancing fertility of soils through their faeces and urine. This role of cattle in providing manure for soil nutrient cycling that enhances soil fertility cannot be overemphasized (Herrero et al., 2010). According to Chaudhry (2008) cattle and other ruminant animals are capable of transforming unproductive land for productive use through addition of nutrients. Apart from its use in enhancing soil fertility, cattle also play a critical role in maintaining biodiversity through grazing. Grazing reduces the vigour of the most dominant grass species thereby, increases the competitiveness of the less dominant grass species (Herrero et al., 2010). Cattle also help in seed dispersal throughout the rangeland ultimately, promoting evenness. Over and above all cattle also have an aesthetic value of contributing to a diverse and pleasing rural landscape. Cattle and ruminants create opportunities to make some idling resources like fibrous forages and crop residues enter the human food chain utilizing marginal resources. Extensive cattle production is in most cases restricted to marginal natural grazing areas which are not suitable for field crops (Scholtz et al., 2008). This affects productivity of cattle and contributes to further environmental degradation hence, these systems are generally regarded as unsustainable.

Cultural norms in many societies place a considerable value on cattle as an indicator of social well-being (Randolph et al., 2007). Social importance in the community is based on the family's total cattle holding or in their sharing of cattle with others to strengthen social bonds (Kitalyi et al., 2005). Waters-Bayer & Letty (2010) further indicated that cattle also contribute to gender balance particularly, in cases where women are afforded the opportunity to own cattle. Overall, cattle are considered as

men's livestock while, ownership of other smaller livestock like chicken and goats is left for women (Ngxetwane, 2011). Affording women opportunities to own cattle will help to elevate their social status thereby, promoting gender balance. Once a high social status is attained, it may translate to access or even authority over a broader base of community resources (Randolph et al., 2007).

Cattle also play a significant role in other important socio-cultural practices such as paying a bride price, wedding gifts, inheritance, ancestor communion and circumcision presents (Coetzee et al., 2005). Normally, the youth or newly married couple is given cattle as starting capital. They are also used for other cultural roles including veneration of ancestral spirits, installation of spirit-mediums, appeasing avenging spirits, exorcism of evil spirits and payment for service to traditional healers (Monsthwe et al., 2005). However, commercialization of cattle belonging to smallholder farmers, if accompanied by increased cattle productivity, is thought to lead to diminishing some of the roles mentioned above. This was supported by Musemwa et al. (2010) who stated that the market oriented goal of smallholder cattle production will reduce the prestige of cattle in other roles. For example, the role of cattle to enhance one's social status will be diminished when cattle are used as the major source of income.

According to Coetzee et al. (2005) the Integrated Sustainable Agricultural Rural Development (ISRD) identified the potential of livestock farming in alleviating poverty by improving food security and enhancing the smallholder farmer livelihoods. Similarly, Scholtz et al. (2008) considered cattle production in the Eastern Cape Province a potential vehicle for household income generation with very high opportunities for poverty alleviation and generally improved livelihoods among the smallholder cattle producers. More recent publications (Mapiye et al., 2010; 2011; Musemwa et al., 2010) also acknowledge the great potential inherent in smallholder cattle to address sensitive issues concerning food security, poverty alleviation and social security of smallholder

farmers. Nevertheless, unlocking this potential has been the sticky point for many years. Meanwhile, Monsthwe et al. (2005) suggested that access to formal markets by smallholder livestock farmers hold the key to successful transition of the farmers towards commercialization. While other authors are advocating for more holistic, inter-disciplinary interventions, that considers the socio-economic and environmental capacity of the smallholder cattle production systems (McDemott et al. 2010; Astier et al. (2012).

The evolving production and marketing systems require smallholder cattle producers to increase the efficiency of resource utilization and risk mitigation measures so as to provide higher quality beef to the market (McDemott et al. 2010). The calls for intensification of smallholder production systems should be done within the realms of sustainability without any negative influences on the social, environmental and economic aspects of production.

2.4 Sustainability of the smallholder cattle production system in South Africa

Since the popularization of the concept of sustainability by the Bruntland report (World Commission on Environment and Development (WCED), 1987) the term has had so many definitions in literature and its vagueness has increased (Lopez-Ridaura, 2005). For this reason, there is no universal and unequivocal definition of sustainability. Nevertheless, the concept of sustainability simultaneously combines environmental goals, such as ensuring resource availability, avoiding negative environmental impacts and maintaining biodiversity, with economic, viability goals and social goals, such as, gender balance, equal distribution of resources and social justice (Domanski et al., 1993; Smith & McDonald, 1998; Bell, 2003). As such, efforts should rather be directed towards operationalization of sustainability in system-specific cases taking into consideration the recognized social, economic and environmental goals (Lopez-Ridaura, 2005). In this context, non-sustainable systems would be regarded as those

that are dysfunction the triple phases of social, environmental and economic dimensions. However, Atanga et al. (2013) highlighted the concept of conditional sustainability where the measures of social, environmental and economic dimensions may not reach ultimate sustainability standards but are not too low to be described as entirely unsustainable. Conditional sustainability is therefore, an intermediate measure between the two extremes.

Likewise, sustainable cattle production presents an ideal opportunity for operationalization of the concept of sustainability. Although, far too many definitions have been suggested in literature, there is no concise, unequivocal, universally accepted definition of sustainable cattle production (Truppe, 2000; Hoffmann, 2011; van Eenannam, 2013). For this reason, some authors view it as a management philosophy rather than a scientific operation method (Heitschmidt, 1996). Bosshard (2000) considers it as 'one of the most challenging and, at the same time, fuzzy contemporary paradigms'. Regardless of the absence of a precise definition, many livestock specialists are in agreement of the paramount importance of the concept of sustainability to the biosphere and its ever increasing population (Heitschmidt, 1996). Although no definition of sustainable cattle production would be attempted in this study, key principles of achieving profitable cattle production under socially acceptable conditions with no net deterioration of the natural pastures will guide the context of this study. In essence, cattle offtake should not reduce the natural pasture's ability to continue producing adequate forage for further sustained offtake (Vavra, 1999).

About 40% of the South African population live in rural areas where livestock, especially cattle, is one of the major sources of food and income to the households' livelihood (World Bank, 2014; Lahiff & Cousins, 2005). Smallholder cattle are raised extensively on natural pastures which is usually a communally owned resource. For this reason, the natural pasture is a critically valuable resource whose productivity is

positively correlated to cattle productivity (van der Zijpp et al., 2010). The majority of smallholder cattle producers largely perceive natural pastures as a free resource which can exist indefinitely without any form of management. According to Nowers et al. (2013) concepts such as overgrazing, soil erosion, alien species and maintenance of biodiversity have very little emotional appeal among smallholder cattle producers. This confirms Fraser's (1995) statement that grazing resources in smallholder areas are grossly overutilised above their sustainable carrying capacities. The critical implication of this is compromised sustainability of the whole system principally driven by progressive deterioration of the natural pasture (Roy and Chan, 2012). Effects of overgrazing, little ground cover or increased proportion of undesirable, alien plant species, leads to soil erosion, low cattle productivity and ultimately to low cattle offtake which will reduce smallholder household income and exacerbate poverty.

The fact that cattle in the smallholder areas largely rely on natural pastures, whose quality, particularly crude protein content, decline during the dry season leads to losses in animal body weight and condition (Ainslie et al., 2002). This subsequently, results in sub-optimal carcass and meat attributes (Muchenje et al., 2008), which leads to low prices fetched by smallholder cattle producers when they market their animals through formal markets (Musemwa et al., 2010). In addition, the smallholder cattle herd is dominated by nondescript crossbreds between indigenous and imported breeds. These crossbreds have high nutritional requirements (Mapiye et al., 2011), are more susceptible to local diseases and parasites (Marufu et al., 2010; 2011) and could be less heat tolerant than indigenous breeds. Exacerbating these challenges, is the prediction that South Africa will get hotter by up to 3°C over most land areas by 2060 (Davis, 2011). This potentially causes heat stress in livestock, reduction in quality and quantity of natural pastures, failure of fodder crops and changes in disease profiles (Nardone et al., 2010). As believed by many authors, cattle can significantly contribute to sustainable smallholder farmer food security and household income (Mapiye et al.

2010; Nardone et al. 2010). This necessitates the need to assess the sustainability of the smallholder cattle production system to identify shortfalls and suggest possible alternatives.

2.5 Assessment of sustainability of the smallholder cattle production system

The concept of sustainable cattle production system is perceived differently by different stakeholders such as farmers, extension workers, researchers, development workers and policy makers (Heitschmidt et al., 1996). Furthermore, knowledge on assessment methods of the system is little understood by the same stakeholders, in some cases this knowledge is either inadequate or completely absent (Astier et al., 2012). Like in all systems, assessment of sustainability is an indispensable step that advices on design, directives and implementation of alternatives (Lopez-Ridaura, 2005). Sustainability assessments provide benchmarks for decision making (Atanga et al., 2013). Astier et al. (2012) stated that the need of evaluating a system arises when there is comparison of different systems or whenever a research or developmental goal is aimed at designing a sustainable alternative system to replace an existing technology.

To date most sustainability evaluation analyses are done at global, regional or national level often targeting sectors such as agriculture, industry or forestry (Astier et al., 2012). Localised system-based sustainability analysis is often overlooked despite the strong sentiments by Manuel-Navarrete et al. (2006) that it is crucial for bottom-up co-management strategies (Fraser et al., 2006). The authors then recommended robust system-specific sustainability assessments using a participatory approach. Through this approach, the majority of smallholder livestock producers in developing countries whose livelihoods are directly dependant on the resources and services provided by the natural ecosystems would be expected to play a key role in sustainability evaluation. This is opposed to implementing top-down approach where smallholder

livestock producers are either marginalized or completely alienated in sustainability evaluations. Technically, sustainability assessment or evaluation can be achieved by using sustainability indicators, indices or methodological frameworks (Lopez-Ridaura, 2005).

2.5.1 Sustainability indicators

During the early periods of familiarization with the concept of sustainability, short-term rapid assessments were carried out from simple frameworks and long lists of unbundled sustainability indicators (Stockle et al. 1994, Mitchell et al. 1995; UN, 1996). Over the years sustainability assessments have become more sophisticated as stakeholders are facing the challenge of incorporating diverse economic, environmental and social indicators in sustainability assessments (Lopez-Ridaura, 2005). The nature of sustainability indicators used in different studies varies with studies' objectives, characteristics of farming systems and their prevailing environment (Atanga et al., 2013). For example, in the Netherlands, nitrogen and phosphorus surpluses as well as pesticide-related ecological indicators are included in many agricultural systems analyses (Aarts, 2000; Wolfert, 2002; Hart, 2004) while analyses on smallholder agriculture in Sub-Saharan Africa is mainly done using soil organic matter and nutrient balances as ecological sustainability indicators (Samaké, 2004).

As observed by Bossel (2001) the most crucial yet complex stage in sustainability assessments is designing an appropriate set of relevant indicators that allows for quantification of sustainability. When too few indicators are used, some critical aspects of sustainability as well certain trade-offs might escape analysis. Alternatively, using too many indicators raises complications associated with data collection, validation and proper monitoring of some relationships within a system. However, Rasul and Thapa (2004) pointed out that there is no universally accepted standard of designing indicators for sustainability assessment. Fraser et al. (2006) emphasized the

importance of participatory community involvement in sustainability indicators identification. This is in contrast to a situation where development experts and other stakeholders decide the sustainability indicators for the community (Reed et al., 2006). According to Fraser et al. (2006) locally identified sustainability indicators will have the following benefits;

1. They would ensure that identified indicators are relevant and that their measures are locally important;
2. Regular input from the local community will also ensure that indicators change in response to prevailing circumstance changes.

Like in other participatory studies, dissemination of research results would be less complex in cases where communities have been involved. Community involvement is also important for capacity building as it may enhance the capacity of the community to address future problems. The 'bottom-up' technique, supposedly driven by the failure of the 'top-down' technique (Bell and Morse, 2001) has been reported to be successful in a number of case studies but still need to be investigated further (Fraser et al., 2006). However, Atanga et al. (2013) stated that where appropriate sustainability indicators are used, they provide essential direct or indirect information about the system's future viability. Trends in cattle production may also be identified by using sustainability indicators. Additionally, sustainability indicators can indicate where gaps occur in current knowledge and also point out flaws in data collection. Otherwise, ideal sustainability indicators must be those that can be used as early indicators of the system by being highly sensitive to minor stress signals of that system (Atanga et al., 2013).

The key step of indicator selection is essentially critical for providing transparency and credibility to sustainability assessment studies (Lebacq et al., 2013). In addition, well defined, appropriate indicators allow for reproducibility of the study to enhance validation of inferences made from such indicators. According to Lebacq et al. (2013) the selection of appropriate and representative indicators from literature involves, contextualization of the assessment, comparison of indicators found in literature based on accessibility of data and selection of a minimum, consistently sufficient and representative set of indicators.

Contextualization entails clearly defining the objectives of the study and the production system involved (Bockstaller et al., 2008; Binder et al., 2010). The sustainability concept should also be defined during this stage along with all the stakeholders involved and their roles in the study (Lebacq et al. 2013). Other authors suggest additional information on the end users of the information (Bockstaller et al., 2008). During comparison, an inventory of sustainability indicators available in literature is compiled and relevant measurable indicators that provide information of great value to end users of the study are selected. The final stage is putting together a complete, comprehensive set of indicators that closely represent the complex system taking into consideration the interactions between indicators. Table 2.1 presents the different dimensions of sustainability indicators, their measurement units and scoring system that were used by Atanga et al. (2013).

As with any other agricultural systems, the sustainability of a smallholder cattle production system cannot be precisely measured for many reasons including the externalities inherent in every system. As indicated by Atanga et al. (2013); Webster (1999) and Lopez-Ridaura (2005) it is unrealistic to compile a fixed set of standardized, operational sustainability indicators that remain relevant over a certain period of time

because each system is both unique and dynamic. It is therefore, recommended that any set of indicators derived should be time and system specific Webster, 1999).

In each study, sustainability indicators are determined by the differences in the levels of data, information, time and other resources (Lopez-Ridaura, 2005). Sustainability indicators are system, site and time specific and not universal. Thus, no set of indicators, no matter how comprehensive, can be able to precisely describe a system over a period of time, hence, the development of frameworks that will be discussed in the subsequent section. Webster (1999) stated that in most cases measures of sustainability are merely a reflection of the perspectives of the analyst depending on the main objectives of their study. Therefore, research remains constrained by lack of quantifiable and verifiable standardized sustainability indicators that can be used for comparisons of different locations. To overcome these shortcomings, environmental, economic and social dimensions of smallholder cattle production can be integrated into composite sustainability indices.

Table 2.1: Sustainability indicators and the scoring system of the analysis guided by land user's and local researcher's experiences

Dimension	*Indicator*	*Unit of Measurement*	*Scoring System*
Environmental	Water availability	Rainfall ($mm \cdot yr^{-1}$)	0%-30% = non-sustainable;
	Forage shortage	Amount of forage consumed ($kg \cdot household^{-1}$)	30%-60% = conditionally sustainable
	Biodiversity conservation	Number of grazing plant species present	60%-90%+ = sustainable.
	Health impact	Amount of pesticides used ($l\ household^{-1} \cdot yr^{-1}$)	
Economic	Gross farm income	income ($R\ household^{-1} \cdot yr^{-1}$)	0%–30% = non-sustainable;
	Input self sufficiency	Local versus imported input ($R\ household^{-1} \cdot yr^{-1}$)	30%–60% = conditionally sustainable
	Savings & investment	Total income saved & invested ($R.household^{-1} \cdot yr^{-1}$)	60%–90%+ = sustainable.
Social	Gender equality	Male:female ratio in labour force, agricultural extension programs, community farmer cooperatives, land and productive resource control	0%–30% = non-sustainable;
	Income equality	Cumulative % income versus cumulative % of households ($R\ household^{-1} \cdot yr^{-1}$; Gini Index)	30%–60% = conditionally sustainable
	Food distribution	Number of meals consumed$\cdot day^{-1} \cdot household^{-1}$	60%–90%+ = sustainable.
	Type of land tenure	% of land leased % of land privately owned (titled and non-titled) % of land communally owned	

(Source; Atanga et al., 2013)

2.5.2 Sustainability indices

According to Atanga et al. (2013) composite indices were developed to get around the complications of practically and operationally assessing all the individual indicators of the different dimensions of sustainability and their quantification. The composite indices integrate information from a fixed set of sustainability indicators into a single value. This allows for a more robust comparison of systems. Some common indices include the Farmer Sustainability Index (FSI) (Roy and Chan, 2012), Indicator of Sustainable Agriculture Practice (ISAP) (Bell and Morse, 2008) and Agriculture Sustainability Index (ASI) (Ostrom, 2009) among others.

Many of the limitations of using composite indices arise from their reliance on use of sustainability indicators for their computation. For this reasons, all the limitations of using sustainability indicators mentioned above also apply for composite indices. In addition, composite indices are criticised for the discrepancies that arise from the weights allocated to each indicator. It is almost impossible to have a consensus on the appropriate weights allocated to each indicator as the importance of each indicator vary from place to place, system to system and time to time among other factors (Atanga et al., 2013).

2.5.3 Sustainability frameworks

More recently, there have been developments of general sustainability frameworks that are applied to sustainability evaluations in place of varied and isolated indicators and composite indices. According to Lopez-Ridaura (2005) the ideal sustainability evaluation frameworks should provide, in a flexible and participatory manner, the theoretical and practical tools to:

1. Assist stakeholders in identifying the main issues related to sustainability in specific case studies from a robust and interdisciplinary theoretical perspective.

2. Assist stakeholders in the selection and assessment of case-specific indicators to evaluate the limitations and potentials of current practices and alternatives.
3. Assist stakeholders in the integration of the information supplied by the indicators. The information is essential in designing alternatives and the associated decision making and development processes.

A group of Mexican researchers and developmental workers developed a special program adapted for smallholder farmers called MESMIS which is a Spanish acronym for 'Indicator-based Sustainability Assessment Framework' (Astier et al., 2012). The MESMIS program makes use of both measurement-based and process based approaches to sustainability assessment. The MESMIS framework is a five component structure program aimed at localised evaluation of sustainability especially where current systems are being compared to alternatives (Astier et al., 2012). The five component structure of the MESMIS framework is shown in Figure 2.1. The theoretical framework is a cognitive (knowledge) based component that is essential for integration of sustainability indicators into an operational framework. The operational structure is the methodological component of the framework which relies on active participatory approach by the community and an interdisciplinary evaluation team (Astier et al., 2012). The approach should provide information for cyclical sustainability assessment using seven general systemic attributes of productivity, stability, reliability, resilience, adaptability, equity and self-reliance. The cyclical assessment follows step-wise procedures as illustrated in Figure 2.2.

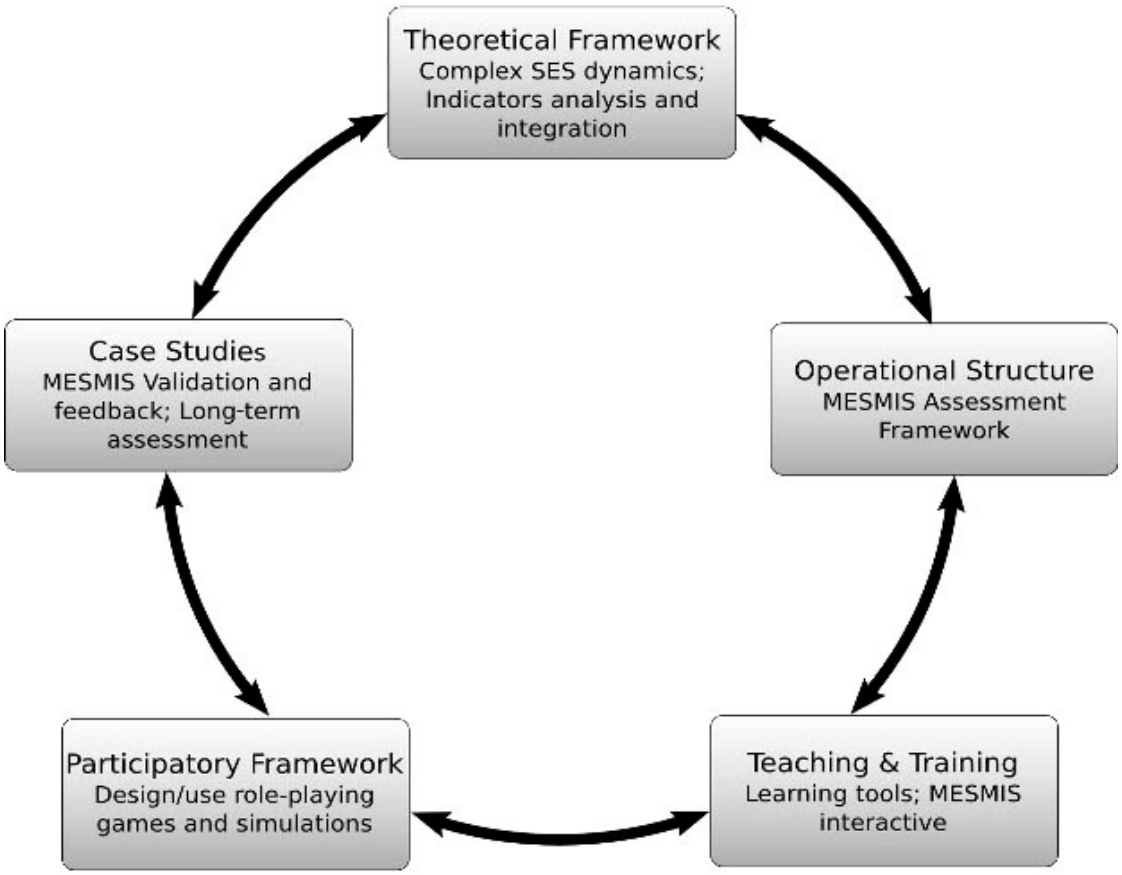


Figure 2.1: The five component structure of the MESMIS program and its interactions (Source: Lopez-Ridaura, 2005)

Teaching and learning forms the pedagogical component of the MESMIS program and involves a simplified but highly graphic and interactive training sessions with all the stakeholders involved. The participatory framework appreciates that the task of reconciling land use among smallholder rural communities is a complex, cumbersome, and challenging one. Ostrom (2009) suggested that this would require a comprehensive and adaptive co-management process with active participation of all stakeholders. Finally case studies are done in different geographical locations to validate and give feedback to the framework. The flexibility of MESMIS is important to allow the application of the framework in different smallholder systems environments. However, the framework lacks strategies for integration of sustainability indicators. This was reiterated by Bell and Morse (2003) who indicated that the pressure-state-

response framework isolates indicators and ignores the inter-relationships among them. Nevertheless, despite the weaknesses of the sustainability assessment methods, they remain essential in disclosing the operational viability of production systems. It is however, important to determine factors that affect the economic, environmental and social integrity of the smallholder cattle production system and make way for holistic appropriate interventions.

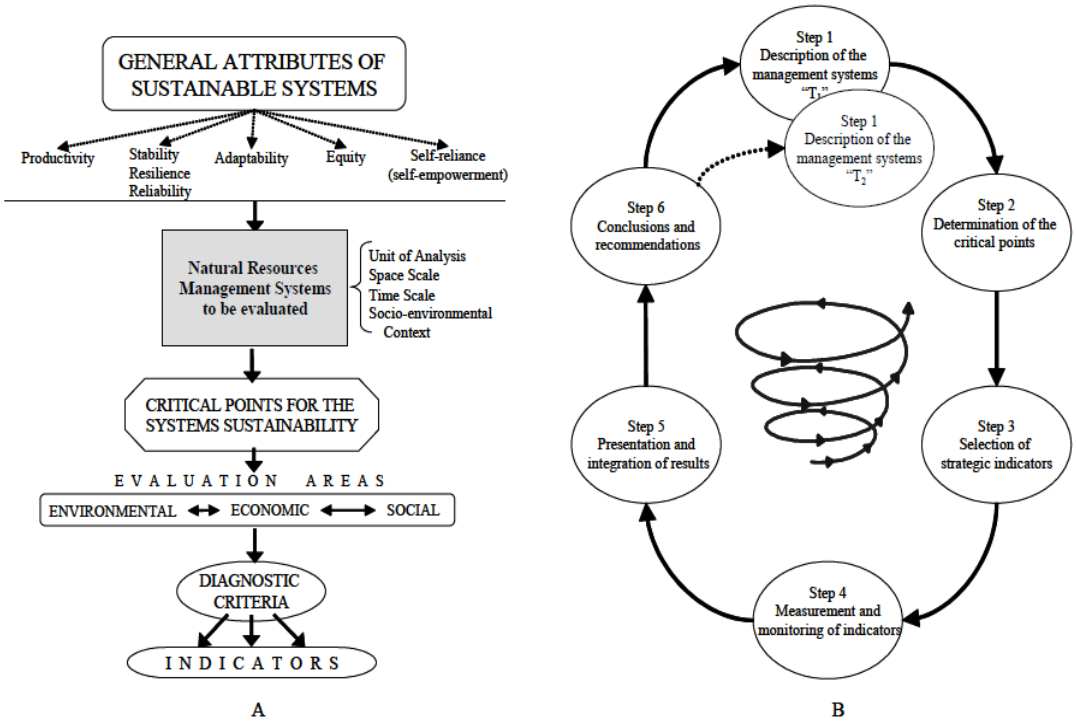


Figure 2.2: The MESMIS operational structure: (A) attributes to indicators and (B) Step-wise cyclical evaluation procedure (Source: Lopez-Ridaura, 2005)

2.6 Factors affecting vertical integration of the smallholder cattle production system into the formal beef market value chain

Many factors affecting vertical integration of the smallholder cattle production will ultimately affect the social, environmental and economic dimensions of sustainability. Some of these factors are discussed in the preceding subsections, although, in some cases multi-effects of one factor may result in overlaps.

2.6.1 Small herd sizes and poor body conditions

One of the major constraints of the smallholder cattle production system is small cattle herd sizes resulting in low numbers of saleable cattle per individual producer (Phiri, 2009). Ticks and tick-borne diseases are one of the greatest limitations to cattle productivity and herd size increases (Mapiye et al., 2009) in cattle raised on natural pasture. Ticks reduce live weight gain (Marufu et al., 2014), fertility (Nowers et al., 2013), meat quality (Muchenje et al., 2008) and are responsible for the bulk cattle mortality in most communal areas (Nowers et al., 2013). These effects lead to low returns realised from cattle, thereby, affecting the economic sustainability of the smallholder cattle production system. Low live weight, poor body conditions and old age of cattle have also been cited as the reasons why smallholder cattle fetch low farm gate prices (Monsthwe et al., 2005). A study carried out by NERPO and IDT (2005) reported that most smallholder cattle producers in the ECP sell cattle that are too old and lean yet they demand high prices for them.

Low cattle numbers for each individual household herd and poor cattle conditions are attributed to fluctuations in quantity and quality of natural pastures resources coupled by poor natural pasture management and climate change (Nardone et al., 2010). Abundant good quality natural pastures are found in the rainy season. The quantity and quality of the natural pasture deteriorates in the dry season, crude protein, in particular, falls below 7% required to meet maintenance requirements for a mature beef animal (NRC, 2000). Poor nutrition negatively influences the animal's body condition prior to sell and product quality (Altman et al., 2009). Low cattle numbers and poor body conditions of cattle partly reflect on the status of the environmental dimension of sustainability. Well managed natural pastures with good soil fertility and high levels of biodiversity have positive effect on cattle body conditions through provision of higher nutrient quality natural pasture. In turn, improved nutrient quality

leads to increased cattle productivity which may ultimately increase the probability of smallholder producers to sell their cattle Bester et al., (2003).

Low cattle production also affect the social dimension of sustainability as social hierachy in smallholder cattle production system depends on the size of the herd owned by a household. According to Randolph et al. (2007) social bonds are also maintained by sharing cattle across household for either traction, transportation or breeding purposes. Studies by Stroebel et al. (2010) also revealed that smallholder households with a larger cattle herd are more food secure than those with less or no cattle. The reason is not limited to the diversification role played by cattle in minimizing risk, providing traction and manure for field crop production (Vandamme et al., 2010) but also the contribution of cattle towards higher household income through cattle sales.

2.6.2 Low market offtake rates

Cattle marketing provide a mechanism by which cattle producers engage with buyers and exchange their cattle for money. Cattle market offtake rate is calculated as the number of cattle sold as a proportion of the total herd per given period of time. According to Ainslie et al. (2002) and Musemwa et al (2010) cattle market offtake rate per annum in the smallholder areas of South Africa is estimated at 2 to 10%. This is very low compared to offtake rates of 20% to 40% reported for the commercial sector (Musemwa et al. 2010). The low cattle market offtake rates in smallholder areas are reflective of the multiple uses of cattle with little emphasis on the role of cattle as a major source of income. Increased cattle productivity may likely increase cattle market offtake rates and has a positive bearing on the economic dimension of sustainability of the smallholder cattle production system. This is realised through higher household income levels which may ultimately lead to household food security. The national

economy may also be enhanced through increased offtake and reductions in beef imports.

Increasing cattle market offtake have the added benefit of taking away pressure from the fast deteriorating natural pastures of most smallholder areas. Heitschmidt et al. (1996), Herrero et al. (2010) and Hoffman (2011) have all reported that communally grazed rangelands are continuously overgrazed leading to deterioration of the rangelands. This presents a common challenge of communal resources management where the benefits of the resources accrue to certain individuals while the consequences of such are borne by every member of that community. However, Nowers et al. (2013) predicted that cattle offtake in smallholder areas is not likely to increase unless there are sound financial, ecological and social interventions by stakeholders to improve animal performance prior to marketing, connect farmers to formal markets and increase profits realised by marketing cattle through formal markets. Monsthwe (2006) also considered the great financial potential inherent in smallholder cattle that will only be realised after dedicated institutional support and comprehensive strategies to improve cattle productivity and market access (Coetzee et al., 2005). Moreover, access to stable and reliable beef markets can provide incentives for increased cattle production.

2.6.3 Inappropriate carcass classification systems in the formal market

Smallholder cattle farmers in South Africa are keen to sell beef to formal markets but the classification system used to value beef carcasses in these markets favours young well-muscled animals. However, most smallholder cattle producers keep their cattle on farm for longer as they use them for other purposes. Marketing of cattle is only considered towards the end of the animal's life when its ability to provide other roles becomes diminished. For this reason it is important to revise the current carcass classification system to also consider preferences of consumers that favour beef from

older animals. A beef market segmentation study previously conducted by Thompson et al. (2010) revealed the existence of consumers that prefer beef from mature natural pasture-fed cattle. It would be prudent to establish a market that caters for these consumer preferences and develop strategies to fully expand it. However, the practice of keeping cattle on the natural pasture until they get old is ecologically unsustainable for two reasons. Firstly, the longer cattle stay on the natural pasture, the greater the pressure exerted on vegetation. Secondly, as an animal gets older, its feed utilization efficiency decreases (Mapiye et al., 2009). Consequently, an older animal consumes more feed for lesser animal tissue gain than a younger animal of the same species.

2.6.4 Few and unreliable marketing channels

Paterson (1997) suggested that a perfect market scenario should prevail for successful marketing of cattle belonging to smallholder farmers. This implies that there should be many buyers and many sellers at a defined market place with a certain level of market organisation. Currently, smallholder cattle producers use cattle marketing channels of their own choice depending on availability of the markets, prevailing market prices, distance to the market and the extent of relationships developed in previous transactions among other reasons. Most smallholder cattle producers including those from the ECP prefer marketing their cattle through informal channels (USAID, 2003; Monsthwe et al., 2005; NERPO, 2005).

The informal or private market is characterized by more localised sales between the farmers themselves or sales to other non-farming individuals from the same or neighbouring communities. It may also refer to sales made to local institutions such as clinics, hospitals, schools and churches. Informal marketing is highly seasonal with no fixed market prices but prices are a result of deliberations and negotiations between the buyer and the seller (Coetzee et al., 2005). For this reason, the prices hardly reflect prevailing formal beef market prices. Rendani (2003) further indicated that the informal

market thrive prior to Christmas and Easter holidays to coincide with the celebration time as urban based family members return home and also being the season when most traditional activities are conducted. A high demand for cattle in the informal market results in a few cattle being sold through the formal marketing channels (USAID, 2003) during the above mentioned celebration festivals.

Speculators or middlemen offer an alternative marketing channel to smallholder cattle. The speculators have prior knowledge that most smallholder cattle producers sell their cattle when a critical need for a relatively large amount of cash arises, for example, to pay school fees, emergency medical expenses or a funeral (Ainslie et al., 2002). They then take advantage of the poor bargaining power of the farmers during this period and buy their cattle at very low prices for resell to formal markets. For this reason, speculators operate in very remote and least accessible areas where marketing infrastructure and marketing institutions do not exist (Musemwa et al., 2007). This marketing channel was described by Musemwa et al. (2010) as open exploitation of smallholder cattle producers but one that is necessitated by poor or lack of appropriate marketing infrastructure in smallholder areas. Monsthwe et al. (2005) confirmed this by stating that in the absence of appropriate marketing infrastructure, smallholder cattle producers resort to alternative marketing channels often at their disadvantage. On the contrary, Fraser (1991) expressed that provision of marketing infrastructural facilities has little influence on market participation as this depends on the farmers' herd size and the roles of cattle in that herd.

Another alternative marketing channel available for smallholder cattle producers is the auction system which operates on a bid and offer basis (Coetzee et al., 2005). Under the auction system the highest bidder become the owner of cattle prior to slaughter. During auctions, cattle are sold on a weight basis. However, the majority of smallholder cattle producers do not fully understand the mode of operation of the auction system.

According to Monsthwe (2006) smallholder cattle producers often choose to ignore the price per kilogram system preferring their expected prices the same way they do in informal sales. Nevertheless, the major drawback of the auction marketing channel is the lack of adequate cattle numbers. This has led to failure of this marketing channel in many smallholder areas in the ECP (NERPO, 2005). Overall, cattle buyers in the smallholder areas have the wrong perception that indigenous cattle are inferior because of their small-frame. On the contrary, a recent study conducted by Muchenje et al. (2008) revealed that indigenous Nguni cattle breeds have the potential to produce high quality and healthy beef in an ethically and environmentally conscious manner.

2.6.5 Inadequate marketing infrastructure

As stated by Bailey et al. (1999) appropriate marketing physical infrastructure that is important includes accessible road networks, transport, holding and loading facilities. In addition a reasonable marketing organization will enable a smooth physical flow of cattle. However, the market infrastructure in most smallholder areas is far from desirable. In communities where these facilities exist, they are often either in deplorable conditions due to poor maintenance (Monsthwe et al., 2005) or completely non-functional (Musemwa et al., 2008). In extreme cases some smallholder areas are located in very remote areas far from major markets where marketing infrastructure do not exist completely (Rendani, 2003).

According to Monsthwe (2005) and Musemwa et al. (2008), apart from providing for a smooth physical flow of cattle at trade, physical and institutional marketing infrastructure also act as an incentive for smallholder cattle producers to participate in formal beef markets. Lack of adequate marketing infrastructure seriously impedes the sale of cattle. A poor road network for example, affects the farmers' ability to attract buyers (NERPO, 2005) because of its association with high transport costs (Musemwa et al., 2010). Marketing infrastructure is also regarded as a positive stride towards

development of smallholder areas. Likewise, lack of marketing infrastructure is generally considered to hinder developmental initiatives in smallholder areas (Monsthwe, 2005). On the contrary, Fidzani (1993) disputes the influence of marketing infrastructure in market participation by smallholder cattle producers and argues that cattle buyers normally provide their loading and transport facilities.

2.6.6 Insufficient marketing information

Information such as prevailing production techniques, market opportunities and consumer demands on type of beef, quality, quantity, prices is essential for cattle producers to make more informed market decisions (Bailey et al., 1999). Similarly, Coetzee et al. (2005) added that access to sufficient relevant marketing information prevent cattle producers' from being exploited by more informed buyers by strengthening their negotiating ability with buyers during transactions. Monsthwe (2006) suggested the role of public market information services as necessary considering that market information is public good. There is also evidence to suggest that provision of sufficient marketing information to smallholder cattle producers helps to create an atmosphere of inclusiveness that increases transparency resulting in improved market participation (Musemwa et al., 2008).

However, market information is seldom timeous and sufficient among smallholder cattle producers because of low literacy levels and inefficient communication systems. More recent progress towards improved communication systems by provision of telephone and cellular services has been observed (Ntsephe, 2011). However, smallholder cattle producers still lack sufficient and timeous marketing information. This is largely because this information is usually communicated in English through other channels like radio/television or the internet which cannot be accessed by the majority of smallholder farmers. Strategies to address some of the constraints

mentioned above are essential for sustainable vertical integration of the smallholder cattle production system into the formal market.

2.7 Strategies to improve sustainability of smallholder cattle production

According to Musemwa et al. (2007) an inter-disciplinary integrated approach aimed at understanding the dynamic development of smallholder farmers' livelihoods in a complex community system is required to develop relevant and efficient strategies for improving the sustainability of cattle production system in the smallholder sector.

2.7.1 Disease and parasites control

Smallholder cattle production is greatly restricted by diseases and parasites, particularly, ticks and gastro-intestinal nematodes (Marufu et al., 2014; Assefa, 2015). According to Coetzee et al. (2005) the presence of diseases or parasites is one of the major reasons for discarded carcasses at abattoirs in the Eastern Cape Province. Disease and parasite control is progressively compounded by the rapid parasite resistance to drugs and other anthelmintics (benzimidazoles, imidothiazoles and macrocyclic lactones (Waller, 2006). Reports of super-resistant human microbial pathogens due to the use of antibiotics in livestock production systems exist in literature (Donald, 1994). Complete reliance on drugs and other anthelmintics is therefore, unsustainable. More sustainable disease and parasite control strategies such as, providing adequate feeding, use of breeds adapted to local diseases and parasites, appropriate grazing management strategies and other biological control methods need to be incorporated into integrated disease and parasite control programs. A study by Niezen et al. (1993) revealed that use of feeds rich in tannins or other phenolic compounds reduces parasitic loads in ruminants. This is achieved through reducing worm fertility, eliminating adult worms and retarding the establishment of ingested worm larvae (Waller and Thramsborg, 2004).

These chemical-free strategies are consistent with recent consumer demands for beef and beef products from cattle raised free from agro-chemicals (Atanga et al., 2013). This arises from consumers becoming more aware of the effects of agro-chemicals on human health and the environment.

2.7.2 Supplementary feeding

To overcome problems of feed shortage and increase smallholder livestock farmers' access and capacity to expand existing market or enter new markets can be achieved by finishing animals with low-cost locally available natural pasture-based (i.e., natural pasture hay and indigenous browse tree legume leaf-meals) diets prior to marketing (Mapiye et al., 2008). This can cost-effectively improve animal weights and body condition (Mapiye et al., 2011), reduce age at slaughter and consequently, increase volume and quality of the marketable animals from the smallholder areas. Several studies have shown that ruminant animals fed natural pasture-based diets produce high quality and healthy meat (Muchenje et al., 2008; Mapiye et al., 2011).

2.7.3 Group marketing

Altman (2009) reported that individual smallholder cattle producers do not have sufficient animal numbers to meet the supply requirements for large high value formal markets.This is often the reason for low market participation by smallholder cattle producers. While, this may be compounded by the multi-functionality role of cattle under the smallholder cattle production sector, the problem stems from the general low productivity of cattle in this sector. These challenges can be overcome by organizing smallholder cattle producers into marketing groups. Marketing groups are considered an important strategy with great potential to encourage smallholder farmers to participate in formal cattle markets. This was adopted from other commodity farmers, such as the vegetable farmers, where the strategy has been extremely successful (David et al., 2005). The benefits of group marketing include, lower transaction costs,

increased access to relevant marketing information leading to enhanced bargaining power. Furthermore, by integrating into groups, smallholder cattle producers can potentially achieve greater economies of scale in accessing relevant services such as, transport, information, and infrastructure (Musemwa et al., 2007). In South Africa, group cattle marketing is the major focus of many organisations that work with smallholder cattle producers.

2.7.4 Forward contracts

Contract farming involves beef cattle production being carried out on the basis of an agreement between the buyer and producers. It involves the buyer specifying the quantity and quality of animals required at a particular price, with the producer agreeing to deliver animals at a future date. Connecting the organized marketing groups to local formal markets by establishing pre-slaughter agreements (forward contracting) with buyers will reduce marketing costs for the farmers, increase their bargaining power and allow them to enjoy economies of scale. Pre-slaughter agreements will not only allow producers to sell many animals, but will also guarantee favourable prices, reduce risks of price fluctuations and guarantee continuity of beef supply for local consumers. Studies designed to link up farmers to formal markets using forward contracts are rare in South Africa.

2.7.5 Market segmentation

Market segmentation involves subdividing a large market into clearly defined subsets of consumers with similar demand characteristics (Thompson et al. 2010). The main objective of market segmentation is to be able to design and implement strategies that target the segmented consumers. In the context of this study it would be important to identify a subset of consumers who prefer beef from extensively raised cattle fed on

natural pasture feed resources. Market segmentation studies for the beef industry are very few in South Africa. One such market segmentation research conducted by Thompson et al. (2010) characterized different groups of beef consumers. The authors confirmed the existence of a segment of beef consumers who prefer beef from slightly older animals finished on natural pastures.

2.7.6 Beef branding

Giving particular beef products a brand name is a way of indicating unique quality characteristics of the beef to consumers. Froehlich et al. (2009) described it as signalling unique characteristics that separates it from other generic beef products. Of late, beef brand names are more than just ownership labels as in the past. Current beef brand names are designed to stand out to consumers and indicate instantly what aspects of the brand are unique and to what benefit is the beef brand to consumers. Ideally beef brands are targeted for a specific segmented subset of consumers where they capitalize on their demand for specific attributes of beef. Some common beef attributes used to build brands includes; natural/grass-fed beef, organic, free from (undesirable attributes), lean, tenderness, presence of omega-3-fatty acids, cattle breed, origin of beef among others. The certified Angus beef brand is an example of a beef marketed in South Africa. Recent studies by Muchenje et al. 2008) and Mapiye et al. (2011) have revealed that, Nguni cattle entirely raised on natural pasture feed resources can produce high quality and healthy beef ethically with limited use of external chemicals, acaricides, growth promotants and synthetic feeds. This presents an opportunity to develop breed-specific and/or production system-based brands for such beef. In South Africa there are currently a few if any studies related to development of production system-based beef brands.

2.8 Summary

Smallholder cattle production currently plays an important role towards achieving food, economic, ecological and social security among smallholder households in South Africa. For a long time, economic sustainability in particular has had major limitations including low productivity and low offtake among others. These can be overcome by supplementary feeding to improve cattle condition prior to slaughter, group marketing, forward contracting, market segmentation and beef branding among other strategies. It is, therefore, important that the sustainability of smallholder cattle production systems be prioritized to ensure the existence of resources for future generations of cattle producers. Sustainability evaluations of the system are essential to point out the shortfalls of some aspects of the smallholder cattle production practices.

References:

Aarts, H.F.M. (2000). Resource management in a 'De Marke' dairy farming system. Ph. D. Thesis, Wageningen University. The Netherlands. 222 pp.

Ainslie, A., Kepe, T., Ntsebeza, L., Ntshona, Z., & Turner, S. (2002). Cattle ownership and production in the communal areas of the Eastern Cape, South Africa. Research Report no. 10. University of the Western Cape.

Altman, M. Hart, T. and Jacobs, P. (2009). Household food security status in South Africa. *Agrekon*, **48**(4): *345-361*.

Assefa, F. (2015). The role of plant phenolic compounds in controlling parasitic nematodes of small ruminants. *Global Journal of Poultry Farming and Vaccination*, **3**(1): *134-139*.

Astier, M., García-Barrios, L., Galván-Miyoshi, Y., González-Esquivel, C.E. & Masera. O.R. (2012). Assessing the sustainability of small farmer natural resource management systems. A critical analysis of the MESMIS program (1995-2010). *Ecology and Society* **17**(3): *25*. Accessed on 18 February 2015 at http://dx.doi.org/10.5751/ES-04910-170325.

Atanga, N.L., Treydte, A.C., & Birner, R. (2013). Assessing the Sustainability of Different Small-Scale Livestock Production Systems in the Afar Region, Ethiopia. *Land*, **2**: *726-755.*

Bailey, D., Barrett, C.B., Little, P.D. & Chabari, F. (1999). Livestock markets and risk management among East African pastoralists: A review and research agenda. Unpublished research report, Utah University. USA.

Bell, S and Morse, S. (2001). Breaking through the glass ceiling: who really cares about sustainability indicators? Local Environ 6(3):291–309.

Bell, S. (2003). Morse, S. *Measuring Sustainability: Learning from Doing*; Earthscan Publications: London, UK. *3–48*.

Bell, S. and Morse, S. (2008). Sustainability indicators. Measuring the incommensurable. London, Earthscan.

Bester, J., Matjuda, I.E., Rust, J.M & Fourie, H.J. (2003). The Nguni: case study. In: FAO Community-based management of animal genetic resources. Rome: UNDP, GTZ, CTA, FAO: *45-68*.

Binder, C.R., Feola, G. & Steinberger, J.K. (2010). Considering the normative, systemic and procedural dimensions in indicator-based sustainability assessments in agriculture. *Environmental Impact Assessment Review*, **30**: *71–81.*

Bockstaller, C., Turpin, L., Stapleton, N., Van der Heide, M., Therond, O., Pinto-Corrcia, T., Voltr, V., Raley, M., Bezlepkina, I., Bousset, J.P., Alkan Olsson, J. & Ewert, F. (2009). A structured set of indicators for integrated assessment of future agri-environmental policies. *Agronomy for Sustainable Development*, **28:** *139-149*.

Bossel H (2001) Assessing viability and sustainability: A systems based approach for deriving comprehensive indicator sets. *Conservation Ecology*, **5**(2):*12*.

Bosshard, A. (2000). A methodology and terminology of sustainability assessment and its perspectives for rural planning. *Agriculture, Ecosystems and Environment,* **77**: *29-41*.

Calcaterra, E. (2013). Defining Smallholders Suggestions for a RSB smallholder definitions. Aidenvironment.

Chambers, R, & Conway, G. (1991). Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Accessed on April 13 2015 at http://www.smallstock.info/reference/IDS/dp296.pdf

Chambers, R. & Conway, G.R. (1991). Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Institute of Development Studies DP 296, 1991. University of Sussex: Brighton

Chaudhry, A.S. (2008). Forage based animal production systems and sustainability, an invited keynote. *Revista Brasileira De Zootecnia*. **37**: *78-84*.

Chimonyo M, Kusina NT, Hamudikuwanda H, Nyoni O, Ncube I (2000). Effects of dietary supplementation and work stress on ovarian activity in non-lactating Mashona cows in a smallholder farming area of Zimbabwe. Anim. Sci. **70** (2): *317-323*.

Coetzee, L., Montshwe, B.D. & Jooste, A. (2005). The marketing of livestock on communal lands in the Eastern Cape Province: Contraints, Challenges and Implications for the extension services. *South African Journal of Agricultural Extention*, **34**(1): *81-103*.

CSIR (2004). Eastern Cape Province State of the environment report. Division of water, environment & forestry technology. Durban, South Africa. Accessed on 14 December 2015 at http://www.environment.gov.za/soer/ecpae/download_report.html

Davis, C.L, (2011). Climate Risk and Vulnerability: A Handbook for Southern Africa. Council for Scientific and Industrial Research, Pretoria, South Africa, 92pp. ISBN: 978-0-620-50627-4.

Department of Agriculture Fisheries & Forestry (DAFF) (2012). Accessed on 15 November, 2014 at .http://www.nda.agric.za/docs/AMCP/Beef2012-13.pdf

Devendra, C. (2010). Small farms in Asia. Revitalising Agricultural Production, Food Security and Rural Prosperity. Academy of Sciences Malaysia, Kuala Lumpur, Malaysia.

Donald, A.D. (1994). Parasites, production and sustainable development. *Veterinary Parasitology*, **54**: *27–47*.

Dumanski, J., Smyth, A.J., Spendjian, G., Swift, M.J. & Thornton, P.K. (1993). FESLM: An International Framework for Evaluating Sustainable Land Management. In *World Soil Resources Report 73*; Food and Agriculture Organization of the United Nations: Rome, Italy; pp. *6–37*.

FAO. (2009). State of Food and Agriculture (SOFA). *Livestock in the balance*. FAO, Rome, Italy.

Fidzani, N.H. (1993). Understanding cattle offtake rates in Botswana. PhD dissertation. Boston University, Boston. USA.

Fraser, E.D.G., Dougill, A.J., Mabee, W.E., Reeda, M. & McAlpine, P. (2006). Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management*, **78**; *114–127*.

Fraser, G.C.G. (1991). Agricultural Marketing in Less Developed Countries with special reference to Ciskei. Unpublished PhD Thesis, University of Stellenbosch.

Freeman, A., Kaitibie, S., Moyo, S. & Perry, B. (2007). Livestock, livelihoods and vulnerability in selected SADC countries (Lesotho, Malawi and Zambia). ILRI Research Report 8. ILRI, Nairobi, Kenya.

Froehlich, E.J., Carlberg, J.G. & Ward, C.E. (2009). Willingness-to-Pay for Fresh Brand Name Beef *Canadian Journal of Agricultural Economics* ***57****:119–137.*

Gibona, A., Sibbaldb, A.R., Flamanta, J.C., Lhostec, P., Revillad, R., Rubinoe, R. & Sørensen, J.T. (1999). Livestock farming systems research in Europe and its potential contribution for managing towards sustainability in livestock farming. *Livestock Production Science*, ***61***: *121–137.*

Hart, M. (2004). Sustainable measures. Accessed 15 December 2015 at http://www.sustainablemeasures.com

Heitschmidt, R.K., Short, R.E & Grings, E.E. (1996). Ecosystems, sustainability, and animal agriculture. *Journal of Animal Science*, **74**:*1395-1405*.

Herrero, M., Thornton, P.K., Gerber, P., van der Zijpp, A., van de Steeg, J., Notenbaert, A.M., Lecomte, P. & Grace, D. (2010). The way forward on livestock and the environment. In: Swanepoel, F.J.C., Stroebel, A. & Moyo, S. (Eds) *The role of livestock in developing communities: Enhancing multifunctionality*. CTA, Wageningen, The Netherlands.

Hoddinott, J. (2006). Shocks and their consequences across and within households in rural Zimbabwe. *Journal of Developmental Studies,* **42**:*301–321*.

Hoffman, D., Riethmuller, P. & Steane, D. (2003). Some issues associated with the livestock industries of the developing countries of Asia: Opening Pandora's Box. J. Food Agric. Environ. **1**(3&4): *148–154*.

Hoffman, I. (2011). Livestock biodiversity and sustainability. *Livestock science*, special issue **139**: *69 – 79*.

Karakok, S.G. (2007). Small scale cattle farmers and their sustainability in lowland villages of Adana province, Turkey. *Livestock Research for Rural Development.* **19**(6): Accessed on April 13 2015 at http://www.lrrd.org/lrrd19/6/kara19087.htm

Kirsten, J. F. & Van Zyl, J. (1998). Defining small-scale farmers in the South African context. *Agrekon,* **37**(4): *560-571*.

Kitalyi, A., Mtenga, L., Morton, J., Mcleod, A., Thornton, P., Dorward, A., Saadullah, M. (2005). Why keep livestock if you are poor?, in: Owen, E., Kitalyi, A.,

Jayasuriya, N., Smith, T. (Eds.), *Livestock and Wealth Creation*. Nottingham University Press, Nottingham, UK.

Lahiff, E. & Cousins, B. (2005). Smallholder Agriculture and Land Reform in South Africa. *Institute of Development Studies (IDS) Bulletin*, **36**(2): *127-128*.

Lebacq, T., Baret, P.V. & Stilmant, D. (2013). Sustainability indicators for livestock farming. A review. *Agronomy for Sustainable Development*, **33**(2): *311-327*.

López Ridaura, S., (2005). Multi-Scale Sustainability Evaluation: A framework for the derivation and quantification of indicators for natural resource management systems. Ph. D. Thesis, Wageningen University.

López-Ridaura, S., O. Masera, and M. Astier. (2002). Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecological Indicators* **2**:*135-148* Accessed on 28 January 2015, from, http://dx.doi.org/10.1016/S1470-160X(02)00043-2

Lundy, M., Becx, G., Zamierowski, N., Amrein, A., Hurtado, J.J., Mosquera, E.E. & Rodríguez, F. (2012). Link methodology: A participatory guide to business models that link smallholders to markets. CIAT Publication No. 380. Cali, Colombia: International Center for Tropical Agriculture (CIAT).

Manuel-Navarrete, D., Slocombe, S., Mitchell, B., 2006. Science for place-based socioecological management: lessons from the Maya forest (Chiapas and Petén). *Ecology and Society*, **11**: 8.

Mapiye, C., Chimonyo, M., Dzama, K., Hugo, A., Strydom, P.E. & Muchenje, V. (2011). Fatty acid composition of beef from Nguni steers supplemented with Acacia karroo leafmeal. Journal of Food Composition and Analysis, **24**(4-5):*523-528*.

Mapiye, C., Chimonyo, M., Dzama, K., Strydom, P.E. & Muchenje, V. (2010). Meat quality attributes of Nguni steers supplemented with Acacia karroo leaf-meal. Meat Science, **8**(4): *621-627*.

Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. & Mapekula, M. (2009). Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. Livestock Science **124**: *196-204*.

Marufu, C. M., Dzama, K., & Chimonyo, M. (2014). Cellular responses to Rhipicephalus microplus infestations in pre-sensitised cattle with differing phenotypes of infestation. Experimental and Applied Acarology, **62:** *241-252*.

Marufu, C. M., Qokweni, L., Chimonyo, M., & Dzama, K. (2011). Relationships between tick counts and coat characteristics in Nguni and Bonsmara cattle reared on semiarid rangelands in South Africa. Ticks and Tick-Borne Diseases, **2:** *172-177*.

McDermott, J.J., Staal, S.J., Freeman, H.A., Herrero, M & Van de Steeg, J.A. (2010). Sustaining intensification of smallholder livestock systems in the tropics. Livestock science, doi: 10.1016/j.livsc.2010.02.014.

Mitchell, G., May, A. & McDonald. A. (1995). PICABUE: a methodological framework for the development of indicators of sustainable development. *International Journal of Sustainable Development & World Ecology* **2**: 104-123. Accessed on 14 January 2015 at http://dx.doi.org/10.1080/13504509509469893

Montshwe, B.D., (2006). Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa. MSc thesis. University of the Free State, Bloemfontein.

Montshwe, B.D., Jooste, A. & Alemu, Z.G. (2005). An econometric analysis of the determinants of market participation within the South African Small-scale Cattle Sub-sector. *A paper presented at the 42nd annual conference of the Agricultural Economics Association of South Africa*, Lord Charles hotel, Somerset West. 21–23 September 2004.

Muchenje, V., Dzama, K., Chimonyo, M., Raats, J.G. & Strydom, P.E. (2008). Meat quality of Nguni, Bosmara and Aberdeen Angus steers raised on natural pasture in the Eastern Cape, South Africa. Meat Science, **79**: *20-28*.

Musemwa, L. Mushunje, A. Chimonyo, M. Fraser, G. Mapiye C. & V. Muchenje (2008). Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. African Journal of Agricultural Research, **3**(4): *239-245.*

Musemwa, L., Chagwiza, C., Sikuka*, W., Fraser, G., Chimonyo, M. & Mzileni, N. (2007). Analysis of cattle marketing channels used by small scale farmers in the Eastern Cape Province, South Africa. *Livestock Research for Rural Development*, **19**(9). Accessed on 28 September 2014 on http://www.lrrd.org/lrrd19/9/muse19131.htm

Musemwa, L., Mushunje, A., Chimonyo, M., & Mapiye C. (2010). Low cattle market offtake rates in communal production systems of South Africa: Causes and migration strategies. Journal of Sustainable Development in Africa, **12**: *209-226*.

Murphy, S.P. & Allen, L.H. (2003). Nutritional importance of animal source foods. *Journal of Nutrition*, **133**(11): *39325–39355*.

Nagayates, O. (2005) Small farms: Current status and key trends, Information Brief, Prepared for the Future of Small Farms, Research Workshop, Wye College.

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M.S. & Bernabucci, U (2010). Effects of climate change on animal production and sustainability of livestock systems. Livestock Science 130, 57-69.

National Department of Agriculture (NDA). (2006). Crops and Markets. Directorate Agricultural Information Services, Pretoria. Accessed on 27 March 2015, at www.nda.agric.za/docs/cropestimates/definition%20comm%20and%20subsistence.apro6.doc

National Research Council (NRC) (2000). Nutrient requirements of beef cattle. 7th edition, National Academies Press, Washington D.C.

NERPO & IDT (2005). An assessment of production and marketing of cattle from rural livestock owners in Nyandeni and Port St Johns Local Municipalities. A study commissioned by IDT. Eastern Cape Province.

NERPO (2005). Emerging red meat industry analysis in South Africa. A study commissioned by the Department of Agriculture. Pretoria

Ngxetwane, V. (2011). Integrated crop-livestock farming system for sustainable Economic empowerment of small-scale and emerging Farmers in the former homeland of the Eastern Cape Province of South Africa: Case study of Ciskei area in Nkonkobe municipality. Unpublished MSc Thesis, University of Fort Hare, South Africa.

Niezen, J.H., Waghorn, T.S., Waghorn, G.C. & Charleston, W.A.G. (1993). Internal parasites and lamb production - a role for plants containing condensed tannins? *Meat Production and Processing New Zealand Society of Animal Production*, **53**: *235– 238*.

Nowers, C.B., Nobumba, L.M. & Welgemoed, J. (2013). Reproduction and production potential of communal cattle on sour rangeland in the Eastern Cape Province, *South African Applied Animal Husbandry & Rural Development*, **6**: *48-54:* Accessed on 16 November 2014 at http://www.sasas.co.za/aahrd

Oettle, N., Fakir, S., Wentzel, W., Giddings, S. & Whiteside, M. (1998). Encouraging Sustainable Smallholder Agriculture in South Africa. Environment and Development Consultancy Ltd, Hillside.

Ostrom, E. (2009). A general framework for analysing sustainability of social-ecological systems. *Science* **325**: *419-422*. Accessed on 26 January 2015 at http://dx.doi.org/10.1126/science.1172133

Ouma, E.A., Obare, G.A. & Staal, S.J. (2003). Cattle as assets: Assessment of non-market benefits from cattle in smallholder Kenyan crop-livestock systems. Paper presented at the International Conference of Agricultural Economists.

Palmer, T. & Ainslie, A. (2006). Country pasture/forage resource profiles: South Africa. Department of Agriculture, Republic of South Africa.

Paterson, A.G. (1997). Farm support services in South Africa. Unpublished report, Development Bank of Southern Africa, Midrand.

Randolph, T.F., Schelling, E., Grace, D., Nicholson, C.F., Leroy, J. L., Cole, D.C., Demment, M.W., Omore, A., Zinsstag, J. & Ruel, M. (2007). Invited Review: Role of livestock in human nutrition and health for poverty reduction in developing countries. *Journal of Animal Science*: *2788-2800*

Rasul, G. & Thapa, G.B. (2004). Sustainability of ecological and conventional agricultural systems in Bangladesh: an assessment based on environmental, economic and social perspectives. *Agricultural Systems,* **79**(3): *327–351*.

Reed, M.S., Fraser, E.D.G. & Dougill, A.J. (2006). An adaptive learning process for developing and applying sustainability indicators with local communities. *Ecological Economics,* **59**(4): *406–418*.

Rendani, R. (2003). An economic assessment of the value of cattle to the rural communities in the former Venda region. *Development Southern Africa* **20**(1): *89-103*.

Rivington, M., Matthews, K.B., Bellocchi, G., Buchan, K., Stöckle, C.O. & Donatelli, M., (2007). An integrated assessment approach to conduct analyses of climate change impacts on whole-farm systems. Environmental Modelling & Software **22**: *202-210*.

Roy, R. & Chan, W.N. (2012). An assessment of agricultural sustainability indicators in Bangladesh: review and synthesis. *Environmentalist,* **32**: *99–110*.

Scholtz, M.M., Bester, J., Mamabolo, J.M., & Ramsay, K.A. (2008). Results of the national cattle survey undertaken in South Africa, with emphasis on beef. *Applied Animal Husbandry and Rural Development*, **1**: *1-9*. Accessed on 18 December 2014 at www.sasas.co.za/aahrd/

Smith, C.S. & McDonald, G.T. (1998). Assessing the sustainability of agriculture at the planning stage. *Journal of Environmental Management*, **52**: *15–37.*

Steinfeld, H., Wassenaar T. & Jutzi, S. (2006). Livestock production systems in developing countries: Drivers, status, trends. Rev.Sci.Tech.Off.Int. Epiz. **25**(2): *505–516*. FAO.

Stockle, C.O., Papendick, R.I., Saxton, K.E., Campbell, G.S. & van Evert. F.K. (1994). A framework for evaluating the sustainability of agricultural production systems. *American Journal of Alternative Agriculture* **9**: *45-50*. Accessed on 14 January 2015 at http://dx.doi.org/10.1017/S0889189300005555.

Stroebel, A., Swanepoel, F.J.C. & Pell, A.N. (2010). Sustainable smallholder livestock systems: A case study of Limpopo Province, South Africa. *Livestock Science*, 139: *186-190*.

Thompson, J., Polkinghorne, R., Gee, A., Motiang, D., Strydom, P., Mashau, M., Ng'ambi, J., deKock R. & Burrow, H. (2010). Beef palatability in the Republic of South Africa: implications for niche-marketing strategies. ACIAR report.

Thornton, P.K., Boone, R.B., Galvin, K.A., Burnsilver, S.B., Waithaka, M.M., Kuyiah, J., Karanja, S., Gonzalez-Estrada, E. & Herrero, M. (2007). Coping strategies in livestock-dependent households in East and southern Africa: A synthesis of four case studies. *Human Ecology*, **35**: *461-476*.

Truppe, A. (2000). Cultivating diversity: agro-biodiversity and food security. *International affairs*, **76** (2): *265 – 281*.

United Nations (UN). (1996). *United Nations, indicators of sustainable development framework and methodologies.* United Nations Sales Publication No. E.96.II.A.16. New York, New York, USA.

Van der Zijpp, A., Wilke, P., Carson, S. (2010). Sustainable livestock intensification. In: The role of livestock in developing communities: Enhancing multifunctionality edited by Swanepoel ,F.J.C., Stroebel,A. and Moyo, S. Wageningen, The Netherlands: CTA,. 123.

Van Eenenaam, A.L. (2013). Sustainable Animal Agriculture. CAB International. London. UK. *53 – 66*.

Vandamme, M., D'Haese, M., Speelman, S. & D'Haese, L. (2010). Livestock against risk and vulnerability: Multifunctionality of livestock keeping in Burundi. In: Swanepoel, F.J.C., Stroebel, A. & Moyo, S. (Eds). The role of livestock in developing communities: Enhancing multifunctionality. CTA, Wageningen, The Netherlands.

Vavra, M. (1996). Sustainability of animal production systems: an ecological perspective. *Journal of Animal Science,* **74**: *1418-1423*. Accessed on 19 November 2014 at http://www.journalofanimalscience.org/content/74/6/1418

Waller, P.J. (2006). Sustainable nematode parasite control strategies for ruminant livestock by grazing management and biological control. *Animal Feed Science and Technology*, **126**: *277-289*.

Waller, P.J. and Thramsborg, S.M. (2004). Nematode control in 'green' ruminant production systems. *Trends in Parasitology*, **20** (10): *493- 497*.

Waters-Beyer, A. & Letty, B. (2010). Promoting gender equality and empowering woman through livestock. In: Swanepoel, F.J.C., Stroebel, A. & Moyo, S. (Eds) *The role of livestock in developing communities: Enhancing multifunctionality*. CTA, Wageningen, The Netherlands.

Webster, P. (1999). The challenge of sustainability at the farm level: Presidential address. *Journal of Agricultural Economics*, **50**; *371–387*.

Wilson, T., A. Pearson, N. Bradbear, A. Jayasuriya, H. Laswai, L. Mtenga, S. Richards, & R. Smith. (2005). Livestock products: Valuable and more valuable. Pages *109–126* in Livestock and Wealth Creation: Improving the Husbandry of Animals Kept by Resource-Poor People in Developing Countries. E. A. Owen, A. Kitalyi, N. Jayasuriya, and T. Smith. ed. Nottingham Univ. Press, Nottingham, UK.

Wolfert, J. (2002). Sustainable agriculture: How to make it work? A modeling approach to support management of a mixed ecological farm. Ph.D. Thesis, Wageningen University, The Netherlands. 278 pp.

World Bank (2008). World Development Report 2008. The World Bank, Washington, D.C., USA.

World Bank (2014). World Development Report 2014. The World Bank, Washington, D.C., USA.

World Commission on Environment and Development (WCED). (1987). Our Common Future (Bruntland Report), Oxford University Press. 398 pp.

CHAPTER 3: Indicator-based sustainability assessment of the smallholder cattle production system in South Africa

Abstract

Ninety-five farmers were involved in deriving a set of social, environmental and economic sustainability indicators which were used to assess sustainability of the smallholder cattle production system in Ncorha and Gxwalibomvu communities in the Eastern Cape, South Africa. The derived indicators were scored on a five-point Likert-type scale and aggregated to provide a score for each of the three dimensions of sustainability and the net sustainability score. Aggregated sustainability scores were grouped into three categories; non-sustainable (<33%), conditionally sustainable (33-65%) and sustainable (>65%). Most respondents indicated good to excellent operational levels for social indicators including access to information (67%) and gender balance (66%). For environmental sustainability, respondents indicated very good to excellent operational levels for air quality (100%) and chemical use (85%). Most respondents received less than R1000/mo, with social grants (53%) dominating the economic indicators. Cattle, however, had the highest income levels, with 15% of the respondents receiving more than R3000/mo. Aggregate sustainability scores revealed that cattle production systems in Ncorha and Gxwalibomvu, respectively, were socially (48.2% and 56.6%) and environmentally (54.2% and 57%) conditionally sustainable but economically (15.7% and 10.8%) non-sustainable. Overall, cattle production systems in Ncorha (39.4%) and Gxwalibomvu (41.5%) were conditionally sustainable.

Keywords: sustainability; indicator-based; smallholder cattle production

3.1 Introduction

Intensive cattle production system is widely condemned for its negative influence on the health and social well-being of communities as well as progressive detrimental effects on the environment (Pretty et al. 2011). Environmental damage is partly due to

extensive use of synthetic chemicals which also escalates production costs leading to diminished farm profit margins (Boogaard et al. 2011). Collectively, the negative impacts on the social, environmental and economic scopes render intensive cattle production system overall unsustainable and tend to favour extensive cattle production systems (Astier et al. 2012; Stoorvogel et al. 2004). In addition, a small but gradually increasing proportion of affluent South African beef consumers have been reported to prefer healthier and ethically produced beef produced entirely from natural pastures (Vimiso et al. 2008; Taljaard et al. 2006). This tends to favour extensive cattle production systems which, in South Africa, are mainly managed by smallholder cattle producers. The main challenge in developing countries is to ensure that extensive cattle production in general and smallholder cattle production, in particular, sustainably produce adequate beef and other cattle products to meet the consumer demand. However, there are no studies that have evaluated the sustainability of the smallholder beef cattle production system in South Africa to ensure continuous supply of cattle products.

Sustainability assessments indicate gaps in production systems and inform appropriate interventions (Boogaard et al. 2011). As stated by Astier et al. (2012) sustainability assessment is an indispensable step that advices on design, directives and implementation of alternatives. Several assessment methods and sustainability indicators have been developed or highlighted by different researchers (Lopez-Ridaura et al. 2005; Gomez-Limon & Sanchez-Fernandez, 2010; Atanga et al. 2013). Unfortunately, numerous sustainability assessment methods and indicators have resulted in widespread confusion. For instance, selecting an appropriate sustainability assessment method and a corresponding set of indicators is a major challenge that confronts researchers willing to scientifically assess the sustainability of a particular production system. Lebacq et al. (2013) stressed the importance of the indicator

selection stage as it influences the quality of assessment and conclusions derived from indicator-based sustainability assessments.

The need to reduce the complexity of too many sustainability indicators suggested for the triple dimensions of environmental, economic and social sustainability necessitated the development of composite indices (Gomez-Limon and Sanchez-Fernandez, 2010; Sydorovych and Wossink, 2008). These authors specified the role of composite indices as providing a summary of information provided by base indicators as well as providing a single index that indicates the level of sustainability. The current study seeks to develop and use local indicators to assess sustainability of the existing beef cattle production system in the communal areas of the Eastern Cape Province (ECP) of South Africa.

3.2 Materials and methods

3.2.1 Site description

The study was conducted in Ncorha and Gxwalibomvu rural communities in Intsika Yethu local municipality of the Chris Hani District Municipality in the ECP. Figure 3.1 below shows a map with the location of the ECP and the two surveyed communities. Overall, the ECP has an arid to semi-arid climate. The province is considered the country's premier livestock region. It is also popular for being the province where communal farming is practised at the largest scale in the country (ECDC, 2012).

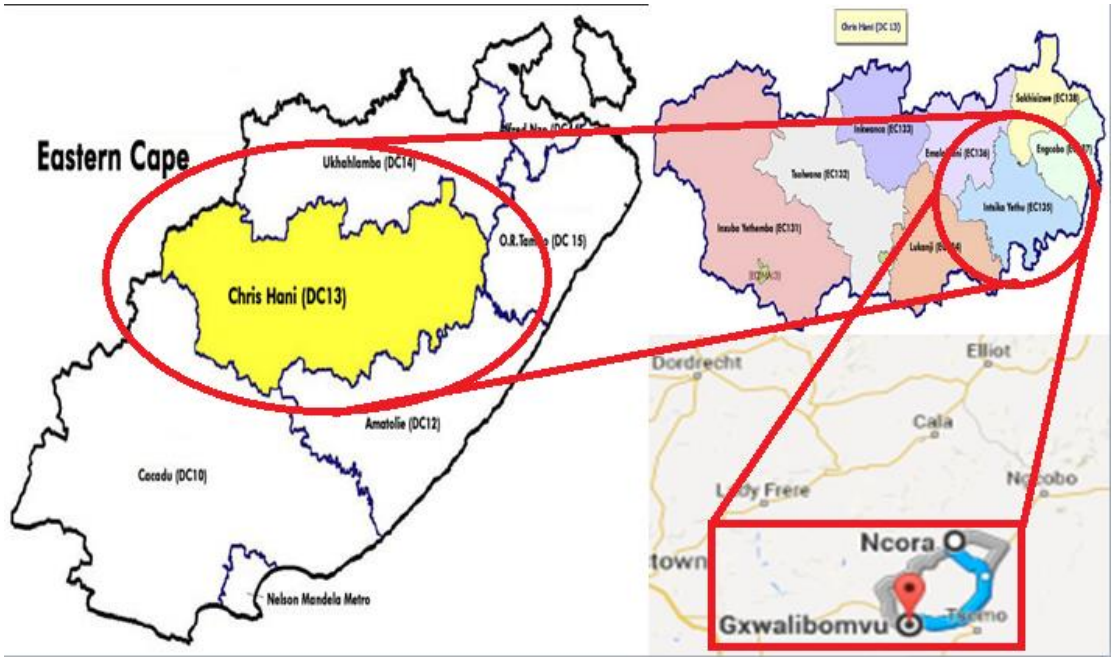


Figure 3.1: Location of the study sites in the Eastern Cape Province, South Africa

The SSA (2003) report revealed that the ECP is ranked the second poorest in South Africa. Chris Hani District Municipality (CHDM), in particular, has about 43% of its population estimated to be living in poverty (DAFF, 2012) even though cattle production is by far the predominant agricultural activity in this district (ECDC, 2012). Intsika Yethu local municipality is also characterised by extremely high levels of poverty (~85%) and unemployment (~70%: DWA, 2012). It is comprised of a youthful population with more than half its population (54%) being below the age of 20 years (DWA, 2012).

Ncorha village lies on 31^{o} 49’ 0”S and 27^{o} 44’ 0” E. The climate is largely described as semi-arid, which receives mean annual summer rainfall of between 400 and 600 mm. Average annual temperature ranges from 14 to 20 ^{o}C. The area is comprised of 106 spatially located rural village homesteads on plots measuring 2500 m^{2} on average. Gxwalibomvu community near Cofimvaba lies on 32^{o} 1’ 12”S and 27^{o} 45’ 6”E. The area receives mean annual rainfall of 600 mm mainly in the form of thunderstorms

sometimes accompanied by hail. However, evaporation rates in the area, averaging 1700 mm per annum, are much higher than average annual precipitation leaving the area in a negative moisture balance. This compounds the efforts of crop production as it thrives under conditions that conserve soil moisture.

Both Ncorha and Gxwalibomvu communities have forage that can be classified as mixed-natural pasture. A mixed-natural pasture consists of different proportions of forage that are normally classified under sour and sweet-natural pasture. Sour-natural pasture forages are characterized by low nutritive values and are predominantly unpalatable during the dry season. Sweet-natural pasture forages have high nutritive values and remain palatable during the dry season. Acacia species are the predominant trees in both areas. In fact, both study sites are heavily infested with invasive species, especially *Acacia mearnsii*. The combinations of climatic, topographic and geological features limit crop production in the two areas such that a greater part of the land is natural pastures used for communal grazing (CSIR, 2004).

3.2.2 Sampling methods

Intsika Yethu local municipality was selected purposively on the basis of the presence of a vibrant National Agricultural Marketing Council (NAMC) custom feeding program for smallholder cattle producers. Currently the custom feeding program emulates intensive cattle production practices but research is underway to formulate natural pasture based cattle diets with no chemical additives. Ncorha and Gxwalibomvu communities are the only beneficiaries of the NAMC custom feeding programs in Instikha Yethu local municipality. All the smallholder farmers from both communities who owned at least five cattle were included in the study. A total of 95 smallholder cattle producers from Ncorha (47) and Gxwalibomvu (48) communities were interviewed in February 2015 using pre-tested questionnaires administered to household heads in the vernacular isiXhosa language by trained enumerators. Key

informant interviews were also conducted with local councillors, community heads, NAMC project personnel, and local extension officers.

3.2.3 Deriving sustainability indicators for smallholder beef cattle production

The study employed hierarchical sustainability assessment methodologies proposed by (Gomez-Limon and Sanchez-Fernandez, 2010; Atanga, et al., 2013). This involved the contexualization stage where the objectives of the study were outlined together with the description of the system being assessed and the period of assessment. The second stage was the selection of an appropriate set of indicators that can be used for sustainability assessment. Finally, the method used for validation of the indicators was described and the subsequent derivation of the sustainability estimate. These stages are described in the following sections.

3.2.3.1 Contextualization

The purpose of the research was to assess sustainability, on a community level, of smallholder cattle production in Ncorha and Gxwalibomvu communities in Intsika yethu local municipality of the CHDM in the ECP of South Africa. Social, environmental and economic sustainability indicators were derived through focus group discussions with stakeholders (farmers, local agricultural extension officers, feedlot workers, community heads and NAMC personnel) using PRA techniques as described by Atanga et al. (2013). Additional indicators were derived from various literature sources as were methods used to validate indicators such as rainfall data, vegetation information and others (Atanga et al., 2013; Lebacq et al., 2013).

3.2.3.2 Indicator selection process

A set of 19 (7 social, 7 environmental and 5 economic) indicators were selected for use in the current study. Social indicators comprised of; household food access, availability of safe drinking water, household health status, education level, access to

information, gender balance and cattle herd size. Environmental indicators were; air quality, chemical use level, soil erosion, soil fertility, biodiversity, forage quality and rainfall. Economic indicators comprised of; social grants income, non-farm income, crops income, other livestock income and cattle income. All the social, environmental and economic indicators selected were allocated scores by respondents during interviews using a five point Likert-type scale (Vagias, 2006). The scale ranged from 1(poor/low) to 5 (excellent). In the case of income, zero '0' was used to denote that a particular indicator does not apply to the respondent. For example, a respondent who did not receive income from cattle in the period under review would indicate a zero. All the income figures were averaged per month. Table 3.1 shows the proposed set of social sustainability indicators used in the two study areas. To reduce subjectivity in scoring indicators, guiding information was added to appraise the details of each score and help respondents in scoring.

Education level of household head affects access to information and consequently implementation of developed technologies in cattle production and marketing. Reference values for household health status were indicated by the number of treatment visits to a healthcare centre of choice during the period under assessment. Visits for medical check-ups and medical treatments for pregnant women and immunisation programs for children below five years old were excluded. Poor health affects labour allocation towards cattle production leading. The health of family members is a priority and this might take away money that would otherwise be channelled towards cattle productions. Months of Adequate Household Food Provisioning (MAHFP) was used as a proxy for household food access (Bill and Melinda Gates Foundation (BMGF), 2010). According to Billinksy & Swindale (2010) MAHFP is informed by households indicating all the months that a household had adequate food. Food access is an important requirement that provides the energy and

drive for sustainable cattle production. Safety of drinking water was determined from the farmers' perspectives. Safety was considered as cleanliness/ turbidity of water, presence of floating solid debris, whether the water source is open or covered and treatment of water for drinking. The importance of availability of safe drinking water is related to individual, family and community health status of the surveyed areas.

Stakeholders identified radios, televisions, cell phones, internet and the print media (newspapers, farming magazines and newsletters) as five common sources of information that can be accessed by farmers. Ownership and/or consistent access to these sources were used to develop categories for scoring access to information as shown in Table 3.1. Randolph et al. (2007) reported success in cattle production in households with greater access to relevant information, the authors stated that access to relevant information is akin to extension services. The percentage of women involvement in major livestock management related roles per household was used as a proxy for gender balance in decision making. It was assumed that the more involved women are in important management activities, the greater the role they play in decision making. Gender balance is essential for providing a diversity of ideas in cattle production.

Table 3.1: Proposed indicators used to assess social sustainability of smallholder cattle production system in the ECP

Indicator	***1 Poor***	***2 Fair***	***3 Good***	***4 Very good***	***5 Excellent***
Cattle herd size	Own 1-2 cattle	Own 3-5 cattle	Own 6-10 cattle	Own 11-20 cattle	Own >20 cattle
Education level	No education	Primary	Secondary	Matric	Tertiary
Household health status	>5 visits to a healthcare centre	4-5 visits to a healthcare centre	2-3 visits to a healthcare centre	1 visits to a healthcare centre	Did not visit a healthcare centre
Months of inadequate food access	9-12 months	6-8 months	3-5 months	1-2 months	None
Safety of drinking water	Very dirty with solid debris turbid water from an open source	Unsafe turbid water without debris from an open source	Relatively turbid water from a closed source	Safe water from a closed source	Very safe, treated tap water
Access to information	Had no access to all the five prescribed sources of information	Had access to one of the five prescribed sources of information	Had access to 2 to 3 of the five prescribed sources of information	Had access to 4 of the five prescribed sources of information	Had access to all of the five prescribed sources of information
Gender balance	≤20% women involvement	21-40% women involvement	41-60% women involvement	61-80% women involvement	>80% women involvement

Table 3.2 presents the environmental indicators derived for the current study. Most environmental indicators have direct effects on ecosystem and community health which can adversely reduce cattle production. Environmental indicators selected include rainfall, forage quality, soil fertility, level of chemical use, biodiversity, soil erosion and air quality. Stakeholders suggested the levels of chemical use that they perceived as normal and that which is perceived to be excessive for their farming practices. According to the suggested criteria, use of more than 80 kg of diluted agricultural chemicals per month including crop and livestock chemicals was considered to be poor (excessive) and was allocated score 1. Less than 20 kg of diluted chemical use per month for crops and livestock was considered as excellent and allocated score 5. All the chemicals were assumed to have the same environmental impact. Vegetation species richness was used as a proxy for biodiversity. Scoring criteria that use number of vegetation species was employed with poor/low (score 1) being given for areas dominated by single species per square meter and excellent vegetation species richness (score 5) being considered at above ten species per square meter. Scoring criteria for soil erosion ranged from visible very deep galleys due to water erosion (score 1) to no visible signs of soil erosion with an excellent score of five awarded to soil completely covered by vegetation. Air quality was scored according to toxicity and the perceived impurities in the air.

For most environmental indicators reference values were guided by literature. Although, reference values for indicators such as rainfall could be obtained from literature, respondents' scores were necessary to give an indication of their opinions on rainfall sufficiency as well as appropriateness of duration. Forage quality was scored on the basis of the experience of respondents on perceived nutrient quality level of the vegetation as well as palatability of the plants. Soil fertility was scored on the basis of soil nutrient levels, soil depth and presents of organic matter (OM) based

on their farming experience. All the indicators used for this study were considered to contribute equally to sustainability (i.e., they were equally weighted).

The selected economic sustainability indicators included cash income from cattle, other livestock and crops sales plus cash income from sales of other by products from cattle and other livestock products such as meat, milk, hides and manure among others. Income from sales was then averaged per month of the period under review, this was calculated as follows.

$$Income\ from\ sales\ per\ month = \frac{number\ of\ units\ sold \times price\ per\ unit}{12\ months}$$

Non-farm income included an aggregate of all income from off-farm activities including wages from full-time, part-time or once-off peace jobs. Income from social grants was considered literally as it is acquired on a monthly basis.

Table 3.2: Indicators used to assess environmental sustainability of the smallholder cattle production system In the ECP

Indicators	***1 Poor/low***	***2 Fair***	***3 Good***	***4 Very good***	***5 Excellent***
Rainfall	<250 mm	250-450 mm	450-650 mm	650-800 mm	>800 mm
Forage quality	Unpalatable forages of very low nutrient, content.	Fairly palatable forages of low nutrient content	Palatable forages of moderate nutrient content	Palatable forages of high nutrient content	Highly palatable, forages of excellent nutrient content
Soil fertility	Very low nutrient content shallow soils, no organic matter (OM)	Low nutrient content, shallow soils, no OM	Moderate nutrient content deep, soils, with trace OM	High nutrient content, deep soils with low OM	High nutrient content, deep soils, very high OM
Chemical use	>80 kg of chemicals	61-80 kg of chemicals	41-60 kg of chemicals	21-40 kg of chemicals	<20 kg of chemicals
Biodiversity	0-1 plant species/m^2	2-3 plant species/m^2	4-6 plant species/m^2	7-10 plant species/m^2	>10 plant species/m^2
Soil erosion	Very deep galleys	Shallow galleys	No galleys but visible sheet erosion	Slightly visible sheet erosion	No visible signs of soil erosion
Air quality	Toxic air polluted by industrial & exhaust, fumes	Non-toxic air, light chemical, exhaust or dust impurities	Non-toxic air, highly humid or excessively dry air	Fresh air with occasional dust	Very fresh natural air

Table 3.3: Indicators used to assess economic sustainability of the smallholder cattle production system

Indicators	***1 Poor/low***	***2 Fair***	***3 Good***	***4 Very Good***	***5 Excellent***
Cattle income (R)	<1000	1001-2000	2001-3000	3001-5000	>5000
Other livestock income (R)	<1000	1001-2000	2001-3000	3001-5000	>5000
Crops income (R)	<1000	1001-2000	2001-3000	3001-5000	>5000
Non-farm income (R)	<1000	1001-2000	2001-3000	3001-5000	>5000
Social grants income(R)	<1000	1001-2000	2001-3000	3001-5000	>5000

3.2.4 Statistical analysis

Household socio-demographic and social, environmental and economic indicators were subjected to descriptive statistics using PROC FREQ of the Statistical Analysis System (SAS) (2012). Analysis of mean scores of economic, environmental and social indicators was performed using the Wilcoxon rank-sum test of SAS (2012). For total sustainability scores, the score allocated to each indicator was weighted by its relative responses. The weighted averages of the indicators were then aggregated within the three dimensions of sustainability for both communities. The average score for the three dimensions was computed to represent the net sustainability score as described by (Atanga et al., 2013). Aggregate sustainability scores were then divided into three categories as described by Muller (1997) and Atanga et al. (2013) namely; non-sustainable (NS ≤ 33%), conditionally sustainable (CS= 34 to 65%) and Sustainable (S ≥ 66%).

3.3 Results and discussion

3.3.1 Demographic information

About 65% of respondents in the surveyed areas were males. Married household heads constituted over 70% of respondents in both communities. About 90% of respondents from Ncorha had primary education and below while, the proportion with the similar education levels in Gxwalibomvu was almost 55%. Almost half of the respondents in Gxwalibomvu had secondary and tertiary education compared to 13% in Ncorha. The reason for the discrepancy might have been that Gxwalibomvu being closer to a black urban township called Comfimvaba, might have benefited from education offered in this town. Some respondents from this community may have attended schools in Cofimvaba during the colonial period when education was heavily rationed to indigenous black South Africans (Mwabu and Schultz, 1996). Ncorha on

the other hand, did not have any schools in its proximity hence, the low education levels. Previous studies by Grwambi et al. (2006) also reported low levels of education among smallholder cattle producers in South Africa. The authors attributed low education levels to an unfair education delivery system during the Apartheid era which was biased against indigenous black South Africans.

Christianity was the most common religion in both communities recorded by about 65% and over 85% of respondents from Ncorha and Gxwalibomvu, respectively. Nearly 30% of respondents from Ncorha indicated that they believed in the traditional religion compared to less than 10% in Gxwalibomvu. High education levels experienced in Gxwalibomvu might have influenced the differences in religion between the two communities. It is unofficially believed that the education curriculum in most public schools was designed to teach more of Christianity than other religions. Alternatively, the proximity of Gxwalibomvu to urban towns may also have influenced the slow decay of the traditional religion. Less than 5% of the farmers practiced both Christianity and Traditional religion. About one third of Ncorha respondents and over half of Gxwalibomvu respondents were pensioners. There were more (44%) unemployed respondents from Ncorha than Gxwalibomvu (21%). The proportion of pensioners corresponds to age range results mentioned earlier. However, unemployment rates exhibited by the two communities are well below the over 80% unemployment rates reported for Intsika Yethu local municipality (ECDC, 2012). This may be due to the household head age characteristics of the two communities which relegate them to pensioners.

Respondents from both communities indicated that they did not know the actual size of their farms and therefore could not determine the size of their arable and grazing lands. However, average land sizes per household as stated in the ECDC (2012) were 2500 m^2 in both Ncorha and Gxwalibomvu. The majority of respondents from Ncorha

were between the ages of 40 to 60 years (47%). Smallholder cattle producers over 60 years old constituted the majority in Gxwalibomvu (70%) followed by those aged between 40 and 60 years (20%). Only a few respondents (<15%) were aged less than 40 years old in both communities. Both communities are conspicuous of extremely low levels of participation by youths in cattle production which is largely dominated by the elderly. Jari and Fraser (2009) attributed this trend to rural-urban migration where most young people migrate to urban areas which they perceive to have more employment opportunities in both formal and informal sectors.Farmers' cattle farming experience in both communities ranged from 2 to 60 years with an average of 26 years. The mean farming experiences of respondents from the two study areas enhances the credibility of the information about their cattle production system as it is acquired through years of first hand monitoring.

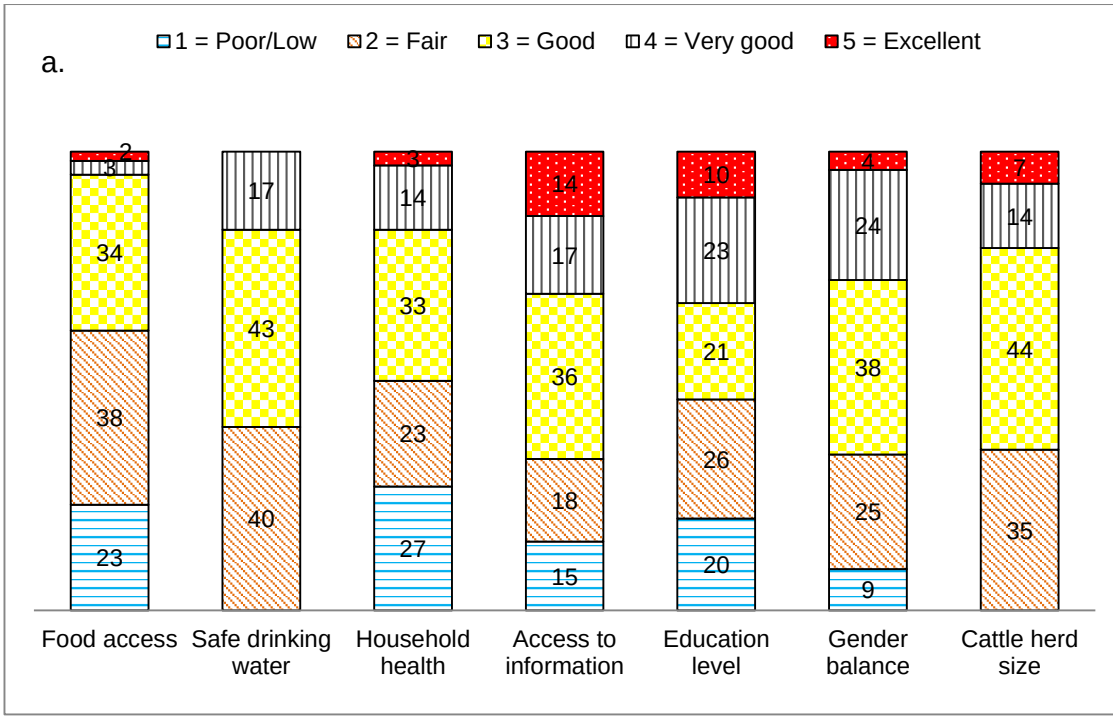
3.3.2 Social sustainability indicators

Figure 3.2 (a) shows the percentage of respondents for each score allocated to a given social indicator in Ncorha and Gxwalibomvu. The majority of respondents (38%) indicated that they faced food shortages for about six to eight months during the year under review. A greater proportion were from Gxwalibomvu (44%) compared to Ncorha (32%). The results are consistent with findings made by Jacobs (2012) who reported less than 25% of rural households being food insecure. The reason for the difference between the two communities is not clear but could be related to the fact that some Ncorha farmers produce more food due to the presence of a government funded irrigation project in the area. A similar irrigation project is not present in Gxwalibomvu. The irrigation project may have assisted some farmers to produce food for home consumption for a greater part of the year. Access to food in smallholder households is usually not a responsibility of the present household members alone but there are usually interventions from other household members employed in urban towns or extended families. According to Ngxetwane (2011) an estimated 35% of the 7 million

ECP population live and work in urban areas and only visit the rural areas occasionally. Although, the contributions of urban household members were not considered in the current study, the apparent significance of these contributions warrants investigation in future studies.

Cumulatively, 60% of respondents from both communities acquired drinking water from closed sources during the period under review (score 3 and above). A greater proportion of respondents from Gxwalibomvu (82%) had access to drinking water from closed sources than those from Ncorha (38%). Availability of a communal borehole in Gxwalibomvu may have been the main reason for the discrepancy as there was no borehole in Ncorha. The perceived safety of acquiring drinking water from closed surfaces was dismissed by Momba et al. (2006) who indicated that most rural communities in the ECP have access to ground water which does not meet the minimum quality and quantity standards required by the government. This is due to both surface and below ground properties, particularly the underlying parent rock. Poor sanitation facilities in most rural communities exacerbate the risk of surface and ground water contamination. However, access to safe drinking water is stated by WHO (2003) as a fundamental basic human right. Unsafe drinking water is a risk to both physical and social health of affected people.

a.



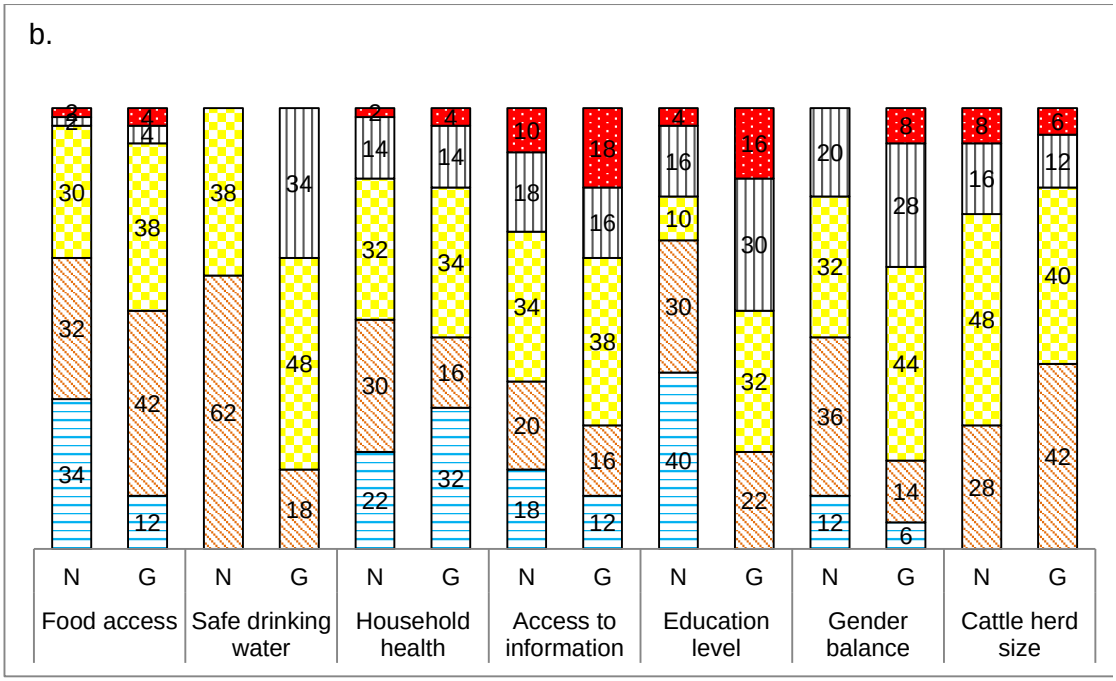


Figure 3.2(a): Combined percentage responses for each score allocated to a given social indicators in Ncorha and Gxwalibomvu communities in the ECP of South Africa

Figure 3.2(b): Percentage of total responses per community for each score allocated to a given social indicator in Ncorha and Gxwalibomvu communities in the ECP

Over 30% of respondents from both communities indicated that they made two or three medical visits to a healthcare centre of their choice during the period under review. Almost 25% had more than five visits while less than 5% indicated never having a medical visit for treatment during the period under review. Proportionally, poor to fair health was recorded by 52% and 48% of respondents from Ncorha and Gxwalibomvu, respectively. Overall, the current findings show that the health status for farmers from both communities was fair to excellent with no distinct variations between the two communities. Household health is one of the prime indicators of household well-being. Illness of a household member does not only represent one less farm labour but also

takes away the labour that must be provided by those who will need to give up their time to nurse the sick. In addition, poor health among household members might result in higher medical expenses which may in turn limit the investments channelled towards agriculture.

Eight-five percent of the respondents had fair to excellent access to information in both communities. However, respondents from Gxwalibomvu (18%) had access to all the five prescribed source of information compared to those in Ncorha (8%). The higher education levels of Gxwalibomvu respondents than Ncorha respondents might have influence their desire to acquire information including the print media which may not be favoured by the less educated Ncorha respondents. Smallholder cattle producers who exhibit low access to information are at risk of being exploited by unscrupulous buyers (Coetzee et al., 2005). They are also likely to lag behind in cattle production as they may take long to receive and understand innovative strategies to improve cattle productivity (Monsthwe et al., 2005). Existing evidence also suggest that provision of sufficient marketing information to smallholder cattle producers helps to create an atmosphere of inclusiveness that increases transparency resulting in improved market participation (Musemwa et al., 2008).

About 20% of respondents had no formal education and all were from Ncorha. Only 30% of respondents from Ncorha and 78% from Gxwalibomvu attained secondary to tertiary education. Similarities can be noticed to education trends of the CHDM presented in the ECDC (2012) report. The report states that 22.8% of CHDM residents had no formal education, while, 19.6% and 42.2% had primary education and secondary education, respectively. Gxwalibomvu respondents may have benefited from the community's proximity to an urban township called Cofimvaba where most respondents might have attended school during the apartheid era when the pre-independence government heavily rationed education to indigenous black South

Africans (Mwabu and Schultz, 1996). Ncorha community on the hand, with no urban township in its proximity, did not have access to schools. Education level of household head determines decision making, implementation of accessed information and acumen for improved general household welfare (Ainslie et al., 2002). At low levels of education, the ability of individuals to contribute meaningfully to community development is diminished (Coetzee et al., 2005). However, even without formal education, the knowledge acquired from farming experience is beyond valuation. The real impact of this indigenous knowledge acquired from experience need to be investigated further.

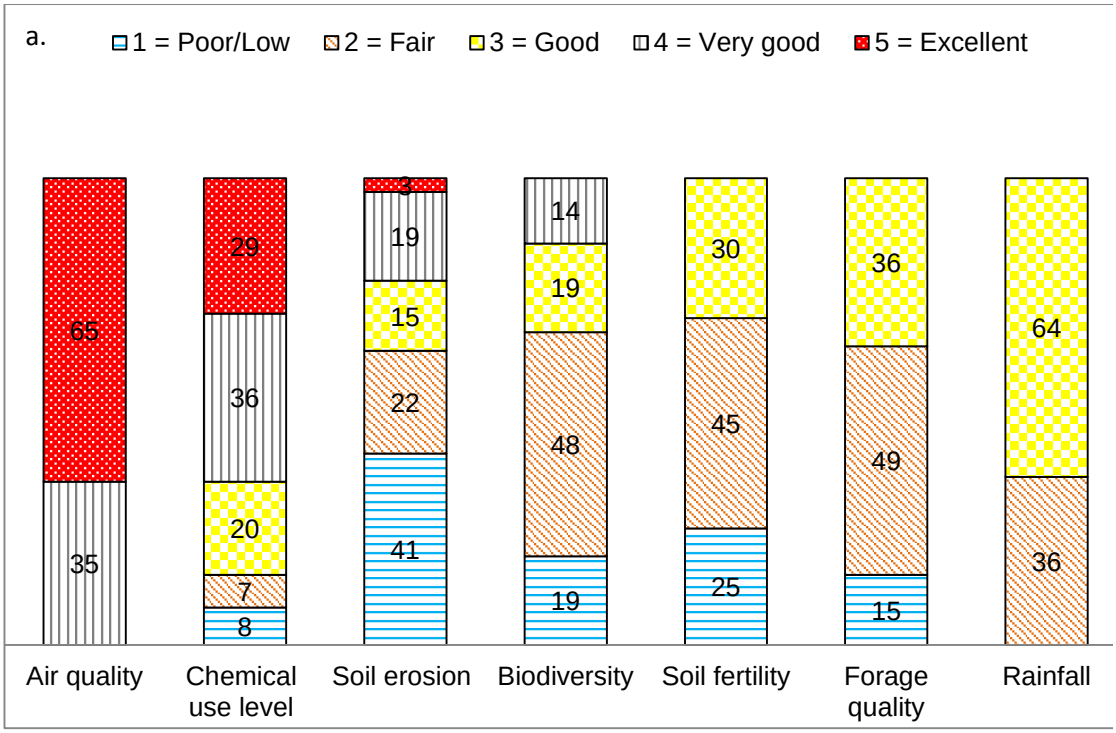
In the majority of households (66%) women were involved in between 41 to 100% of the important livestock related roles. Of these households, a larger proportion of Gxwalibomvu respondents (80%) recorded good to excellent involvement of women in livestock related roles than Ncorha (52%). The current study revealed that Gxwalibomvu had more men involved in off-farm activities and receiving non-farm income. This may have left more women from this community solely responsible for livestock management. The discrepancy might have been related to results of the current study which revealed more income from other livestock in Gxwalibomvu than Ncorha. In this regard, livestock such as sheep, goats and chickens are usually left under the management of women in smallholder communities while men concern themselves with management of larger livestock like cattle which have higher financial as well as cultural value (Randolph et al., 2007). Gender balance in decision making is vital to exploring the full potential of management of natural resources. Quisumbing and Yohannes (2004) reported a positive correlation between ownership of assets by women and improvement of household health and education. Gender balance also enhances the status of women in society and ultimately improves their bargaining power (Quisumbing and Yohannes, 2004).

The majority of smallholder cattle producers (44%) owned six to ten cattle. Respondents who owned more than 10 cattle were proportionally more in Ncorha (48%) than in Gxwalibomvu (40%). Household cattle herd size provides essential information on household wealth status and financial security (Coetzee et al., 2005; Montshwe, 2006). This is because in many communities, livestock particularly cattle, are regarded as indispensable assets used to store household wealth (Mapiye et al., 2009; Njuki et al., 2011). In fact, in smallholder communities, cattle herd size is considered a better measure of welfare than cash income due to multiple roles played by cattle including providing financial security to manage long term risk, generating income through hired drought power and meeting household nutritional requirements of meat and milk (Njuki et al., 2011). Respondents who had low cattle herd sizes might be affected by a combination of factors that limit productivity of cattle including feeding shortages, poor management and unsound breeding practices (Marufu et al., 2011) coupled with climate challenges (Nardone et al., 2010) limit productivity in smallholder cattle production systems. High cattle herd sizes might give misleading household wealth status as they are complex ownership patterns within herds belonging to the same household. As reported by Chikura (2006) cattle belonging to one household may have several owners some of whom may be employed in urban towns and are not even involved in the day to day cattle management activities. These complex ownership patterns affect decision making by the people directly involved in cattle management.

3.3.3 Environmental indicators

Figure 3.3 shows the percentage of respondents for each score allocated to a given environmental indicator in Ncorha and Gxwalibomvu whereas figure 3.3 (b) shows proportions of total responses for each score allocated to a given environmental indicator in Ncorha and Gxwalibomvu. Overall, the majority of respondents (65%) from Ncorha and Gxwalibomvu considered air quality to be excellent. The excellent air quality recorded by most respondents is expected of areas located far from mining, manufacturing and processing industries and where the volume of traffic is very low. According to DWA (2012) the two communities under study are completely rural with the urban towns being Ngcobo which is 34 km from Ncorha and Comfimvaba which is about 7 km from Gxwalibomvu. However, air quality may also be compromised by wind-blown dust, mist or fog which is common during the rainy season. More appropriate quantification of air quality using appropriate scientific procedures is required for validation.

Most respondents (85%) reported that chemical use level was good to excellent in both communities (Figure 3.3a). However some community differences were observed with more respondents (74%) acknowledging use of up 40 kg of agricultural chemicals per month in Ncorha compared to 56% in Gxwalibomvu. Respondents who indicated excellent chemical use might have been cattle producers who were not involved in crop production. Personal observations established that common agricultural chemicals used by smallholder farmers at household level include fertilizers, pesticides, acaricides, vaccines and other therapeutic drugs for treating livestock. However, livestock chemicals are rarely used at household level.



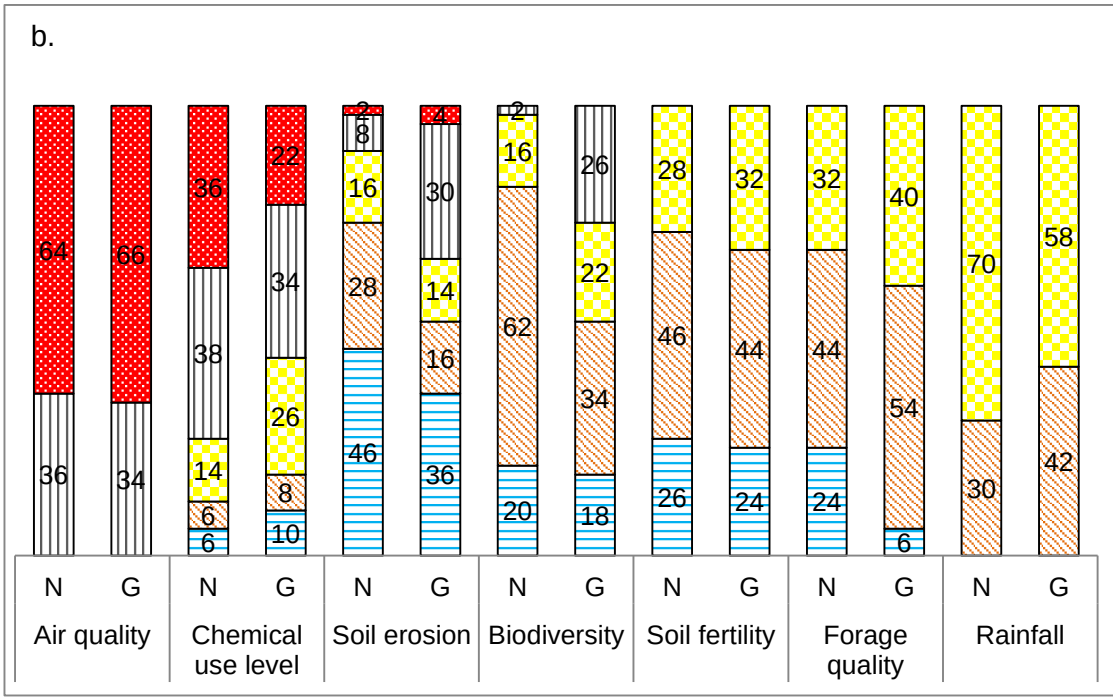


Figure 3.3(a): Combined percentage responses for each score allocated to a given environmental indicator in Ncorha and Gxwalibomvu communities in the ECP of South Africa

Figure 3.3(b): Percentage responses for each score allocated to environmental indicator in Ncorha and Gxwalibomvu communities in the ECP of South Africa

The low income levels of smallholder cattle producers might be contributing to low chemical use levels. Especially considering that chemicals are used prominently during funded exercises such as mass vaccinations, dipping or community based treatments of livestock (Marufu et al., 2011). This was also reiterated by Ngxetwane (2011) who reported low livestock treatment culture among smallholder farmers. However, the actual impact of the chemical use level on surface and underground water sources should be investigated to determine the proper reference values.

About 40% of respondents mentioned that their natural pastures were heavily eroded. Of these respondents, the majority were from Ncorha (46%). Thirty-seven percent of respondents from both study sites consider the soil erosion status of their natural pastures good to excellent. However, most of these respondents were from Gxwalibomvu (48%). The reason for differences in soil erosion status could be due the fact that Ncorha had a steeper slope than that of Gxwalibomvu. Given that the convectional rains are the major causes of galley erosion in the two study areas, it is logical that the site with a steeper slope was more eroded. Deep galleys on the slopes extending from the mountain tops to the foot of mountains are a common sight in Ncorha indicating severe mass soil erosion which according to the ECDC (2012) report is critical problem in most parts of the ECP.

Nearly 80% of the respondents indicated fair to very good levels of biodiversity in the surveyed sites. Biodiversity is an important determinant of primary ecosystem productivity (Cousins et al., 2007; Munyai, 2012). It is hypothesized that higher primary ecosystem productivity is achieved with more plant species resulting in complementary relationships in soil nutrient extraction and enhancement of plant canopy for maximum trapping of sunlight (Tilman, 1997). The high levels of plant biodiversity might offer opportunities for high forage biomass yield for grazing cattle (Darnhofer et al., 2010).

Grazing cattle are also presented with a wider range for selective grazing which may translate to improved forage quality and cattle production. This is especially true when the plant biodiversity include a mixture of grasses of high energy content and legumes of high crude protein content. Usually well managed natural pastures show a climax state of mixtures of indigenous vegetation species existing together as opposed to a dominion of single species (Darnhofer et al., 2010).

Respondents in both communities considered soil fertility status to be fair (45%) to good (25%). Only 25% of respondents from both communities considered soil fertility status to be poor. Overall, proportions of total responses for each score allocated to a given environmental indicator were similar for the surveyed communities. Similar to current results, Phiri (2009) described the Intsika Yethu local municipality as having poor (less fertile and less productive) soils that restricts livestock farming. There is a generally known gradual decline in soil fertility as one move inland from the ocean according to ECDC (2012). Consequently, in most inland areas the soils are shallow and generally unsuitable for crop production. The poor soils were also mentioned by Ngxetwane (2011) as one of the reasons for poor crop production in most of the ECP inland areas. Fertility properties of the soil found in the two study sites are determined by the sedimentary rock underlying the two areas (du Bryne, 2006). The same author described the soils in the two study sites as largely poor having developed from the Beaufort and Molteno series of the Karoo sequence. These are predominantly sedimentary comprising of shale, sandstone and mudstone except for areas with igneous rock intrusions which results in red soils.

The majority of respondents from both communities regarded the forage quality from their natural pastures to be fair (49%) or good (36%). Proportionally, the majority of the respondents from Gxwalibomvu (94%) regarded their forage quality as fair to good

compared to 76% in Ncorha. The differences in perceptions of forage quality between the two communities might have been that Ncorha area is more evidently invaded by alien species than Gxwalibomvu. Personal observations showed natural pastures, especially along gulleys and water ways in Ncorha were intensely invaded by *A. mearnsii* (black wattle) and Sporobolus species compared to Gxwalibomvu. *Acacia mearnsii* is a problematic invasive tree species which usually takes advantage of high nutrient and moisture levels of the gulleys, rivers and other water ways (DWA, 2012). Generally, natural pasture feed resources quantity and quality is largely determined by rainfall (de Bruyn, 2006). However, there is a common belief that natural pastures in smallholder areas are generally overgrazed and dominated by undesirable grass species of poor nutritional quality (Moyo et al., 2008; 2013). Contrary to this belief, smallholder cattle producers from the two study sites were of the view that their major problem is seasonality of rainfall as there is plenty of high quality forages during the rainy season. Otherwise, their major concern was that of supplements to help feed their cattle through the dry season. Forage quality in these two areas might also have been influenced by a combination of other factors like soil type, soil fertility, grazing pressure and invasion by alien species such as *A. mearnsii*.

Rainfall was generally regarded as fair by 36% of the respondents and good by 64% of the respondents from both communities. At community level good rainfall was acknowledged by proportionally more respondents from Ncorha (70%) than Gxwalibomvu (58%). Rainfall is used in this study as an important indicator of water availability and a vital determinant of both forage quantity and quality (Halberg et al., 2005). This is especially important given that cattle production in the two communities entirely depend on rain-fed natural pasture feed resources. Rainfall scores by the majority of respondents commensurate with mean annual rainfall range of between 520 mm and 630 mm reported by the ECDC (2012) for the two study sites. More

importantly, the rainfall values given by the ECDC (2012) correspond to average rainfall according to reference values agreed upon by stakeholders.

3.3.4 Economic sustainability indicators

Figure 3.4 (a) shows the percentages of respondents for each score allocated to a given economic indicators in Ncorha and Gxwalibomvu whilst figure 3.4 (b) shows proportions of total responses for each score allocated to a given economic indicator in Ncorha and Gxwalibomvu. The majority of respondents (45-60%) indicated that they did not receive income from each of the five economic sustainability indicators. About 54% of respondents received income from social grants although the income was less than R1000 per month. Social grants were received by a proportion of 52% and 56% of respondents from Ncorha and Gxwalibomvu, respectively. The reason for this slight difference in respondents receiving social grants between Ncorha and Gxwalibomvu may be due to the fact that Gxwalibomvu had more respondents (68.8%) above the age of 60 years than Ncorha respondents (46.8%) given that the minimum age for old age grant is 60 years. Different households might have been receiving social grants for reasons other than age although this was not investigated in the current study. Nevertheless, social grants were the major economic indicator contributing towards household income. However, relying on social grants as an external source of income may not be sustainable. It is more prudent for smallholder cattle producers to derive their major source of income from local resources. To a certain extent, social grants limit the efficiency of production of potentially more sustainable income sources by providing an alternative to income generation.

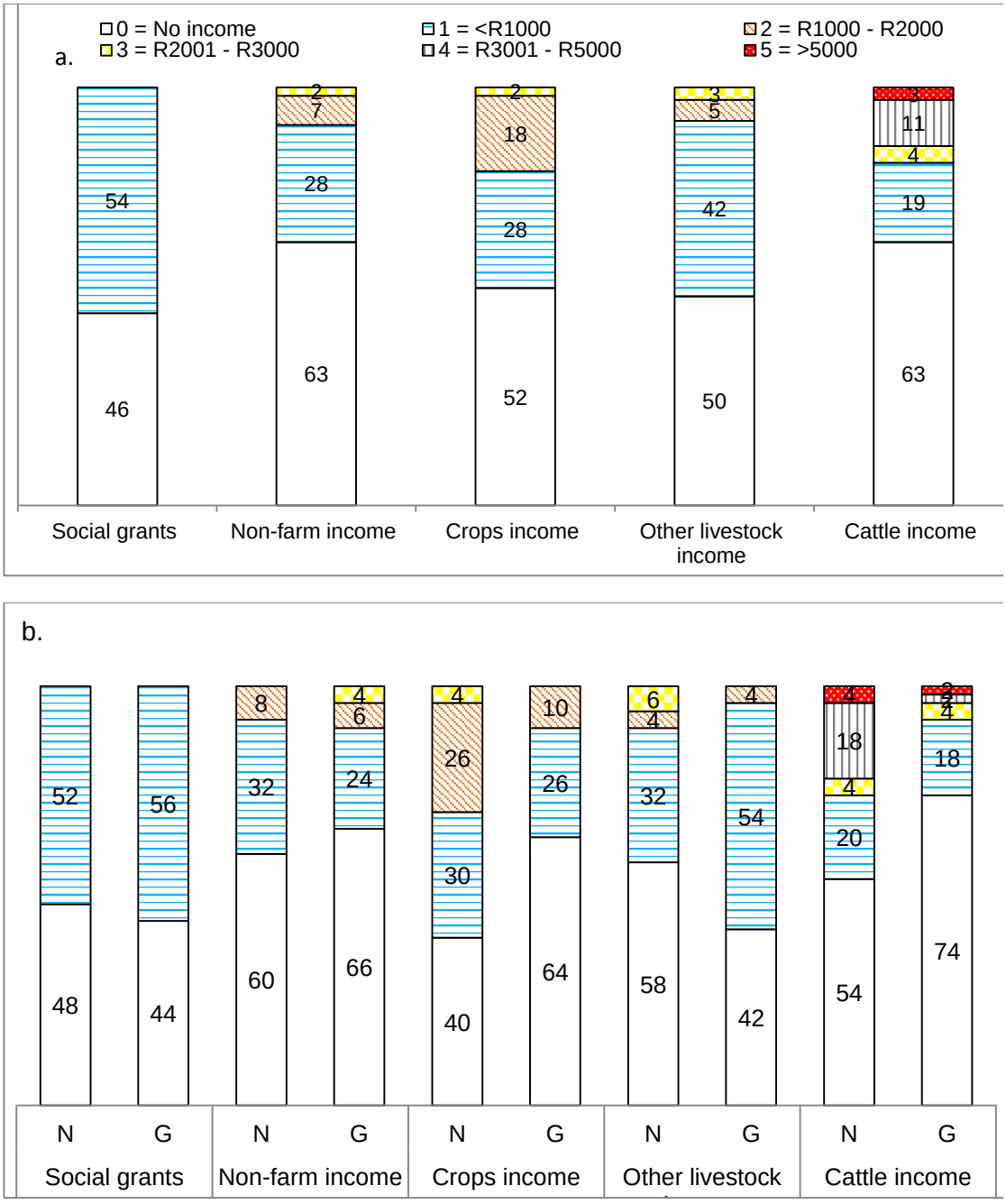


Figure 3.4(a): Combined percentage responses for each score allocated to a given economic indicator in Ncorha and Gxwalibomvu communities in the ECP of South Africa

Figure 3.4(b): Proportions of total responses per community for each score allocated to a given economic indicator in Ncorha and Gxwalibomvu communities in the ECP of South Africa

Over 60% of the respondents did not receive any income from non-farming activities in communities. Non-farm income was received by over 35% of respondents from both communities where proportions were 40% and 34% for Ncorha and Gxwalibomvu, respectively. The fact that farming is mostly left for the elderly, mainly pensioners, in both communities as a result of urbanisation may be the reason for low non-farm income levels reported in the current study. As stated by Ngxetwane (2011) the aged household heads have less energy to engage in off-farm activities to enhance their livelihoods. On the hand, low non-farm income levels may have been due to high unemployment rates in the ECP. Instika Yethu local municipality in particular was reported to be characterised by high unemployment and high poverty levels with 65% of the economically active population being said to be unemployed (DWA, 2012).

Generally, over half of the respondents did not receive income from crops of these respondents, 40% were from Ncorha and 64% from Gxwalibomvu. Of the respondents who had income from crops, 28% received less than R1000 per month and 20% received R2000-R5000 per month. The majority of respondents who received income from crops were from Ncorha (60%) and only 36% were from Gxwalibomvu. The discrepancy may be due to the fact that some farmers from Ncorha are involved in the community based irrigation project operated at Ncorha dam, hence, the higher income from crops in this community. However, this is a highly subsidised project with the government responsible for over 80% of operational costs of the project (Libala, 2014). The project is, however, reported to be facing operational challenges believed to be emanating from the lack of a participatory administrative approach by agents put in place to manage the project (Libala, 2014). This is reflected by the relatively low crops income levels reported in the current study. Low levels of returns from the irrigation project may also be due to a combination of poor soils, climate and low levels of input, poor management among other problems. According to a report by CSIR (2004) the

combination of climatic, topographic and geological features limits crop production for most inland areas of the ECP.

Half of the respondents from both study sites did not receive any income from other livestock (sheep, goats and chickens). Of those that received other livestock income 42% received less than R1000 per month and less than 5% received between R1000 and R3000 per month. Gxwalibomvu proportionally had more respondents (58%) that received income from other livestock than Ncorha (42%). The difference might have been caused by the significantly higher number of chickens in Gxwalibomvu than in Ncorha reported in Chapter 4. Gxwalibomvu respondents had a mean household chicken flock of 21.0 ± 5.2 birds compared to 8.8 ± 5.3 birds owned by Ncorha respondents (Chapter 4). According to Makhura (2002) the most common transactions in smallholder farming systems involve the sale of poultry, particularly, chickens due to lower transaction costs involved. Furthermore, women who are largely in charge of poultry are known to keep livestock for livelihood purposes rather than social status (Makhura, 2002). However, the relatively low value of other livestock disqualifies this income source as a priority vehicle for enhancing smallholder household income levels.

Of the 63% respondents who did not receive income from cattle, 72% were from Gxwalibomvu and 54% were from Ncorha. The observation that the majority of cattle producers did not receive income from any of the stated indicators is supported by the Chris Hani District Municipality (CHDM) report which revealed that most farmers do not have dependable sources of income (DWA, 2012). Most of their routine expenses like school fees, electricity and food are settled by other family members usually working in urban towns. The need for cash arises during emergencies like illness or death in the family in which case livestock are sold to cover these costs as a very last

resort. However, it is possible that some cattle producers misrepresented their income levels in anticipation of financial subsidies. A similar misdemeanour was mentioned by Chikura (2006) who noted some level of dishonest from income information provided by farmers even if issues of confidentiality and absence of any form of rewards are explained clearly prior to the interview.

Among the 19% of the respondents that received cattle income, about 10% in both communities acknowledged receiving less than R1000 per month. It is important to note that 14% of respondents received more than R3000 per month (score 4 and 5) as cattle income during the period under review. These consisted of 22% of respondents from Ncorha and only 6% from Gxwalibomvu. This could be a result of differences in cattle herd sizes which were 13.7 ± 1.9 in Ncorha and 11.3 ± 1.9 in Gxwalibomvu (Chapter 4). Alternatively, the Ncorha custom feeding program is two years older than that of Gxwalibomvu, possibly making Ncorha cattle producers more experienced on strategies to realise higher income from cattle sales.

Cattle producers with cattle income of less than R1000 per month may have sold only one cow, given that the average price of a mature cow ranges between R2000 and R11000. The low cattle income recorded in the surveyed communities could be attributed to low offtake as reported earlier by Musemwa et al. (2008; 2010). Mapiye et al. (2009) attributed low cattle market offtake rates to low cattle productivity culminating from a low feed resource base and high mortality rates due to diseases and parasites. Musemwa et al. (2010) also mentioned low prices being offered for smallholder cattle producers because of emaciated body conditions, lack of appropriate marketing equipment and infrastructure (e.g., scales and holding pens) and simply a common case of exploitation of cattle producers by middlemen. The low income levels of exhibited in by smallholder cattle producers in the current study also

concurs with what was previously stated by Ngxetwane (2011) that communal farmers operate on very low cash basis as they produce most of their basic requirements. In support of the current findings the ECDC (2012) also revealed that over 80% of smallholder farmers in the ECP earn less than R2000 per month.

High levels (over R3000/month) of cattle income reported in the current study reveal the great potential inherent in cattle to significantly contribute to smallholder household food security and income compared to other sources of income. Coetzee et al. (2005) previously acknowledged the potential of cattle in enhancing communal farmers' livelihoods, alleviating poverty and improving food security. In this regard, improving cattle performance and market access might therefore, increase cattle offtake and subsequently food and income for the resource-poor smallholder cattle producers. That may also improve the sustainability of the smallholder beef cattle production system.

Total household income was indicated as less than R2000 by the majority of respondents from both communities. This is less than the R2606.78 stipulated minimum wage for farm workers in South Africa (SSA, 2014). The fact that more Ncorha respondents receive less than the minimum wage is consistent with their low levels of education and relatively higher unemployment rates than Gxwalibomvu. However, results of the current study also show that the majority of respondents from both communities receive income that is above the Food Poverty Line (FPL) and the Lower Boundary Poverty Line (LBPL). The FPL is defined as the Rand value below which an individual would not be able to consume enough food to supply them with minimum energy requirements for a good health. The LBPL on the other hand, includes food and food non-food items. According to Statistics South Africa (SSA, 2014) the FPL and LBPL are R400 and R544 per capita per month, respectively. However, it is

possible that some cattle producers misrepresented their income levels in anticipation of financial subsidies. Similar misdemeanours were mentioned by Chikura (2006) who noted some level of dishonest from income information provided by smallholder farmers even if issues of confidentiality and absence of any form of rewards are explained clearly prior to the interview.

3.3.5 Sustainability scores

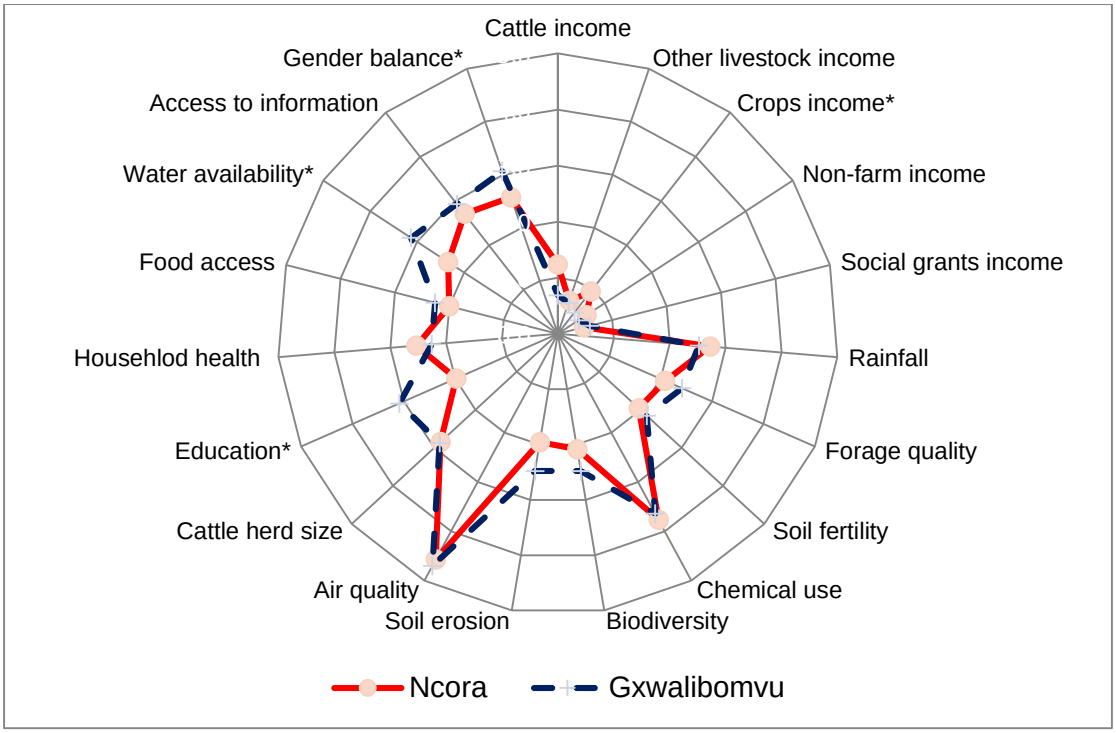
Figure 3.5 below shows mean scores for each indicator used to assess sustainability in Ncorha and Gxwalibomvu communities in the ECP of South Africa. Wilcoxon rank-sum test results showed that community had no effect ($P > 0.05$) on most social, environmental and economic sustainability indicators except for crops income, education level, availability of safe drinking water and gender balance. Mean scores for crops income were significantly higher ($P < 0.05$) in Ncorha than in Gxwalibomvu. This may be due to the fact that some smallholder cattle producers from Ncorha are involved in the community irrigation project at Ncorha dam. According to the Libala (2014) it is a 1000 ha maize project set to benefit smallholder farmers from 10 surrounding villages. Smallholder farmers from Gxwalibomvu on the other hand do not have a similar project and they largely depend on rain-fed crop production system.

Mean score for education level was significantly higher ($P > 0.05$) in Gxwalibomvu than in Ncorha. As explained previously, higher education level mean score for Gxwalibomvu might have been due to its proximity to Cofimvaba town. Education empowers households through better access to relevant and important information (Dovie et al., 2003). Nyangito (1986) ascertained that the more educated cattle producers are better able to adopt and implement newly developed technologies thereby improving the efficiency of cattle production and marketing. Reports from Nkhori (2004) and Musemwa et al. (2008) highlighted a significant improvement in education delivery across rural communities, in South Africa. This may likely provide

hope for much improved cattle production and greater participation in mainstream cattle markets by future smallholder cattle producers (Monsthwe et al, 2005).

Gxwalibomvu had higher ($P < 0.05$) mean scores for the availability of safe drinking water than in Ncorha. The reason for this could be that a greater proportion of Gxwalibomvu households had access to borehole water while, in Ncorha most households acquired their water from open sources sometimes sharing the same sources with livestock. Better water quality might also have been aided by better sanitation facilities evident in most Gxwalibomvu households but either absent or in poor state for a number of Ncorha households.

Gender balance mean scores were significantly higher ($P < 0.05$; Figure 3.5) in Gxwalibomvu than in Ncorha. This could be due to the fact that Gxwalibomvu had a higher proportion of male household heads employed off farm either permanently or part-time. This may have left women with the sole responsibilities for most cattle management roles and in the process enhancing their involvement in critical decision making. Involvement of women in important farm decision making is vital for improved sustainability of production systems. This is because women are known to make decisions that best benefit the family (Quisumbing and Yohannes, 2004; Njuki et al., 2011). They are also credited for being patient transmitters of information to younger family generations thereby, gradually integrating them into main stream decision making of the production system (Njuki et al., 2011).

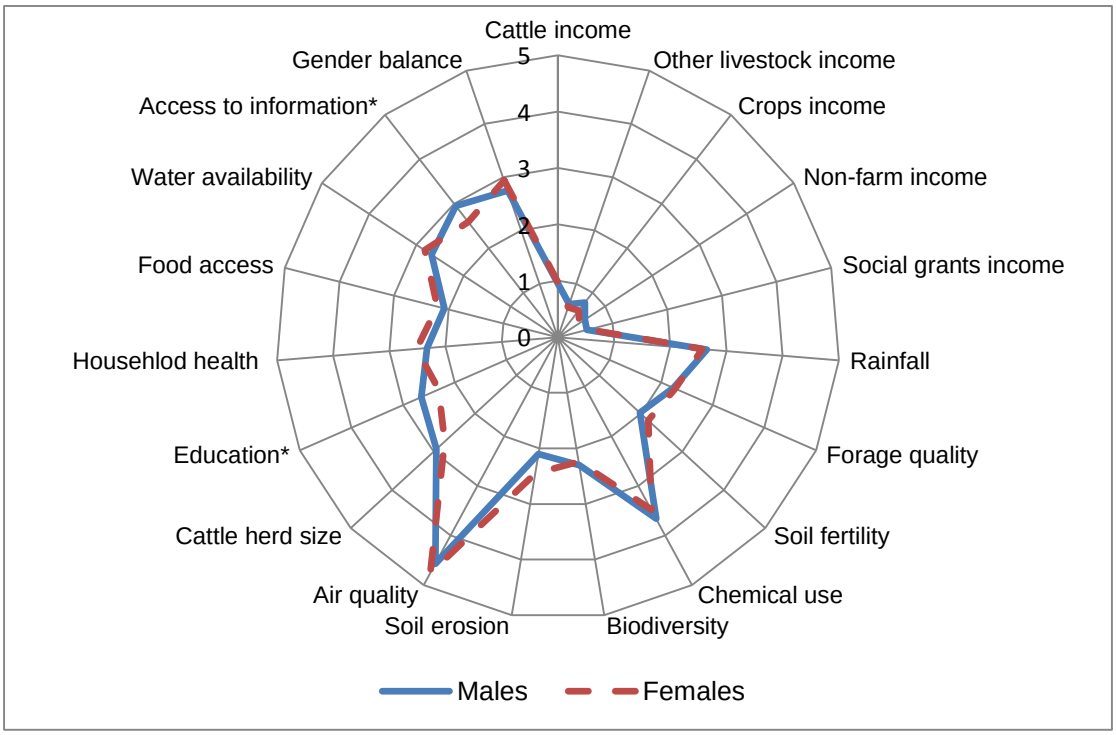


*indicators significantly differ (P < 0.05) between communities

Figure 3.5: Mean scores of indicators used to assess sustainability of the smallholder cattle production system in the ECP

The overall low mean scores for economic indicators but relatively higher mean scores for social indicators (Figure 3.5) is contrary to Binder et al. (2010) and Boogaard et al. (2011) statements that most social indicators are informed by household income levels. This disparity may be due to complexity of the smallholder system. Contrary to the small-scale dairy production system referred to by Boogaard et al. (2011), household economics in the surveyed communities do not entirely depend on cash. Household wealth and general well-being of household members is sometimes derived from moveable and immovable assets possessed by individual households especially position of livestock (Phiri, 2009). For emergencies that require cash, smallholder farmers may source cash from family members working in urban towns or cities or sell livestock (Coetzee et al., 2005).

Figure 3.6 shows the mean scores of indicators by gender used to assess sustainability. Wilcoxon rank-sum test showed that males and females in Ncorha and Gxwalibomvu did not significantly differ (P > 0.05) on the scores they allocated to most social, environmental and economic indicators except for access to information and education.



*indicators significantly differ (P < 0.05) between communities

Figure 3.6: Mean scores of indicators by gender used to assess sustainability of the smallholder cattle production system in the ECP

Males scored significantly higher (P < 0.05) scores for access to information and education indicators than females. This may have been due to the fact that most smallholder households prioritised educating male members of the family than females (Mwabu and Schultz, 1996). This might have been exacerbated by the apartheid governments' gender-biased rationing of education to Africans which left rural communities with very few schools. Consequently, this may have created unlevelled

educational backgrounds hence, the different scores. The differences in mean scores for access to information may have emanated from differences in education. As explained earlier education is necessary to assist smallholder cattle producers' access information and apply it to their operations.

Table 3.4 below shows sustainability scores for each indicator in the three dimensions of sustainability. Sustainability scores were averaged for each dimension of sustainability. An average of all the three dimensions then gave overall sustainability values for each community. The social and environmental dimensions were conditionally sustainable whereas, the economic dimension was not sustainable for both communities. Overall the smallholder cattle production system in the two communities under study was categorized as conditionally sustainable.

All the social indicators used in this study were conditionally sustainable. Most social indicators are positively correlated to economic indicators (Binder et al., 2010; Boogaard et al., 2011). Consequently, an increase in overall household income is likely to result in improved levels of social indicators like cattle herd size, household health, household food access, access to information. Quisumbing & Yohannes (2004) suggested that a gender balanced improvement of income which empowers women has more household benefits than empowering men alone.

Table 3.4: Sustainability scores for indicators used to assess sustainability of smallholder cattle production system in the ECP

Dimension	*Indicator*	*Ncorha (%)*	*Gxwalibomvu (%)*
Social	Household food access	40.4**	44.2**
	Availability of safe drinking water	47.8**	61.2**
	Household health	51.4**	44.2**
	Education level	39.6**	60.4**
	Access to information	53.0**	57.4**
	Cattle herd size	55.6**	56.2**
Average social sustainability score		***48.2****	***56.6****
Environmental	Air quality	93.4***	94.0***
	Chemical use level	64.8**	66.4***
	Soil erosion	40.0**	51.0**
	Biodiversity	42.6**	47.6**
	Soil fertility	40.0**	42.2**
	Forage availability	41.8**	47.2**
	Rainfall	56.6**	50.4**
Average environmental sustainability score		***54.2****	***57.0****
Economic	Income from social grants	9.6*	11.4*
	Non-farm income	12.2*	9.0*
	Income from crops	19.28*	9.6*
	Income from other livestock	12.2*	10.2*
	Income from cattle	25.2*	14.0*
Average economic sustainability score		***15.7****	***10.8****
Overall sustainability of the system		**39.4****	**41.5****

*not sustainable **conditionally sustainable ***sustainable

Likewise all environmental indicators except for air quality and level of chemical use were categorised as conditionally sustainable. Environmental indicators are enhanced by improved management strategies. These strategies must be holistic in their implementation to avoid improving one component while, other components are deteriorating. For example, strategies to curb soil erosion must be integrated with those meant to enhance soil fertility and biodiversity. Land restoration through filling up gulleys is vital in the two study areas. This should be combined with replanting indigenous grass and legume species to hold the soil together. At the same time high levels of soil fertility are required to support plants, this can be enhanced by adding livestock manure or decomposed plant material. In the end, strategies meant to reverse soil erosion will result in increases in biodiversity, enhanced soil fertility and improvement of forage quantity and quality, thereby, reducing overgrazing. Overgrazing has the unilateral potential to reduce plant species diversity, accelerates soil erosion by removing the plant protection covering and holding the soil and reducing soil fertility when the nutrient rich top soil is washed away (de Bruyn, 2006).

All the economic indicators were categorised as not sustainable in both communities. This qualifies the economic dimension of smallholder cattle production sustainability as critical and warrant further research. Low economic levels of smallholder farmers were previously mentioned by various authors including (Ainslie et al., 2002; Phiri, 2009; Altman et al., 2009). As mentioned before, strategies to improve the economic dimension of sustainability should ensure that the social and environmental dimensions are maintained or improved. Income from social grants cannot be improved by any scientific methods. Non-farm income has the potential to provide investment capital in the smallholder cattle production cycle. However, this income source may not improve the sustainability of the smallholder cattle production system as it takes away labour from the system and makes decision making on important farm-

based matters even more complex. Low mean scores of non-farm income as well as social grants is an indication that the smallholder cattle production system should focus more on resources inherent within the boundaries of the two communities and their local, natural resources.

Income from crops is one indicator that can be considered for improving the economic sustainability of smallholder cattle producers in the ECP. However, the fact that its success depends on irrigation renders its energy requirement not suited for the low economic levels of farmers. Irrigated crop production is currently highly subsidised in Ncorha and may not be sustained by farmers without Government support (ECDC, 2012). In addition, the climate, edaphic and topography of most parts of the ECP does not favour rain-fed crop production (Acock, 1988). Potential for improving economic sustainability, therefore, lie in livestock production. However, crop production is also important because of its complementarity with cattle production. According to Jari and Fraser (2009) in integrated crop-livestock systems crops residues are used to feed livestock and manure from livestock are used to improve soil fertility of the crop fields. This complementarity allows for more efficient use of resources.

Of the two livestock-based economic indicators used in the current study, cattle income had relatively higher mean scores than income from other livestock. In fact, mean scores for cattle income were relatively higher, for both communities, than any of the other economic indicators used in the current study. This justifies the importance of focusing on improving cattle income as a priority indicator for improving the economic sustainability of smallholder cattle producers in the ECP. Lack of appropriate marketing infrastructure and reliable high value markets are considered responsible for the low levels of income from cattle and other livestock in the ECP (Ainslie et al., 2002; NERPO, 2005). Monsthwe (2006) acknowledges the phenomenal potential for

enhanced smallholder household economics inherent in cattle and suggests enhanced institutional support in improving marketing infrastructure in rural areas. Coetzee et al. (2005) highlighted some reasons that make smallholder cattle producers reluctant to sell their cattle. The authors further indicated that a reliable cattle marketing system will provide an impetus for more efficient cattle production. It is therefore important to identify marketing opportunities available for smallholder cattle producers in the surveyed communities and explore factors that influence smallholder cattle producers to sell cattle.

3.4 Conclusion

The social and environmental dimensions of smallholder cattle production system in the ECP were conditionally sustainable while, the economic dimension of sustainability was not sustainable. Overall, the smallholder cattle production system in the ECP was conditionally sustainable. It is, therefore, important to develop strategies that improve marketing of smallholder cattle and increase returns realised from cattle sales. Further research to identify strategies that enhance the economic sustainability of the smallholder beef production system are recommended.

References

Acocks, J.P.H. (1988). Veld types of South Africa, 3rd Edition. *Memoirs of the Botanical Survey of South Africa*, **57**: *1–146*.

Ainslie, A., Kepe, T., Ntsebeza, L., Ntshona, Z., & Turner, S. (2002). Cattle ownership and production in the communal areas of the Eastern Cape Province, South Africa. Research Report no. 10. University of the Western Cape.

Altman, M., Hart, T. & Jacobs, P. (2009). Household food security status in South Africa. *Agrekon*, **48**(4): *345-361*.

Astier, M., García-Barrios, L., Galván-Miyoshi, Y., González-Esquivel, C.E. & Masera. O.R. (2012). Assessing the sustainability of small farmer natural resource management systems. A critical analysis of the MESMIS program (1995-2010). *Ecology and Society* **17**(3): *25*. Accessed on 18 February 2015 at http://www.dx.doi.org/10.5751/ES-04910-170325

Atanga, N.L., Treydte, A.C., & Birner, R. (2013). Assessing the Sustainability of Different Small-Scale Livestock Production Systems in the Afar Region, Ethiopia. *Land*, **2**: *726-755.*

Bill and Melinda Gates Foundation (2010) Agricultural Development Outcome Indicators: Initiative and Sub-Initiative Progress Indicators & Pyramid of Outcome Indicators, BMGF.

Billinksy, P and Swindale, A. (2010). Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access: Indicator Guide. Food and Nutrition Technical Assistance Programme. AED /USAID.

Binder, C.R., Feola, G. & Steinberger, J.K. (2010). Considering the normative, systemic and procedural dimensions in indicator-based sustainability assessments in agriculture. *Environmental Impact Assessment Review,* **30**: *71–81.*

Boogaard, B.K., Oosting, S.J., Bock, B.B. & Wiskerke, J.S.C. (2011) The socio-cultural sustainability of livestock farming: an inquiry into social perceptions of dairy farming. *Animal*, **5**(9): *1458–1466*.

Chikura, S. (2006). Herd Structure, Offtake and Mortality of Cattle in a Crop-livestock Farming System of Wedza Communal Area, Zimbabwe. *Journal of Sustainable Development in Africa,* **8**(3): *10-17*.

Coetzee, L., Montshwe, B.D. & Jooste, A. (2005). The marketing of livestock on communal lands in the Eastern Cape Province: Contraints, Challenges and Implications for the extension services. *South African Journal of Agricultural Extention*, **34**(1): *81-103*.

Cousins, B., Hoffman, M.T., Allsopp, N. & Rohde, R.F. (2007). A synthesis of sociological and biological perspectives on sustainable land use in Namaqualand, *Journal of Arid Environments*, **70**: *834-846*.

CSIR. (2004). Eastern Cape Province state of the environment report. CSIR, Division of water, environment and forestry technology. Durban, South Africa. Accessed on 14 December 2015 at: http://www.environment.gov.za/soer/ecpae/download_report.htm

Darnhofer, I., Fairweather, J. & Moller, H. (2010). Assessing a farm's sustainability: insights from resilience thinking. *International Journal of Agricultural Sustainability*, **8**(3): *186-198*.

de Bruyn, T.D. (2006). The condition, productivity and sustainability of communally grazed rangelands in the central Eastern Cape Province Department of Livestock and Pasture Science, University of Fort Hare.

Department of Agriculture Fisheries & Forestry (DAFF) (2012). Accessed on 15 November, 2014 from. http://www.nda.agric.za/docs/AMCP/Beef2012-13.pdf

Department of Water Affairs (DWA), South Africa. (2012). Water Quality management.

Dovie, D.B.K., Shackleton, C.M. & Witkowski, E.T.F. (2006). Valuation of communal area livestock benefits, rural livelihoods and related policy issues. *Land Use Policy*, **23**: *260–271*.

Eastern Cape Development Corporation (ECDC). (2012). Eastern Cape Development Corporation sector profile: Agriculture–Livestock, pp. 1-7. Accessed on 18 September 2014 at: http://www.ecdc.co.za/sectors/sectors.asp?pageid=101.

Fraser, E.D.G., Dougill, A.J., Mabee, W.E., Reeda, M. & McAlpine, P. (2006). Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management*, **78**; *114–127*.

Gómez-Limón, J.A. & Sanchez-Fernandez, G. (2010). Empirical evaluation of agricultural sustainability using composite indicators. *Ecological Economics*, **69**: *1062-1075*.

Grwambi, B., Unathi, K., Maine, N., Mphahlele, K., Raidimi, N and Ramaifo, K. (2006). Livelihoods in the rural areas of Blouberg municipality (Gemarke and early dawn villages), Limpopo Province, South Africa. Working document series 129.

Halberg, N., van der Werf, H.M.G., Basset-Mens, C., Dalgaard, R. & de Boer, I. (2005). Environmental assessment tools for the evaluation and improvement of European livestock production systems. *Livestock Production Science*, **96**: *33–50*.

Jari, B. & Fraser, G.C.G. (2009). An analysis of institutional and technical factors influencing agricultural marketing amongst smallholder farmers in the Kat River Valley, Eastern Cape Province, South Africa. *African Journal of Agricultural Research,* **4**: 1129–1137.

Jacobs, P. (2012). Household food access in rural South Africa: Lessons for emerging food security policy Economic Performance and Development. *Presentation at the International Scientific Symposium on Food and Nutrition Security Information 17-19 January 2012*, FAO Headquarters, Rome, Italy.

Lebacq, T., Baret, P.V. & Stilmant, D. (2013). Sustainability indicators for livestock farming: A review. *Agronomy for Sustainable Development*, **33**(2): *311-327*.

Libala, P. (2014). Ncora irrigation scheme injection. *Community development lifestyles services*. Accessed on 17.09.15 at www.chrishanidm.gov.za/14956-ncorha-irrigation-scheme-injection.html

López Ridaura, S., (2005). Multi-Scale Sustainability Evaluation: A framework for the derivation and quantification of indicators for natural resource management systems. Unpublished PhD. Thesis, Wageningen University.

Makhura, M.T. (2002). Overcoming transaction costs barriers to market participation of smallholder farmers in the Nothern Province of South Africa. Unpublished PhD Dissertation. University of Pretoria.

Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. & Mapekula, M. (2009). Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. *Livestock Science*, **124**: *196-204*.

Mapiye, C., Chimonyo, M., Dzama, K., Strydom, P.E. & Muchenje, V. (2010). Meat quality attributes of Nguni steers supplemented with Acacia karroo leaf-meal. *Meat Science*, **8**(4): *621-627*.

Marufu, C. M., Qokweni, L., Chimonyo, M. & Dzama, K. (2011). Relationships between tick counts and coat characteristics in Nguni and Bonsmara cattle reared on semiarid rangelands in South Africa. *Ticks and Tick-Borne Diseases*, **2**: 172-177.

Momba, M.N.B., Tyafa, Z., Makala, N., Brouckaert, B.M. & Obi, C.L. (2006). Safe drinking water still a dream in rural areas of South Africa. Case Study: The Eastern Cape Province. *Paper was originally presented at the 2006 Water Institute of South Africa (WISA) Biennial Conference, Durban, South Africa*, 21-25 May 2006.

Montshwe, B.D., Jooste, A. & Alemu, Z.G. (2005). An econometric analysis of the determinants of market participation within the South African Small-scale Cattle Sub-sector. *A paper presented at the 42nd annual conference of the Agricultural Economics Association of South Africa*, Lord Charles hotel, Somerset West. 21–23 September 2004.

Moyo, B., Dube, S., Lesoli, M. & Masika, P.J. (2008). Communal area grazing strategies: institutions and traditional practices. *African Journal of Range and Forage Science*, **25**(2): *47–54*.

Moyo, B., Dube, S., Lesoli, M & Masika, P.J. (2013). Seasonal habitat use and movement patterns of cattle grazing different rangeland types in the communal areas of the Eastern Cape Province, South Africa. *African Journal of Agricultural Research*, **8**(1): *36-45*.

Munyai, F.R. (2012). An evaluation of socio-economic and biophysical aspects of small-scale livestock systems based on a case study of Limpopo Province: Mduluni village. Unpublished PHD Thesis University of Free State.

Musemwa, L., Mushunje, A., Chimonyo, M., Fraser, G., Mapiye, C. & Muchenje, V. (2008). Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. *African Journal of Agricultural Research*, **3**(4): *239-245.*

Musemwa, L., Mushunje, A., Chimonyo, M. & Mapiye, C. (2010). Low cattle market offtake rates in communal production systems of South Africa: Causes and migration strategies. *Journal of Sustainable Development in Africa*, **12**: *209-226*.

Mwabu, G. & Scultz, P.T. (1996). Education returns across quantiles of the wage function: Alternative explanations for returns to education by race in South Africa. *The American Economic Review*, **86**(2): *335-339*.

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S. & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science*, **130:** *57-69*.

NERPO (2005). Emerging red meat industry analysis in South Africa. A study commissioned by the Department of Agriculture. Pretoria

Ngxetwane, V. (2011). Integrated crop-livestock farming system for sustainable Economic empowerment of small-scale and emerging Farmers in the former homeland of the Eastern Cape Province of South Africa: Case study of Ciskei area in Nkonkobe municipality. Unpublished MSc Thesis, University of Fort Hare, South Africa.

Njuki, J., Poole, J., Johnson, N., Baltenweck, I., Pali, P., Lokman Z., & Mburu, S. (2011). Gender, Livestock and Livelihoods Indicators. International Livestock Research Institute (ILRI).

Nkhori, P.A. (2004). The impact of transaction costs on the choice of cattle markets in Mahalapye district, Botswana. MSc Dissertation, University of Pretoria, RSA.

Nyangito, H.Z. (1986). A Socio-Economic Analysis of the Factors That Determine the Effect of Potato Post Harvest Practices and Storage Technologies on Kinangop, Kenya. MSc Thesis, University of Nairobi, Kenya.

Phiri, C. (2009). Livestock, rural livelihoods and rural development inrterventions in the Eastern Cape Province: Case studies of Chris Hani, Alfred Nzo and Amathole District Municipalities. Unpublished PhD Thesis, University of Fort Hare.

Pretty, J., Toulmin, C. & Williams, S. (2011). Sustainable intensification in African agriculture, *International Journal of Agricultural Sustainability*, 9(1): *5-24*.

Quisumbing, A.R. & Yohannes, Y. (2004). How Fair is Workfare? Gender, Public Works and Employment in Rural Ethiopia. World Bank Policy Research Working Paper No. 3492.

Randolph, T.F., Schelling, E., Grace, D., Nicholson, C.F., Leroy, J. L., Cole, D.C., Demment, M.W., Omore, A., Zinsstag, J. & Ruel, M. (2007). Invited Review: Role of livestock in human nutrition and health for poverty reduction in developing countries. Journal of Animal Science: *2788-2800*.

Statistical Analytical Systems (SAS) Institute Inc. (2012). Base SAS® 9.3 Procedures Guide. Cary, North Carolina, USA.

Statistics South Africa (SSA). (2003). Republic of South Africa.

Statistics South Africa. (2014). Labour and Development Research Unit, Pretoria, Republic of South Africa.

Stoorvogel, J.J., Antle, J.M., Crissman, C.C. & Bowen, W. (2004). The trade-off analysis model: integrated bio-physical and economic modeling of agricultural production systems. *Agricultural Systems*, **80**: *43–66.*

Sydorovych, O. & Wossink, A. (2008). The meaning of agricultural sustainability: Evidence from a conjoint choice survey. *Agricultural Systems*, **98**: *10-20*.

Tilman, D. (1997). Biodiversity and ecosystem functioning; In Nature's Services Societal Dependence on Natural Ecosystems. Island Press, Washington, D.C: *93-112*.

Vagias, W.M. (2006). Likert-type scale response anchors. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

WHO (2003) Emerging Issues in Water and Infectious Disease, World Health Organisation, Geneva, Switzerland.

Chapter 4: Determinants and opportunities for marketing smallholder beef cattle in South Africa

Abstract

The study was designed to explore the factors influencing the potential of smallholder producers to sell cattle and marketing opportunities for sustainable beef production in South Africa. A total of 95 pretested structured questionnaires were administered to Ncorha and Gxwalibomvu communal areas in the Eastern Cape Province (ECP). Mean household cattle herd size was significantly higher ($P < 0.05$) in Ncorha (13.7 ± 1.9) than in Gxwalibomvu (11.3 ± 1.9). Average annual cattle sales for both villages were 2.1 ± 0.3. The logit model showed that young farmers, Christians and small sized households had a high potential to sell cattle. Similarly, the potential to sell cattle was high for households with small cattle herd sizes, low income and those who received extension services. Most smallholder cattle producers in the ECP indicated that they have the potential and are willing to participate in the development of a NB brand. About 35% of the interviewees from both communities acknowledged that they expect a premium for the beef brand. Strategies suggested for improving cattle marketing in the studied areas were branding (~80% of the respondents), feedlotting (~60%) and group marketing (~55%) and forward contracting (~5%) It was concluded that smallholder cattle producers' potential to sell cattle is influenced by age, size and income of the household, religion, cattle herd size, and availability of extension services. Opportunities for improving access to formal markets by smallholder cattle producers are branding, feedlotting and group marketing, respectively.

Keywords: marketing trends; potential; willingness; natural-pasture beef brand; premium, smallholder cattle producers

4.1 Introduction

Assessment of sustainability of the smallholder cattle production system in Chapter 3 revealed that the economic dimension of sustainability was not sustainable while, the environmental and social dimensions were conditionally sustainable. Appropriate interventions to boost household income of smallholder cattle producers could help improve the economic dimension of sustainability. From the economic indicators used for assessment of sustainability in Chapter 3, cattle income had the largest proportion

of high income earners. Strategies designed at further improving cattle income in a sustainable way are essential. Especially considering the high market value of cattle and also that they are the most preferred livestock among many smallholder farmers.

As reported by Tada et al. (2012), beef cattle production is considered to have great potential to increase smallholder household income, contribute to food and nutrition security of smallholder farmers. Subsequently, cattle can potentially play a central role in building a strong rural economy leading to reduction in poverty and more efficient use of natural resources (Monsthwe et al. 2005). However, Phiri (2009) expressed concern on the underestimation or sometimes total alienation of smallholder cattle production. The authors also suggested identification and implementation of improved cattle production and marketing strategies that are key to unlocking the potential of this livestock sub-sector.

The deregulation of the red meat industry in 1997 in South Africa was described by Monsthwe (2006) as an important policy intervention meant to improve production and marketing of cattle belonging to smallholder farmers. However, over a decade after the deregulation, smallholder cattle producers are still trapped in a vicious cycle of challenges including lack of market access to drive more efficient cattle production. Coetzee et al. (2005) reiterated the pivotal role played by markets in providing incentives that act as an impetus for increased efficiency of production. The current study aims to identify determinants of smallholder producers' potential to sell cattle and marketing opportunities for sustainable beef production in South Africa.

4.2 Materials and methods

4.2.1 Study site and farmer selection

The study location, farmer selection and period of data collection is as described in Chapter 3 section 3.1.

4.2.2 Data collection

Data collected included household socio-demographic information, livestock numbers and ownership, cattle herd composition, slaughters, sales, cattle marketing channels among other marketing information and smallholder producers' perceptions on developing a NB brand. See appendix 1 for more details. Some terms that are going to be used prominently throughout this chapter are defined below.

1. Commercial or market offtake rate includes the number animals sold as percentage of total herd size at the beginning of the period under consideration.
2. Non-commercial offtake includes the number of animals donated, slaughtered or loaned as a percentage of total herd size at the beginning of the period under consideration. However, for the current study only cattle slaughtered will be considered to represent non-commercial offtake as cattle donated or loaned did not apply in the surveyed communities.
3. Gross offtake includes the number of animals sold, donated, slaughtered or loaned as a percentage of a total herd size at the beginning of the period under consideration.

The emphasis in the current study is on commercial offtake rates and not the gross offtake rate which according to Ba et al. (1996) includes the number animals sold, donated, slaughtered, or loaned as a percentage of the adjusted number of animals. Cattle herd size and cattle sales data was used to calculate market off-take rates for each community using the formula below:

$$Commercial\ \ offtake\ in\ the\ last\ 12\ months = \frac{Cattle\ sold\ in\ the\ last\ 12\ months}{Total\ herd\ size\ 12\ months\ ago} x100$$

The importance of market offtake rate lies in its potential to improve the economic sustainability of smallholder cattle producers through enhanced household income.

4.2.3 Statistical analysis

Household socio-demographic data were subjected to descriptive statistics using PROC FREQ of SAS (2012). Livestock ranks were subjected to the PROC NPAR1WAY procedure using the Wilcoxon rank-sum test of SAS (2012). Cattle herd sizes, sales and offtake were analysed using the PROC GLM procedure of SAS (2012). The model fitted data including community, gender, age, education, marital status, income level/status, cattle prices and herd size as fixed effects. Treatment means were generated and separated using the LSMEANS and PDIFF options, respectively. Significance was declared at $P < 0.05$.

PROC LOGISTIC model of SAS (2012) was used to determine factors that effects smallholder producer's potential to sell cattle. Household cattle sales in February 2014 to February 2015 were used as a proxy for the potential of smallholder cattle producers to sell cattle. The logistic distribution function for factors determining the potential of a smallholder cattle producer to sell was according to Gujarat (2003) as:

$$\log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_n \beta X_n$$

Where;

P = Potential of a smallholder cattle producer to sell cattle;

β_1, $\beta_2 \ldots \beta_n$ = coefficients of independent variables;

χ_1, $\chi_2 \ldots \chi_n$ = independent variables.

The empirical specifications of the determinants underlying the binomial logit makes reference to current cattle sales and were formulated as follows:

$$Y_i(Potential\ to\ sell\ cattle) = \beta_0(intercept) + \beta_1(community) + \beta_2(age)$$
$$+ \beta_3(gender) + \beta_4(marital\ status) + \beta_5(household\ size) + \beta_6(religion)$$
$$+ \beta_7(education) + \beta_8(income\ level) + \beta_9(employment\ status)$$
$$+ \beta_{10}(cattle\ herd\ size) + \beta_{11}(average\ market\ price)$$
$$+ \beta_{12}(willingness\ to\ participate\ in\ developing\ a\ natural\ pasture\ beef\ brand)$$
$$+ \beta_{13}(membership\ to\ a\ marketing\ organization)$$

4.3 Results and discussion

4.3.1 Socio-economic characteristics of households

Results of socio-demographic characteristics were reported in Chapter 3 section 3.2.1.

4.3.2 Importance of livestock

Livestock were ranked in a similar trend in both communities with cattle being ranked as the most important livestock followed by sheep, goats, pigs, chickens and horses, respectively (Table 4.1). Ruminants are the most preferred livestock as previously reported by Ainslie et al. (2002). The rank of cattle as the most important livestock is coherent with what was reported by Mahabile et al. (2002). The same results are consistent with socio-economic and cultural values of cattle as, a sign of wealth, a living bank, as well as the preferred asset of inheritance (Musemwa et al., 2010).

Table 4.1: Livestock ranks and mean ranks in the ECP

Livestock	***Ncorha*** *(*n = 47*)* ***Rank*** *(*mean rank*)*	***Gxwalibomvu*** *(*n = 48*)* ***Rank*** *(*mean rank*)*
Cattle	1(1.08)	1(1.24)
Sheep	2(1.92)	2(1.30)
Goats	3(2.89)	3(2.66)
Pigs	4(2.96)	4(3.82)
Chickens	5(3.53)	5(4.51)
Horses	6(4.98)	6(5.73)

The lower the rank of livestock, the greater is its importance.

As shown in Table 4.2, mean flock numbers of sheep, goats and pigs, did not significantly differ (P > 0.05) between Ncorha and Gxwalibomvu communal areas. However, mean chicken numbers were significantly lower (P < 0.05) in Ncorha than in Gxwalibomvu. The higher mean chicken flock sizes in Gxwalibomvu could be as a result of noticeable efforts to improve chicken production in this community. Most households in Gxwalibomvu had high quality poultry structures. This signifies the importance with which chickens are regarded in Gxwalibomvu. One particular interviewed household had devised a brooding strategy of keeping young chicks indoors under naturally controlled environment. The strategy is meant to reduce chick mortality as well as to reduce brooding pressure from hens allowing them to quickly regenerate their reproductive physiological mechanisms and produce more chicks. The mean number of horses was significantly higher (P < 0.05) in Ncorha than in Gxwalibomvu. This may be because the grazing areas were further in Ncorha than in Gxwalibomvu. Horses in the ECP are mainly used by cattle herders when herding cattle or to drive cattle to rangelands during the day and collect in the evening for kraaling.

Table 4.2: Effect of community on livestock flock sizes (Mean ± SE) in the Eastern Cape Province

Livestock	***Ncorha*** *(*n = 47*)*	***Gxwalibomvu*** *(*n = 48*)*
Sheep	38.1 ± 16.2	39.6 ± 17.8
Goats	22.2 ± 5.1	24.7 ± 5.5
Pigs	9.4 ± 3.4	6.1 ± 3.6
Poultry	8.8 ± 5.3[b]	21.0 ± 5.2[a]
Horses	1.4 ±0 .4	0.3 ± 0.1

[ab] Across row LSmeans with different superscripts significantly differ (P < 0.05)

4.3.3 Cattle herd size and composition

Cattle herd sizes and composition for the two communities is shown in Table 4.3. There were no significant differences (P > 0.05) in the numbers of calves, cows and heifers and bulls between the two communities. Ncorha communal area had significantly larger (P < 0.05) numbers of steers and total cattle herd size than Gxwalibomvu. The reason for this difference may be consistent with higher crop production in the Ncorha community reported earlier in the current study. High crop production exposes cattle to more feed resources in the form of crops and crop residues. As stated by Jari and Fraser (2009) crop residues can make tremendous contribution to the cattle diet during the dry season if they are managed well.

Table 4.3: Cattle herd size and composition in the Eastern Cape Province

Herd class	***Ncorha*** *(*n = 47*)*	***Gxwalibomvu*** *(*n = 48*)*
Calves	2.8 ± 0.78	2.7 ± 0.84
Steers	4.3 ± 2.0[a]	2.4 ± 2.0[b]
Cows and heifers	4.6 ± 2.8	3.6 ± 2.8
Bulls	0.9 ± 0.2	0.6 ± 0.2
Cattle herd size	13.7 ± 1.9[a]	11.3 ± 1.9[b]

[ab] Across row Lsmeans with different superscripts significantly differ (P < 0.05)

The differences in numbers of steers could also be a result of some Ncorha cattle producers buying in steers for finishing and resale. This assumption may be valid given the differences in feeding resources between two communities, particularly, during the dry season. Consequently, this may incite some cattle producers to take advantage of this additional feed resource to buy in steers for reselling at a profit.

The trend common to both communities is that cattle herds are largely composed of cows and heifers followed by steers, calves and bulls, respectively. The high composition of breeding females may be due to the fact that they are the source of growth to the herd. In addition, cows also produce milk which enhances food security,

with surplus milk providing a source of livelihoods through milk sales (Phiri, 2009). Low bull numbers may be due to the fact that most male animals are castrated early in life to induce docility so that they can be used for draught power (Mapekula et al., 2009). Extra steers are usually the target for selling (Musemwa et al., 2008) or slaughter for various purposes, hence, the relatively low numbers in this regard.

All the investigated factors, except community, did not significantly affect ($P > 0.05$) cattle herd size. However, employment status showed a tendency to affect ($P \leq 0.05$) cattle herd size. Employed respondents tended to have higher ($P < 0.05$) mean cattle herd sizes than unemployed respondents. These results are not unusual as employed respondents would be expected to be more likely to have the financial capacity to invest in cattle. The results are also consistent with the indications made by the majority of respondents in the current study that they used their own funds to buy their initial cattle herds. Moreover, employed respondents may also be less likely to sell their cattle as they may be able to meet their financial requirements through wages and/or salaries. Ainslie et al. (2002) reported that smallholder farmers are not keen to sell their cattle unless when confronted by emergent need for cash. In this regard, employment respondents may have other options for cash rebates such as bank loans or advance payments from their employers. These options make them less likely to sell cattle for emergency cash demands, hence, larger cattle herd sizes.

4.3.4 Cattle breeds

Over 65% of respondents from both communities had cattle herds comprised of mixed breeds (non-descript cross breeds). Over 20% of respondents from both communities mentioned the Nguni breed as the second most common. Other breeds recorded were the Brahman (7%) and Afrikaner (2%) breeds present in Ncorha but both breeds were not available in Gxwalibomvu. Similar reports by Nqeno et al. (2011) revealed that the majority of cattle breeds kept by smallholder farmers in South Africa are non-descript

cross breds. Muchenje et al (2008) and Mapiye et al. (2009) advocated for more profound use of the Nguni breed by smallholder cattle producers as a way of sustainably improving the contribution of cattle to their food security and livelihoods. The authors reasoned that the Nguni breed is well adapted to the environment and management levels of most smallholder cattle producers and therefore, would likely maintain relatively high productivity under limited resources. Furthermore, Muchenje et al. (2008) also revealed that indigenous Nguni cattle breeds can potentially produce high quality and healthy beef in an ethically and environmentally conscious manner.

4.3.5 Sources of cattle

Slightly more (78%) respondents from Gxwalibomvu bought their own cattle than those from Ncorha (68%). This corresponds with the income trend presented in Chapter 3 which shows that a greater proportion of Gxwalibomvu respondents earn a comparatively higher level income. Thirty-two percent of the respondents from Ncorha received their first cattle through gifts and inheritance compared to 22% in Gxwalibomvu. The probable reason for this may be consistency with their traditional believes. Results from the current study (Chapter 3, section 3.1) revealed that a greater proportion of Ncorha respondents believe in the traditional religion than Gxwalibomvu respondents. According to Munyai (2012) and Stroebel et al. (2001) cattle are offered as gifts at weddings, traditional ceremonies, for example, boys are given cattle as presents during initiation ceremonies that are conducted after they are graduated into manhood through circumcision. Cattle can also be given to a member of a family who inherits the name of a great grandfather or an ancestor.

4.4.6 Knowledge of beef cattle production

Figure 4.2 shows the proportion of smallholder cattle producers who acknowledged possessing good knowledge on the selected fields of beef cattle production. Good knowledge of general cattle production was proportionally acknowledged by almost a

quarter of respondents while. Good knowledge of the rest of the fields was appreciated by less than 20% of the respondents. The trend of good knowledge of the selected fields was similar between both Ncorha and Gxwalibomvu communities. The results can be used to establish areas that require capacity building through on farm skills development programs. Skills such as management of natural pastures, risks and conflicts management are usually underestimated although they have huge environmental and social consequences (Munyai, 2012). Farm business management training is particularly key to provide basic skills to encourage the transition of smallholder cattle producers from subsistence to commercial operational levels.

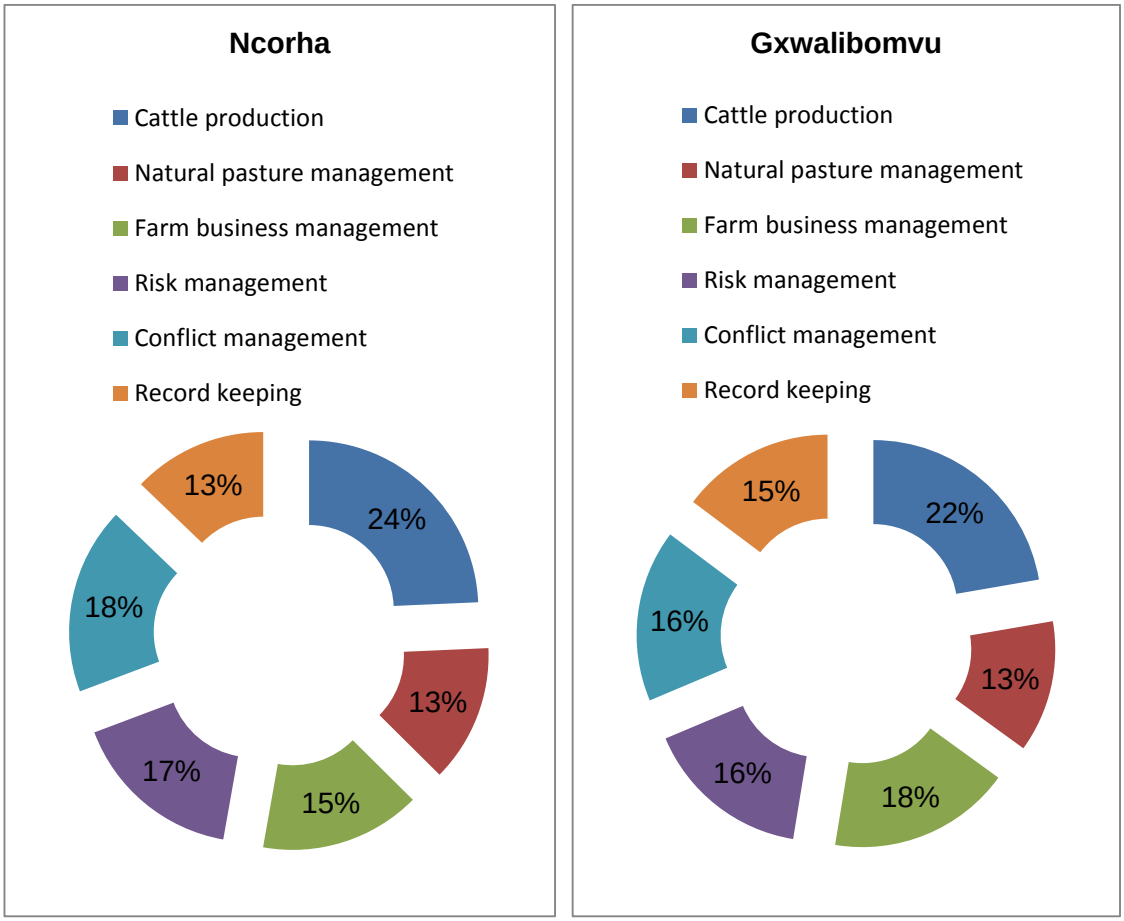


Figure 4.1: Proportion of respondents exhibiting good knowledge of the selected cattle farming aspects in the ECP of South Africa

4.3.7 Marketing of beef cattle

The current study established that over 85% of respondents from both communities sold their cattle through local/private sales and the remaining 15% sold their animals to speculators who buy for resell. Similar results were also recorded by Munyai (2002); Coetzee et al. (2005) and Ndoro et al. (2015) who reported that the majority of cattle sales in communal areas are done through the private sales. In the current case, a key informant narrated that the feedlots established in the two communities with the intention to improve cattle body condition prior to marketing have become central markets for local sales.

Over 90% of respondents from both communities indicated that they get prevailing cattle market prices from grapevine through the word of mouth. The rest of the respondents acknowledged getting cattle market price information from radios televisions or agricultural extension officers. According to Randolph et al. (2007) information such as prevailing production techniques, market opportunities and consumer demands on type, quality and quantity of beef as well as prevailing market prices is essential for beef cattle producers to make more informed market decisions. Coetzee et al. (2005) added that access to relevant marketing information prevent cattle producers' from being exploited by more informed cattle middlemen. A study by Musemwa et al. (2008) provided evidence that an atmosphere of inclusiveness and transparency exist when sufficient marketing information is freely provided to smallholder cattle producers. This will eventually lead to improved market participation. However, smallholder cattle producers still lack sufficient and timeous marketing information because of low literacy levels and inefficient communication systems (Ntshephe, 2011). This could be because this information is usually communicated in English through other channels like radio/television or the internet which cannot be accessed by the majority of smallholder farmers.

Community had no effect ($P > 0.05$) on cattle sales, slaughters and total offtake. Average cattle sales per household for the both Ncorha and Gxwalibomvu were 2.1 ± 0.3 cattle per annum. Respondents in both communities indicated that they slaughter an average of one animal every two years for home consumption. Cattle commercial offtake rate of the two surveyed communities was approximately 20% and did not significantly differ ($P > 0.05$) between the two communities. This commercial offtake rate fall behind the over 25-30% reported for commercial cattle producers in South Africa. It is, however, higher than previously recorded market offtake rates of 10.7% (Montshwe et al., 2005), 12.1% (Musemwa et al., 2010) and 17% (Ndoro et al., 2015) reported in the smallholder areas. This could be the result of improved marketing conditions of cattle through feedlotting programs being administered by the National Agricultural Marketing Council (NAMC). The feedlotting program was hailed by smallholder cattle producers for boosting their income from cattle sales.

All the other investigated factors, except household size, had no significant effect ($P > 0.05$) on cattle sales, slaughter and commercial offtake. Large household sizes with more than ten household members recorded significantly higher ($P < 0.05$) mean cattle sales (2.3 ± 0.4) than those with less than ten household members (1.8 ± 0.3). This may be because larger households are assumed to exert a greater financial burden on household heads thereby forcing them to sell their cattle. The greater financial burden arises from the money required to attain the basic daily requirements of each individual member of the household. Although the current study found no significant differences between household size and cattle herd size, it is also possible that larger households would have larger cattle herds and consequently, would be liable to sell relatively more cattle than smaller households with fewer cattle.

4.3.8 Determinants of smallholder producers' probability to sell beef cattle

Table 4.4 below shows the odds ratio estimates of a household's potential to sell cattle. The logit model shows that probability to sell cattle is more than double for young cattle producers below the age of 40 years than for adults over 40 years. Younger cattle producers were also previous reported to have greater potential to sell more cattle by Monsthwe (2006). This may be due to the fact that younger smallholder cattle producers have a greater affinity for material belongings than their older counterparts (Munyai, 2012). Their higher potential to sell cattle is probably due to the need to generate funds to fulfil material needs such as housing, household property, clothing and other assets. In addition they may also have more dependents in the form of their own young families, their parents as well as other extended families that might be entirely dependent on them for economic social and material needs (Monsthwe, 2006). On the other hand, older smallholder cattle producers might have accumulated most of their material requirements earlier in life leaving them with a lower affinity for material possessions. In addition, they may also have less dependants as most of them may be old enough to be responsible for their own livelihoods. In fact, some of their former dependents may also turn to be providers thereby, leaving older smallholder cattle producers with less pressure to sell cattle for immediate financial needs. Older cattle producers may also be placing more value on the social roles of their cattle and disregarding the economic ones due to less financial pressure.

The potential to sell cattle was almost one and half times higher for Christians than those who believe in the Traditional religion. This may be due to the fact that cattle have more traditional roles associated with them than Christian roles. Some of the unique traditional roles indicated by Herrero et al. (2010) and Mapiye et al. (2009) include bulls used as spirit mediums, to appease spirits, compensate avenging spirits, veneration of ancestors and exorcism of evil spirits. Christians do not have these annotations attached to cattle hence, their greater propensity to sell.

The odds ratio estimate in the logit model results in Table 4.4 also show that the probability to sale cattle decreases as household size increases. It is possible that larger households have larger cattle herds and consequently, would be liable to sell relatively more cattle than smaller households with fewer cattle. However, in reality this may not be the case owing to complex cattle ownership patterns of in the smallholder production systems. Monsthwe et al. (2005) indicated that a herd belonging to one household may be partly owned by various people, some of whom might not be staying on farm. This makes cattle marketing decisions more complex and given that larger households have a greater likelihood for multiple ownership, their potential to sell is reduced.

Table 4.4: Odd ratio estimates, lower and upper confidence interval (CI) of a household's potential to sell cattle

Effects	***Odds ratio***	***Lower CI***	***Upper CI***
Community (Ncorha vs. Gxwalibomvu)	0.79	0.23	2.67
Age (youths vs. adults)	2.65	0.57	12.22
Gender (males vs. females)	0.33	0.08	1.23
Marital status (married vs. not married)	0.71	0.17	2.97
Religion (Christians vs. Traditionalists)	1.42	0.34	5.91
Household size (≤5 members vs. >5 members)	5.34	0.96	29.80
Education (educated vs. not educated)	0.07	0.00	17.99
Cattle herd size (≤10 vs. >10)	2.26	0.63	8.15
Farming experience (≤20 years vs. >20 years)	0.52	0.14	1.89
Employment (employed vs. unemployed)	0.44	0.09	2.07
Breed (Nguni vs. other breeds)	0.64	0.05	7.80
Source of cattle (bought vs. given)	0.86	0.21	3.60
Livestock training (trained vs. untrained)	0.44	0.05	3.80
Availability of extension services (yes vs. no)	1.35	0.45	4.10
Income (≤R3000 vs. >R3000)	1.15	0.24	5.45
Distance to market (≤50km vs. >50km)	0.83	0.27	2.61
Average market price (≥R7000 vs. >R7000)	0.90	0.27	2.94
Participate in branding (yes vs. no)	0.30	0.09	1.08

Households with small cattle herd sizes had a higher propensity to sell cattle than those with larger herd sizes. More precisely, Table 4.4 shows that households with small cattle herd sizes are twice more likely to sell their cattle than those with large cattle herd sizes. This may be due to the fact households with large cattle herds use cattle to show their relative wealth. The notion of showing wealth through keeping a large cattle herd was reported by Randolph et al. (2007) to be rife among communal farmers. Coetzee et al. (2005) also indicated that relatively wealthy smallholder cattle producers are reluctant to sell their cattle as they signify their wealth. In this regard, households with smaller cattle herd may have fewer resources hence, the higher propensity to sell cattle. This is supported by the reports that smallholder cattle producers are mainly forced to sell cattle when a desperate need for cash arises (Musemwa et al., 2008; Monsthwe, 2006; Coetzee et al., 2005).

The odds ratio shows that the smallholder cattle producers' potential to sell cattle increases with availability of extension services. This reinforces the common outcry for more reliable extension services in smallholder farming areas (Agholor, 2013). Extension services have an undoubted essential role in providing relevant information on cattle production and marketing. Bailey et al. (1999) reckoned that the availability of consistent extension services to communal farmers is synonymous to on-farm training. In this regard, smallholder cattle producers who acknowledged availability of extension services may have been more informed and consequently more involved cattle production and marketing, hence, the higher potential to sell cattle.

The odds ratio associated with income suggest that the probability of an individual farmer to sell cattle decreases with increasing income. At low income levels smallholder cattle producers may be more likely to be confronted by financial deficits

which will compel them to sell their cattle. The characteristic routine of smallholder farmers selling cattle in response to desperate financial needs were previous recorded by Ainslie et al. (2002) and Makhura (2002). Similarly, Jari and Fraser (2009) gave examples of situations that might compel farmers to sell cattle as school or hospital fees, funeral and dowry payment. This is opposed to smallholder cattle producers with high income levels as they can afford to settle most of their bills without having to sell livestock. Furthermore, the results are consistent with assertions by Randolph et al. (2007) that as income increases smallholder cattle producers will be more inclined to invest their savings in cattle. As discussed in Chapter 3, innovative strategies are important to increase household income for smallholder cattle producers and improve sustainability of their cattle production system. This will undoubtedly encourage greater investments in cattle resulting in a larger stock for marketing forming a reinforcing loop of the system.

4.3.9 Opportunities for marketing beef cattle in the smallholder areas

Smallholder beef cattle producers' suggestions to improve access to formal markets are shown in Table 4.5 below. More than 80% of the respondents in the studied areas indicated beef branding as the greatest opportunity for improving access to formal markets. This was followed by feedlotting (over 60%) and group marketing (almost 55%). Beef branding may have been more appealing as smallholder cattle producers keep getting involved until the end of beef value chain resulting in higher returns. This is opposed to their current marketing procedure where the majority of their cattle are sold to middlemen who then go and sell the cattle to abattoirs at a profit. Alternatively, beef branding may have gained popularity from the fact that the origin of beef will be placed on the labels for traceability purposes. The fact that beef retailers would be selling beef dedicated to have come from them must have caught the attention of smallholder producers, hence, the popularity. It may also be possible that smallholder

cattle producers saw a real opportunity for improved access to markets in the idea of developing a unique beef brand.

Table 4.5: Strategies to produce quality and volume of animals required to sustain natural beef brand in formal markets

Strategy	***Ncorha***	***Gxwalibomvu***
Branding	41.0	42.0
Feedlotting	32.0	31.0
Group marketing	24.0	25.0
Forward contracting	3.0	2.0

The idea of beef branding could be important in differentiating smallholder produced NB from other beef products from cattle raised under intensive production systems. Upon further probing, 70% of respondents from both communities believed the idea of developing a NB brand was good. About 20% thought it was not good while, 10% were undecided. Those who disputed the idea were predicting operational failure due to low numbers of good quality cattle that can be sold to support the brand consistently. A total of 70% of respondents from Ncorha and half of respondents from Gxwalibomvu indicated that they were willing to participate in developing a NB brand. Most of the respondents who declined to participate in developing the brand were the elderly who stated that they are old and therefore, might not have sufficient energy to work towards sustaining a recognised brand. Other respondents gave multi-ownership of cattle in a single herd as the reason for not willing to participate in brand development. They argued that most cattle herds are owned by up to four different people and rendering marketing decisions difficult to make. This was further complicated by the fact that some of the co-owners of cattle were employed in urban towns and often wants to be present when decisions are made about their cattle.

Nearly 35% of respondents from both communities also acknowledged that they will be expecting a premium to be paid for the beef brand. The majority (65%) of respondents however, felt that the addition of a premium price will make the beef more expensive leading to reduced sales as consumers opt for the conventional beef. Most respondents from both Ncorha (59%) and Gxwalibomvu (56%) believed that a niche market for natural beef exists. However, over 75% of respondents from both study areas predicted that they may develop a problem of consistently meeting the required cattle numbers due to lack of participation by fellow smallholder cattle producers.

Feedlotting was being implemented in both communities by the NAMC hence, its popularity. It was hailed for the positive influences they have had on smallholder cattle producers in these areas. For example, they are reported to have allowed cattle marketing to take place throughout the year as opposed to waiting for good quality natural pasture to finish cattle during the rainy season. In the past individuals seeking to buy cattle would have to move from one farmer to the other or take advantage public gatherings to convey cattle sales messages. With the advent of the feedlots local buyers simply visit the feedlots, identify the animals they want and buy the animal or contact the cattle owner when necessary. Smallholder cattle producers prefer this marketing system as it is simple and ensures instant payment. It is not associated with complexities of transporting cattle to abattoirs which are on average, over 100 km away from both communities and then waiting for days before payment is processed. Through the local sales marketing system smallholder cattle producers also do not have to worry about downgraded or rejected carcasses that sometimes occur at abattoirs. It is without doubt that a strategy to maximize the returns that smallholder cattle producers get from this marketing system was most treasured.

On the other hand, only less than 5% from both communities suggested forward contracting as a strategy to help them meet the market cattle demand. The reason why

smallholder cattle producers are sceptical about forward contracting might be that they are not sure whether they will be able to meet the required standards and cattle numbers to supply the market consistently. Forward contracting may be viewed by most smallholder cattle producers as a forced commitment since farmers will be obliged to supply cattle as prescribed in the contract. This strategy is undoubtedly not suitable for smallholder cattle producers. In this regard, it is logical to develop a unique NB brand that may create a demand and improve smallholder cattle producer's access to formal markets. This requires smallholder cattle producers to be organised into marketing groups to enable them to meet demand. These strategies are likely to maximise returns through cutting off the middlemen and through payment of a premium price charged for the beef brand.

4.4 Conclusion

The major determinants of smallholder producers' potential to sell cattle are age, household size, religion, cattle herd size, availability of extension services and income. Smallholder cattle producers in the ECP currently sell an average of two animals per year to local/private buyers. Marketing opportunities available for vertical integration of smallholder cattle producers into the beef market value chain include beef branding, feedlotting and group marketing. Smallholder cattle producers have the potential to develop a NB brand and are willing to participate in the development of such a brand. Further research to determine beef traders' and consumers' perceptions on the development of a NB brand by smallholder cattle producers could be important.

References

Agholor, I.A. (2013). Analysis of Constraints of Rural Beef Cattle Cooperative Farmers: A Case Study of Ga-kibi, Norma and Mogalakwena in Blouberg. *Journal of Agricultural Science*, **5**(8): *76-86*.

Ainslie, A., Kepe, T., Ntsebeza, L., Ntshona, Z., & Turner, S. (2002). Cattle ownership and production in the communal areas of the Eastern Cape, South Africa. Research Report no. 10. University of the Western Cape.

Ba, S.B., Udo, H.M.J. & Zwart, D. (1996). Impact of veterinary treatments on goat mortality and off take in the semi-arid area of Mali. *Small Ruminant Research,* **19**(1): *1-8*.

Bailey, D., Barrett, C.B., Little, P.D. & Chabari, F. (1999). Livestock markets and risk management among East African pastoralists: A review and research agenda. Utah University, USA.

Coetzee, L., Montshwe, B.D. & Jooste, A. (2005). The marketing of livestock on communal lands in the Eastern Cape Province: Contraints, Challenges and Implications for the extension services. *South African Journal of Agricultural Extention*, **34**(1): *81-103*.

Gujarat, D.N. (2003). Basic Econometrics (4th Ed). McGraw Hill. New York

Herrero, M., Thornton, P.K., Gerber, P., van der Zijpp, A., van de Steeg, J., Notenbaert, A.M., Lecomte, P. & Grace, D. (2010). The way forward on livestock and the environment. In: Swanepoel, F.J.C., Stroebel, A. & Moyo, S. (Eds) *The role of livestock in developing communities: Enhancing multifunctionality*. CTA, Wageningen, The Netherlands.

Jari, B. & Fraser, G.C.G. (2009). An analysis of institutional and technical factors influencing agricultural marketing amongst smallholder farmers in the Kat River Valley, Eastern Cape Province, South Africa. *African Journal of Agricultural Research,* **4**: 1129–1137.

Mahabile, M., Lyne, M. & Panin, A. (2002). Factors affecting the productivity of communal and private livestock farmers in Southern Botswana: A descriptive analysis of sample survey results. *Agrekon*, **41**(4): *326 – 338*.

Makhura, M.T. (2002). Overcoming transaction costs barriers to market participation of smallholder farmers in the Nothern Province of South Africa. Unpublished PhD Dissertation. University of Pretoria.

Mapekula, M., Chimonyo, M., Mapiye, C., & Dzama, K. (2009). Milk production and calf rearing practices in the smallholder areas in the Eastern Cape Province of South Africa. *Tropical Animal Health and Production*, **41**(7): *1475–1485*.

Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. & Mapekula, M. (2009). Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. *Livestock Science*, **124**: *196-204*.

Monsthwe, D.B. (2006). Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa. Unpublished MSc Thesis, University of Free State, Bloemfontein, South Africa.

Montshwe, B.D., Jooste, A. & Alemu, Z.G. (2005). An econometric analysis of the determinants of market participation within the South African Small-scale Cattle

Sub-sector. *A paper presented at the 42nd annual conference of the Agricultural Economics Association of South Africa*, Lord Charles hotel, Somerset West. 21–23 September 2004.

Muchenje, V., Dzama, K., Chimonyo, M., Raats, J.G. & Strydom, P.E. (2008). Meat quality of Nguni, Bosmara and Aberdeen Angus steers raised on natural pasture in the Eastern Cape, South Africa. *Meat Science*, **79**: *20-28*.

Munyai, F.R. (2012). An evaluation of socio-economic and biophysical aspects of small-scale livestock systems based on a case study of Limpopo Province: Mduluni village. Unpublished PHD Thesis University of Free State.

Musemwa, L. Mushunje, A. Chimonyo, M. Fraser, G. Mapiye C. & V. Muchenje (2008). Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. *African Journal of Agricultural Research*, **3**(4): *239-245.*

Musemwa, L., Mushunje, A., Chimonyo, M., & Mapiye C. (2010). Low cattle market offtake rates in communal production systems of South Africa: Causes and migration strategies. *Journal of Sustainable Development in Africa*, **12**: *209-226*.

Ndoro, J.T., Mudhara, M. & Chimonyo, M. (2015): Farmers' choice of cattle marketing channels under transaction cost in rural South Africa: a multinomial logit model, *African Journal of Range & Forage Science*, *1-10*.

Nqeno, N., Chimonyo, M. & Mapiye, C. (2011). Farmers' perceptions of the causes of low reproductive performance in cows kept under low-input communal production systems in South Africa. *Tropical Animal Health and Production*, **43:** *315-321*.

Ntshephe, L. (2011). Marketing information needs of smallholder livestock farmers in the Moretele area in the Bojanala Platinum District Municipality of the North West Province. Unpublished Masters Thesis, University of South Africa.

Phiri, C. (2009). Livestock, rural livelihoods and rural development inrterventions in the Eastern Cape Province: Case studies of Chris Hani, Alfred Nzo and Amathole district municipalities. Unpublished PhD Thesis, University of Fort Hare.

Randolph, T.F., Schelling, E., Grace, D., Nicholson, C.F., Leroy, J. L., Cole, D.C., Demment, M.W., Omore, A., Zinsstag, J. & Ruel, M. (2007). Invited Review: Role of livestock in human nutrition and health for poverty reduction in developing countries. Journal of Animal Science: *2788-2800*.

SAS Institute Inc. (2012). Base SAS® 9.3 Procedures Guide. Cary, NC. SAS Institute Inc.

Tada, O., Muchenje, V. & Dzama, K. (2012). Monetary value, current roles, marketing options and farmer of concerns of communal Nguni cattle in the Eastern Cape Province, South Africa.

Chapter 5: Beef traders' and consumers' perceptions on the development of a natural beef brand in the Eastern Cape Province

Abstract

The study was conducted to determine beef traders' and consumers' perceptions on the development of a natural beef (NB) brand by smallholder cattle producers. A total of 18 structured questionnaires were administered to meat traders comprising of five abattoirs and 13 beef retailers. In addition a total of 155 beef consumers who purchased beef from the selected retailers were interviewed using structured questionnaires. Cattle from smallholder producers comprised 10% of slaughtered cattle at interviewed abattoirs. Overall, beef traders were not willing to assist smallholder cattle producers to develop a NB brand. They mentioned that smallholder cattle producers have to be assessed on their ability to consistently supply high quality beef through the formal marketing channels first before embarking on developing a NB brand. The majority of consumers (81%) were willing to purchase NB when it is made available on the market but they were not willing (81%) to pay a premium for the brand. Logistic regression model revealed that consumers' willingness to buy NB and to pay a premium were influenced by gender, household size, income source, consumer's meat preference and consumption frequency, money spent on beef per month, frequency of beef purchases and consumption. The study concluded that beef traders and consumers in the ECP have different perceptions on the development of a NB brand by smallholder cattle producers.

Keywords: Branding, perceptions, natural beef, consumers, meat traders

5.1 Introduction

Having ascertained the willingness and potential of smallholder cattle producers to develop a NB brand in the preceding chapter, it is necessary to also review the perceptions of beef traders and consumers on such a beef brand. Davis (2011) projected an increase in demand for animal protein in response to a rise in the urban based human population of most African countries including South Africa. An urban based population has relatively high income levels and high affinity for animal based protein sources (Burger et al., 2004). Furthermore, it is widely believed that extrinsic

beef characteristics such as price, origin and production practices including animal welfare and other ethical considerations will be more influential to South African beef consumers' future preferences (Vimiso et al., 2012). Taljaard et al. (2006) also reported that non-economic factors were increasingly becoming more important to consumers. The anticipated increase in demand for animal products together with consumer preferences for healthier and ethically produced food will influence consumer perceptions on beef and its by-products (Vimiso et al., 2012).

In addition as the population become urbanised and cosmopolitan, the South African beef industry is confronted by various challenges (Poonyth et al., 2001) such as competitiveness of the industry, complexity of the heterogeneous multi-racial and multi-cultural market, failure to meet increasing local beef demands, quality control, changing consumer needs among others (Leonardi, 2007). Unlike in the previous decades where quality policies were meant to assess and control products prior to their presentation to consumers, recent protocols are aimed at incorporating consumers' quality perceptions in product development (Brendahl, 2003). Consumers in the developed countries demand more clarity on price, nutritious value, origin, production practices including level of chemical use and nature of the chemicals used, animal welfare and other ethical considerations (Wertenbroch and Skiera, 2002). South African affluent consumers are following a similar trend and less affluent consumers are likely to exhibit the same pattern in the near future (Loureiro and Umberger, 2007; Vimiso et al., 2012). The anticipated increase in demand for animal products together with consumer preferences for healthier and ethically produced foods will influence consumer perceptions on beef and its by-products (Vimiso et al., 2012). This implies that the whole beef supply chain have to be actively integrated in implementing strategies that meet consumer expectations (de Carlos et al., 2005). In this regard, the efficiency of the beef value chain is determined by its capacity to provide honest and reliable information that answers consumer's questions.

Branding is one way of providing information about the product to the consumer (Froehlich et al., 2009). It is an important marketing strategy that highlights the unique quality of a product to a consumer (Froehlich et al., 2009). This improves the competitiveness of a particular brand by orienting itself towards a consumer (Xue et al., 2009). The objective of this chapter was to assess the perceptions of beef traders and consumers on the development of a NB brand by smallholder cattle producers in the Eastern Cape Province of South Africa.

5.2 Materials and methods

5.2.1 Study sites

The study was conducted in rural towns surrounding Ncorha and Gwalibomvu communal areas in the ECP namely; Cala, Comfimvaba, Elliot, Ngcobo and Quenstown (Figure 5.1).

Figure 5.1: Location of towns sampled for beef traders and consumers surveys

5.2.2 Selection of respondents

A total of 23 meat traders (5 abattoirs and 18 meat retailers) were sampled in this study. All the beef traders from Cala, Comfimvaba, Elliot, Ngcobo and Queenstown were willing to participate in the study were selected for the study. The towns were selected on the basis of their proximity to the two study areas mentioned in Chapter 3. Consumers who directly purchased beef from the sampled beef retailers were targeted and asked a qualifying question before being selected for the study. The qualifying consumers had to be above the age of 18 and be the primary person or one with shared responsibility of buying beef for the household. Three different structured questionnaires (one for abattoirs, meat retailers and consumers) were then used to conduct guided interviews with abattoir and meat retailers' managers or supervisors as well as selected consumers. The questionnaires were prepared in English but interviews were conducted in the local Xhosa language by trained enumerators.

5.2.3 Data collection

5.2.3.1 Abattoirs

Demographic data collected from abattoir respondents included age, gender and educational qualifications. In addition, data on total number of slaughtered cattle/month, number of slaughtered cattle from smallholder cattle producers/month, body conditions of smallholder cattle before slaughter, annual trends of cattle supply, willingness to assist smallholder farmers to develop a NB brand, possible challenges associated with brand production and possible solutions were also collected. See appendix 3 for more details.

5.2.3.2 Meat retailers

Demographic data collected from meat traders was similar to that of abattoirs. In addition, data on; total beef purchases and sales the previous month, contracts with beef suppliers, form in which beef is sold, whether they sell branded beef, price, origin and sales trends of the brands currently in existence, their perceptions on branded

beef sales and how they are willing to assist in the development of that brand were also collected. See appendix 2 for more details.

5.2.3.3 Consumers

Data collected from consumers included household demographic information, major source of income, income class, most preferred beef market, frequency of beef purchase, type of beef purchased, factors considered when buying beef, previous experience with branded beef, branded beef preferences, willingness to buy a NB brand on the market, factors likely to be considered when buying NB, willingness to pay a premium for NB brand and information they would like to be included on the label for pasture-fed beef. See appendix 3 for more details.

5.2.4 Statistical analysis

Demographic data were subjected to descriptive statistics using the PROC FREQ procedure of SAS (2012). Data on money spent by consumers on beef the previous month was subjected to Analysis of Variance (ANOVA) using the PROC GLM procedure of SAS (2012). A logit model was used to determine the influence of different socio-demographic characteristics on consumers' willingness to buy the NB brand if made available on the market. The empirical model was formulated as follows:

$$Y_i(Willingness\ to\ buy\ NPB) = \beta_0(intercept) + \beta_1(gender) + \beta_2(age) + \beta_3(marital\ status) + \beta_4(household\ size) + \beta_5(education\ level) + \beta_6(income\ source) + \beta_7(income\ level) + \beta_8(amount\ spent\ on\ beef) + \beta_9(preferred\ meat) + \beta_{10}(most\ consumed\ meat) + \beta_{11}(frequency\ of\ beef\ purchases) + \beta_{12}(frequency\ of\ beef\ consumption)$$

A similar model was used to determine the willingness of consumers to pay a premium for a NB brand.

5.3 Results and discussions

5.3.1 Socio-demographic information

Table 5.1 below shows the socio-demographic characteristics of respondents. All the beef traders' respondents were males while 52% of consumers were females. The majority of beef traders and consumers (>45%) were over 30 years old. About 60% of abattoir respondents had tertiary qualifications but the majority of meat retailers (59%) and consumers (55%) had secondary education. Almost 70% of beef consumers were married with over 55% of the consumers' households having between five and ten members. Salaries (40%) and private self-businesses (38%) constituted the major sources of income for consumers (Figure 5.2). Forty-five percent of the consumers indicated household income of less than R3000 per a month (Figure 5.2).

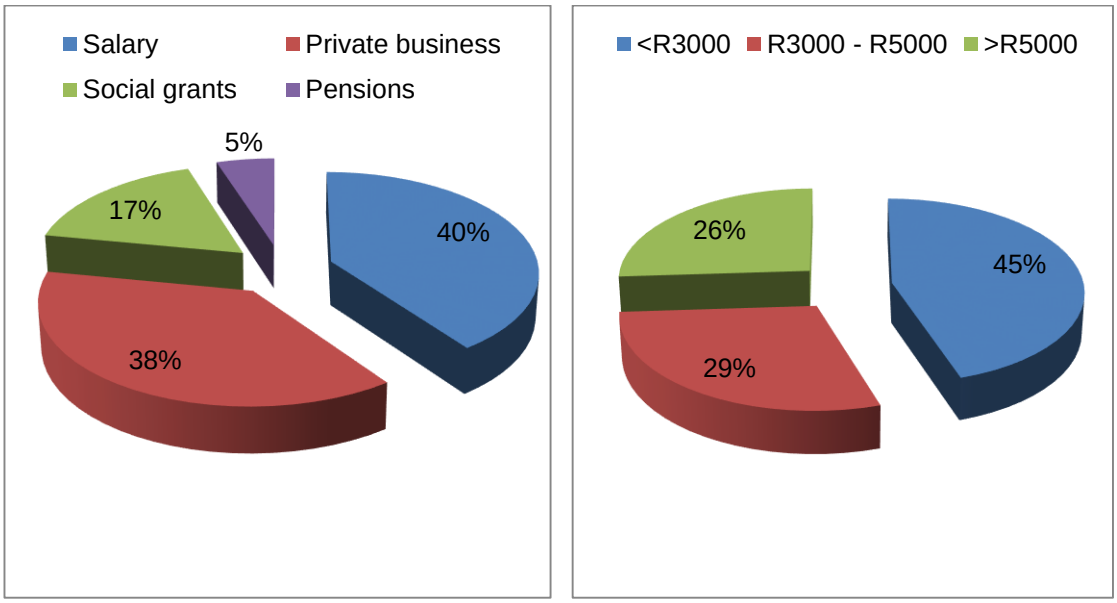


Figure 5.2: Income sources and levels for beef consumers in the Eastern Cape Province

Figure 5.3 below shows the most preferred meat as well as the most consumed meat. The majority of consumers (over 40%) indicated beef as their most preferred meat. This was congruent with studies by Vimiso et al. (2012) which revealed a high preference for beef compared to other meats. However, the most consumed meat was

chicken (51%) with beef being indicated as second. The fact that chicken are generally considered to be cheap and easy to prepare might have influenced the high consumption levels. Particularly given that South African consumers are reported to be extremely beef price sensitivity (Jooste, 1996). In support of the current results, Burger et al. (2004) also reported that over the past two decades per capita beef consumption in South Africa has been decreasing while that of chicken has been increasing.

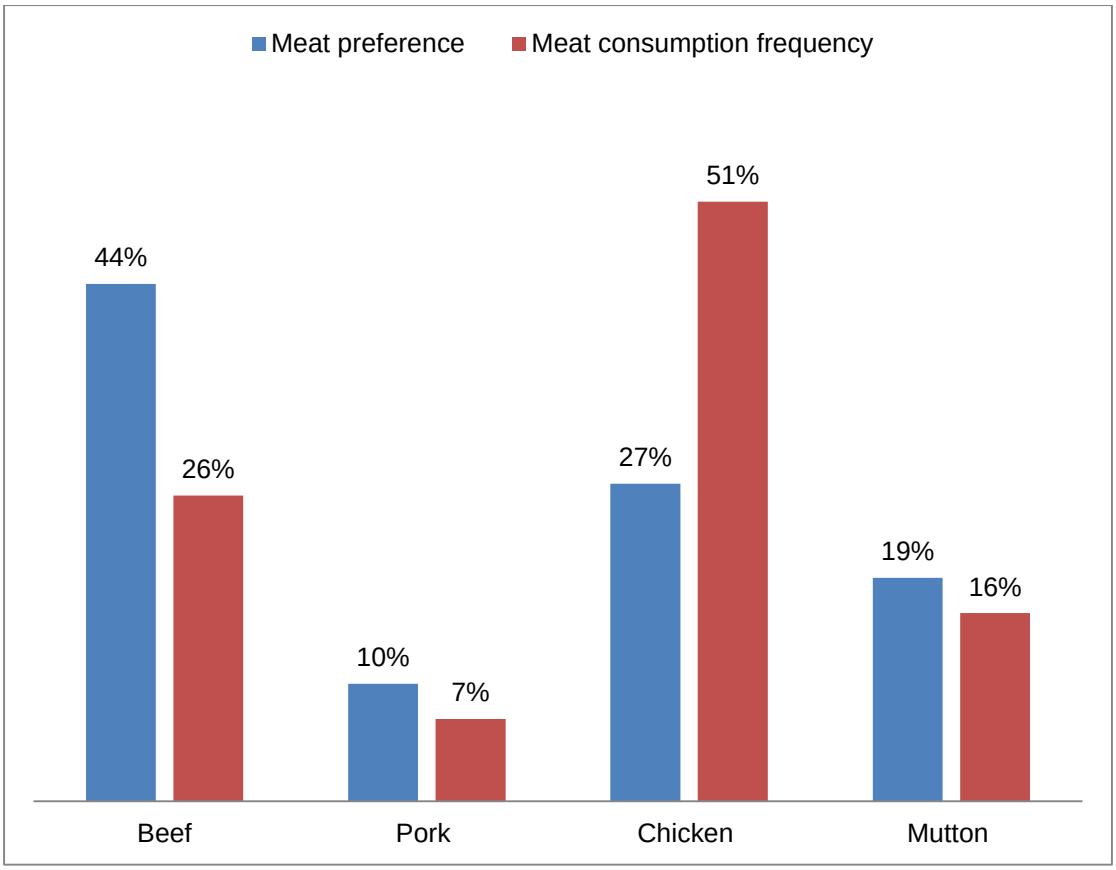


Figure 5.3: Meat preference and meat consumption patterns of meat consumers in the ECP of South Africa

Figure 5.4 shows factors that consumers consider when buying beef. Price is the most commonly considered factor, while, expiry date and packaging were also relatively prioritised. Other extrinsic factors considered but rather less importantly were

healthfulness and ethical quality. South African consumers are generally less concerned about meat safety and animal welfare issues than their counterparts in other developed countries (Hugo, 2005). However, South African consumers' concerns with regard to these issues are expected to increase over time (Loureiro and Umberger, 2007). Intrinsic beef characteristics such as nutritional quality, lean and fat colour were proportionally considered by only 6 to 10% of the respondents. Beef price and packaging were described by Brendahl (2003) as extrinsic quality cues normally considered by consumers when product quality cannot be easily determined instore. This is particularly true for beef whose quality is difficult to determine for inexperienced consumers.

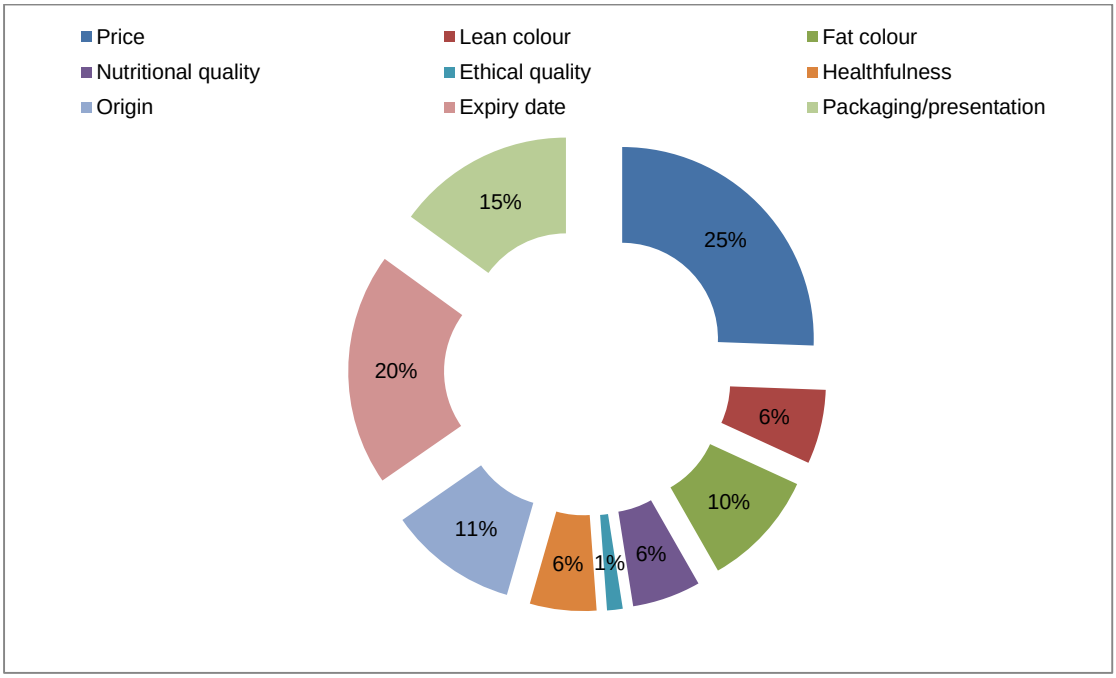


Figure 5.4: Factors considered by consumers when buying beef in the Eastern Cape Province

Nearly 80% of beef consumers purchase beef once or twice a week. Similarly, consumers in the surveyed areas indicated that they eat beef prepared at home once or twice a week. Almost 80% of the interviewed consumers prefer to buy their beef from supermarkets where the majority felt that the beef was healthy, well-packaged

well and reasonably priced. Of all the factors investigated only household size and frequency of beef consumption had a significant effect ($P < 0.05$) on the amount of money spent on beef. The amount of money spent on beef was significantly lower ($P < 0.05$) in households with less than five members than those with over 10 members. The lower expenditure on beef by smaller households is expected as they are expected to consume less beef than larger households.

Households that consumed beef more than three times a week spent significantly more ($P < 0.05$) money on beef than those that consumed beef once or twice a week. The more money spent on beef by more frequent beef consumers is consistent with expectations. An increase in beef consumption in South Africa is attributed to economic growth resulting in higher income levels from employment. According to Jooste (1996), per capita income is the principal factor influencing the demand for beef in low income countries. Population growth and the emerging black middle class were cited as other drivers that impact on the demand for beef (BFAP, 2009). It is possible that some of the respondents from this study belong to the emerging black middle class which is believed to spend more on meat in proportion to their disposable income (BFAP, 2009).

5.3.2 Perceptions of meat traders on the Natural beef brand

Table 5.1 shows the total number of cattle slaughtered in the previous month by the interviewed abattoirs. All the abattoirs except one, indicated that although they have a large capacity to slaughter many animals per month, they only slaughter very low numbers of cattle (≤10%) belonging to smallholder producers per month. This is a common trend in most operational abattoirs in the ECP. The reasons for the low numbers could be any or a combination of the production, offtake and marketing constraints highlighted in the Chapter 3 and Chapter 4. Adelaide abattoir is a small-scale abattoir designed to slaughter cattle for smallholder cattle producers from the

surrounding communal areas. Meat retailers indicated that they purchase a mean of 4169 ± 713.1 kg per month of beef from abattoirs.

Table 5.1: Cattle slaughtered per month by abattoirs in the ECP

Name and location of abattoir	***Total number of cattle slaughtered***	***Total number smallholder cattle slaughtered***
East London abattoir, East London	3500	350
Meat traders abattoir, Queenstown	795	12
Elliot abattoir, Elliot	1000	150
Peace farms, Queenstown	820	80
Adelaide abattoir, Adelaide	72	72

All the interviewed meat traders were not directly involved with marketing of any particular branded beef or beef by-products. Likewise, consumers were not aware of any branded beef or by-products in the ECP. Abattoir operators expressed appreciation that developing a smallholder managed NB brand would improve cattle income and enhance formalised cattle marketing by smallholder cattle producers. They however, indicated that although they have the capacity to assist in the development of a NB, it was inappropriate given the current smallholder cattle production and marketing trends. A key issue raised was pertaining to the ability of smallholder cattle producers to meet the minimum requirements for beef brand registration and certification. In an interview held by Phillips (2012), the chairman of Angus beef South Africa (Hendrik Jacobs) revealed that there are various protocols required prior to brand registration and certification to ensure traceability from 'farm to fork'. The protocols comprehensively cover the whole spectrum of production including breeding, feeding, health management as well as transportation of cattle.

The majority of meat traders suggested that participating smallholder cattle producers identify a single breed adapted to their environmental and management conditions to

consistently supply a uniform product. Other meat traders pointed out that the smallholder cattle production efficiency needs to be enhanced to enable consistency of supply. It was also indicated that the involvement of smallholder cattle producers in the current beef market value chain is insignificant, thus, the current barriers need to be dealt with honestly and exclusively before embarking on brand development. According to suggestions given by other meat traders, smallholder cattle producers need to take a business approach to cattle production as opposed to the current culture of co-existence with cattle. Otherwise, meat retailers indicated that development of a particular brand has to be done through abattoirs as they are mandated by law to buy all meat for resale from a registered abattoir. Beef traders suggested that characterization of beef from cattle fed natural pasture resources found in the smallholder areas rather than development of a NB brand has a higher likelihood of improving smallholder producers' access to formal markets. Beef characterization involves identifying unique beef quality attributes that can be used for labelling purposes without having to legally register the beef as a brand.

Beef traders also raised an important issue of consumer behaviour where they indicated that the majority of consumers that buy beef from them are more concerned about the price of beef. This confirms findings of the current study reported in this section and assertions by Hugo (2005) that most South African beef consumers are more concerned about beef prices and care less about beef safety and animal welfare. About 10% of the butcheries indicated that they do not even sell class A and class B beef as they only target consumers who prefer class C beef and offals. This presents an opportunity for market segmentation studies to be instigated to evaluate the size of the market which prefer more lean beef from relatively older cattle. Results of such studies are essential to indicate the location and size of the market whose beef preferences favour beef produced by smallholder cattle producers. A market segmentation study previously done by Thompson et al. (2010) revealed the existence

of a segment of beef consumers who prefer beef from older cattle raised on natural pasture.

5.3.3 Consumers' perceptions on the development of a NB brand

Over 80% of consumers indicated that they will be willing to buy NB if it is made available on the market. However, a similarly percentage were not willing to pay a premium for the NB brand. They cited the additional cost the premium would have on beef as their major reason for declining to pay.

Table 5.2 shows the odds ratio estimates of consumers' willingness to buy NB as well their willingness to pay a premium. Males were about five times more willing to buy NB than females. Similarly, the willingness of male respondents to pay a premium for a NB brand was almost double that of females (Table 5.3). The fact that men make the majority of absent cattle owners (Monsthwe et al., 2005) might have sensitised their notion to support fellow smallholder cattle producers through buying NB as well paying a premium for it. On the other hand, females may have associated smallholder NB with negative characteristics such as toughness, leanness, low fat content, poor taste, poor cooking quality and unsightliness. This stems from the fact that smallholder cattle are thought to have low live weights, poor body conditions and are generally sold at old age (Ainslie et al., 2002), hence, they are generally regarded to yield poor quality beef.

Young consumers and households with small sizes were more willing to pay a premium for a NB brand than adult consumers and those from larger household sizes. Consumers who earn income through were also more willing to buy NB (Table 5.2) and to pay a premium for NB (Table 5.3) than consumers receiving income from other sources. The differences between all the groups reported might be due to differences in disposable income levels. Young consumers may have been actively employed and earning a salary. On the other hand, adult consumers may have retired and have less

energy to operate private businesses. Similarly, smaller households incur lesser household expenses than larger households. In each case, the prior group is likely to have more disposable income than the later. Consequently, the group with a higher disposable income will be more willing to either buy (those earning a salary) or to pay a premium for a NB brand.

Table 5.2: Odd ratio estimates, lower and upper confidence interval (CI) of consumers' willingness to buy a Natural beef brand

Effect	***Point estimate***	***Lower CI***	***Upper CI***
Gender (male vs. female)	5.01	1.26	19.89
Age (young vs. old)	0.80	0.21	3.09
Household size (≤5 members vs. >5 members)	0.13	0.01	1.69
Education level (educated vs. uneducated)	0.28	0.07	1.19
Income source (salaries vs. other)	1.25	0.33	4.70
Income class (≤R2000 vs. >R2000)	0.12	0.02	0.80
Meat preference (beef vs. other)	10.10	1.91	0.80
Meat consumption frequency (beef vs. other)	2.04	0.43	9.69
Frequency of beef purchase (≥3 times/wk vs. < 3 times/wk)	1.67	0.44	6.30
Frequency of beef consumption (≥3 times/wk vs. < 3 times/wk)	12.17	1.76	84.16
Money spent on beef per month (≤R1000 vs. >R1000)	3.39	0.83	13.84

Odds ratio estimates for willingness to buy NB and willingness to pay a premium were higher for consumers who preferred beef to other meats as well as those who consumed more beef compared to other meats. Consumers who preferred beef to other meats were ten times more willing to buy NB and almost 1.5 times more willing to pay a premium (Table 5.3) than those who preferred other meats. Consumers who mostly eat beef were twice more willing to buy NB and 1.5 times more willing to pay a

premium than consumers who mostly eat other meats. These results are within expectations as consumers are more likely to pay for their preferences. Similarly, more frequent beef consumers would be expected be willing to buy a new brand of beef if it is introduced on the market.

Table 5.3: Odd ratio estimates, lower and upper confidence interval (CI) of consumers' willingness to pay a premium for a Natural beef brand

Effect	***Point estimate***	***Lower CI***	***Upper CI***
Gender (male vs. female)	1.87	0.61	5.69
Age (young vs. old)	1.33	0.36	4.85
Household size (≤5 members vs. >5 members)	4.47	0.48	40.11
Education level (educated vs. uneducated)	0.38	0.07	2.03
Income source (salary vs. other)	1.78	0.60	5.28
Income class (≤R2000 vs. >R2000)	0.76	0.24	2.39
Preferred meat (beef vs. other)	1.44	0.47	4.38
Most consumed meat (beef vs. other)	1.51	0.48	4.75
Frequency of beef purchase (≥3 times/wk vs. < 3 times/wk)	0.75	0.23	2.39
Frequency of beef consumption (≥3 times/wk vs. < 3 times/wk)	0.38	0.09	1.63
Money spent on beef (≤R1000 vs. >R1000)	0.50	0.15	1.64

Consumers who purchase and consume beef more frequently as well those who spend relatively more on beef were more likely to buy NB than those who rarely purchased, consumed or spend less money on beef. As expected the results are following the usual trend purchasing, consumption and expenditure trends for beef among the groups reported. However, the relatively lower odds ratio estimates for willingness to pay a premium for a NB brand presented in Table 5.3 might be due to the price sensitivity of the consumers. The additional costs associated with branding were stated by Labuschagne (2007) as those related to brand registration, market segmentation,

transport among others. The author further indicated that these additional costs would necessitate higher prices for the brand which consumers might not be willing to pay.

5.4 Conclusion

Consumers support the idea of developing the beef brand and are willing to buy the beef brand if it is made available on the market. However, beef consumers are not willing to pay a premium for the NB brand. On the other hand, meat traders suggest that fundamental issues of comprehensive breeding, natural pasture production efficiency, herd health and marketing management be improved to acceptable levels for prior to developing a beef brand dedicated to smallholder cattle producers. However, beef traders recommended that beef characterization would better improve access of smallholder cattle producers to formal markets.

References

Ainslie, A., Kepe, T., Ntsebeza, L., Ntshona, Z. & Turner, S. (2002). Cattle ownership and production in the communal areas of the Eastern Cape, South Africa. Research Report no. 10. University of the Western Cape.

Bureau for Food & Agricultural Policy (BFAP). (2009). Baseline report. Accessed on 5 August 2015 at http://www.bfap.co.za.

Bredahl, L. (2003). Cue utilization and quality perception with regard to branded beef. *Food quality and Preference*, **15:** *65-75*.

Burger, R., van der Berg, S. & Nieftagodien, S. (2004). Consumption Patterns of South Africans Rising Black Middle-Class: Correcting for Measurement Errors. Paper delivered at the conference of the Centre for the Study of African Economies (CSAE) on Poverty Reduction, Growth and Human Development in Africa, Oxford.

Davis, C.L. (2011). Climate Risk and Vulnerability: A Handbook for Southern Africa. Council for Scientific and Industrial Research, Pretoria, South Africa, pp 92, ISBN: 978-0-620-50627-4.

de Carlos, P., Garcia, M., de Felipe, I., Britz, J. & Morais, F. (2005). Analysis of consumer perceptions on quality and food safety in the Spanish beef market: A future application in new production development. *Paper presented at the*

XI^th congress of the European Association of Agricultural Economists; The future of Rural Europe in the Global Agri-Food System, Copenhagen, Denmark.

Froehlich, J.E., Carlberg, G.J. & Clement E.W. (2009). Willingness-to-pay for fresh brand name beef. *Canadian Journal of Agricultural Economics, **57**: 119–137.*

Hugo, A. (2005). Diet and red meat – is there a place for red meat in the modern diet? Accessed on 21 July 2015 at http://samic.co.za/downloads/DietAndRedMeatzip.

Jooste, A. (1996). Regional Beef Trade in Southern Africa. Unpublished MSc thesis. University of Pretoria, Pretoria.

Labuschagne, A. (2007). A consumer orientated study of the South African beef supply chain. Unpublished MBA thesis, University of Pretoria. South Africa.

Leonardi, C. (2007). CEO`s hope shared strategic vision will ease global market demands. Accessed on 4 August 2015 at http://www.fmcg.co.za/default.aspx?tabid=2302

Loureiro, M.L. & Umberger, W.J. (2006). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin and traceability. *Food Policy*, **32**(3): *496-514*.

Montshwe, B.D., Jooste, A. & Alemu, Z.G. (2005). An econometric analysis of the determinants of market participation within the South African Small-scale Cattle Sub-sector. *A paper presented at the 42nd annual conference of the Agricultural Economics Association of South Africa*, Lord Charles hotel, Somerset West. 21–23 September 2004.

Phillips, L. (2012). Certified South African Angus Beef – branding top quality. Farmers weekly.

Poonyth, D., Hassan, R. & Kirsten, J.F. (2001). Random coefficients analysis of changes in meat consumption preferences in South Africa. *Agrekon*, **140**(3): *426-437*.

SAS Institute Inc. (2012). Base SAS® 9.3 Procedures Guide. Cary, NC. SAS Institute Inc.

Taljaard, P.R., Jooste, A. & Asfaha, T.A. (2006). Towards a broader understanding of South African consumer spending on meat. Free State: Department of Agricultural Economics, University of the Free State.

Thompson, J., Polkinghorne, R., Gee, A., Motiang, D., Strydom, P., Mashau, M., Ng'ambi, J., deKock R. & Burrow, H. (2010). Beef palatability in the Republic of South Africa: implications for niche-marketing strategies. ACIAR report.

Umberger, W. (2007). A choice experiment model for beef: What US consumers responses tell us about relative preferences for food safety, country-of-origin labelling and traceability. *Food policy*, **32**(4): *496-514*.

Vimiso, P., Muchenje, V., Marume, U. & Chiruka, R. (2012). Preliminary study on consumers' and meat traders' perceptions of beef quality and how the beef quality is affected by animal welfare practices. *Scientific Research and Essays*, **7**(22): *2037-2048*.

Wertenbroch, K. and Skiera, B. (2002). Measuring Consumers' Willingness to Pay at the Point of Purchase. *Journal of Marketing Research,* **39**(2): *228 244*.

Xue, H., Mainville, D., You, W. and Nayga Jr, R.M. (2009). Nutrition Knowledge, Sensory Characteristics and Consumers' Willingness to Pay for Pasture-Fed Beef. *Paper presented at the Agricultural and Applied Economics Association's 2009 AAEA & ACCI Joint annual meeting*, Milwaukee, West Indies, July 26 – 28, 2009.

Chapter 6: General discussions, conclusions and recommendations

6.1 General discussions

The ECP is considered the cattle capital of South Africa with approximately a quarter of the national cattle herd of which the majority belong to smallholder sector. Despite these significant cattle numbers, the contribution of the smallholder beef sector has remained insufficient to reduce food insecurity and poverty, and sustain the national economic growth. A sustainability assessment of the smallholder cattle production system was conducted in this study to holistically identify its limiting factors and find ways of vertical integrating the system into the formal beef market value chain.

Chapter 3 tested the hypothesis that the smallholder cattle production system in the communal areas of the ECP was not sustainable. Social indicators selected by the farmers include cattle herd size, gender balance, household food access, availability of safe drinking water, household health, education level of household head and access to information. Environmental indicators selected include rainfall, forage availability, soil erosion, soil fertility, biodiversity level of chemical use and air quality. Selected economic indicators include social grants income, non-farm income, crops income, other livestock income and cattle income. The social and environmental dimensions of sustainability were conditionally sustainable while the economic dimension was not sustainable. Overall, the smallholder cattle production system was conditionally sustainable. Thus, interventions to improve sustainability the smallholder beef cattle production system should focus on the economic dimension of sustainability. It could also be important to focus on some social indicators that are positively correlated to economic indicators (Boorgard et al., 2011). Of the economic indicators used in this study, only cattle income was received at levels above R3000. The second phase of the study was then designed to find strategies that could improve

the vertical integration of the smallholder cattle production system into the formal beef market value chain.

The hypothesis tested in Chapter 4 was that smallholder cattle producers do not have the potential and are not willing to develop a Natural beef brand (NB) brand. Smallholder cattle producers ranked cattle as the most important livestock and had mean cattle sales of two cattle per household per annum. Cattle producers sold their animals via informal markets where they obtained high value for their old large-framed animals. The logit model revealed that the potential of smallholder cattle producers to sell cattle was influenced by age, household size, religion, cattle herd size, average market price and income. Beef branding was mentioned as the main strategy that could be implemented to improve the economic dimension of sustainability and consequently overall sustainability of the smallholder cattle production system in South Africa followed by feedlotting, group marketing and forward contracting, respectively. These strategies will also improve its vertical integration into the formal beef market value chain.

Results of Chapter 4 also revealed that the majority of smallholder cattle producers were willing to participate in the development of a NB brand and were expecting a premium to be paid for such a beef brand. However, smallholder cattle producers anticipated challenges that include reluctance of some participating farmers to adhere to basic production requirements for the beef brand, inconsistency of supply and variations in beef quality due to differences in breeds and age at slaughter. Consistency in both supply and quality is vital to avoid frustrating consumers once the NB is introduced on the market. To integrate smallholder cattle producers into the formal beef market value chain the perceptions of other key members of the value

chain such as abattoirs, beef retailers and consumers on the development of the NB brand had to be ascertained.

Chapter 5 tested the hypothesis that beef traders and consumers do not have any perceptions on the development of a NB brand. Beef suppliers and consumers surveys were conducted in Cala, Ngcobo, Comfimvaba, Elliot and Queenstown towns surrounding Ncorha and Gxwalibomvu to determine their perceptions on the development of a NB brand. The majority of beef retailers and abattoirs perceived that current smallholder cattle production practices do not satisfy the basic regulatory requirements for a beef brand registration and certification. They also indicated that supply of a dedicated beef brand cannot be allowed to be erratic. In addition, beef traders perceived that current smallholder cattle production levels cannot support the demand for a NB brand. Moreover, beef retailers highlighted that their current consumers are more concerned about beef price and not beef safety or beef production system. Some retailers resorted to selling only grade C beef and offals in response to consumer demand. This is congruent with a marketing segmentation study by Thompson et al. (2011) which revealed the existence of beef consumers who prefer beef that is too lean. Marketing segmentation studies in the study areas are essential to determine the size of the market and design channels for beef supply. They also mentioned that a NB beef brand is likely to attract demand from the elite beef consumers with very high income levels. These consumers are highly sensitive to inconsistency in supply or in quality of a product of their choice. It was therefore, suggested that fundamental issues of comprehensive natural pasture production, animal feeding and breeding, herd health and marketing management be improved substantively prior to developing a NB brand. On the hand, the majority of consumers expressed their willingness to buy NB if it is made available on the market but they were not willing to pay premium for it. However, additional costs associated with

administration, registration and certification of the beef brand as well as other fixed costs related to maintenance of basic regulations of the beef brand necessitates the need to charge a premium price (Phillips, 2012).

Results of the logistic regression showed that consumers' willingness to buy and pay a premium for NB was influenced by gender, household size, income source, preferred meat, most consumed meat, money spent on beef per month, frequency of beef purchases and consumption. Current findings reveal that it is not appropriate to develop a NB brand under the current circumstances largely due to the smallholder cattle producers' lack of capacity to supply the required volumes and quality of animals to the formal market. In addition the process of beef brand registration and certification is cumbersome with minimum standards requirements which cover the whole spectrum of cattle production and marketing including cattle breeding, feeding, health and marketing management. Instead, characterization of beef from cattle fed natural pasture resources found in the smallholder areas was recommended in place of development of a NB brand.

6.2 Conclusions

The smallholder cattle production system was socially and environmentally conditionally sustainable but economically not sustainable. Overall the smallholder cattle production system was conditionally sustainable. Beef branding was mentioned as the main strategy of improving the economic sustainability of the smallholder beef cattle production system and integrating it into formal beef market value chain. Smallholder cattle producers had the potential and were willing to participate in the development of a NB brand. However, beef traders were not willing to support smallholder cattle producers to develop a NB brand citing producers' lack of capacity to supply the required volumes and quality as the major challenge. Consumers were willing to buy NB if it was made available on the market but were not willing to pay a

premium for it. It was concluded that although the smallholder cattle production system was conditionally sustainable, its sustainability status may not be improved by beef branding in the short-term due to lack of farmers capacity to supply the required numbers and quality of animals. Instead, characterization of beef from cattle fed natural pasture resources found in the smallholder areas was recommended.

6.3 Recommendations

Results from the current study suggest that it is important to improve the operational levels of some sustainability indicators used to assess sustainability of smallholder cattle producers in the ECP, especially the economic indicators which were considered not sustainable. This requires a holistic, integrated approach to fortify strategies considered without compromising other sustainability dimensions. Since it is not feasible to develop a NB brand at the moment, stakeholders were recommended to characterise beef produced by cattle fed natural pasture-based feed resources. It is also recommended to conduct market segmentation studies to determine the market that demands smallholder beef and design appropriate supply strategies. This is meant to improve the economic dimension of sustainability and by virtue of a positive correlation, the social dimension will also be improved. In future, development of a NB brand may only be considered after fundamental challenges highlighted earlier in this study are addressed. In this regard it is also recommended that:

1. Environmental sustainability be improved by comprehensive on-farm training programs be conducted in order to equip farmers with relevant knowledge on cattle production and marketing.
2. Extension services be improved to ensure continuous technical support of farmers.
3. The most suitable cattle breed adapted to the ECP climate and smallholder management levels while tolerant to local diseases and parasites be identified and promoted.

4. Producers' soioeconomic and demographic characteristics need to be considered when developing and implementing livestock based technologies.

6.4 Suggestions for further studies

Further studies are required to investigate and quantify all the cash income and expenditure channels including assets owned by smallholder cattle producers. This could give a clearer picture of the smallholder cattle producers' livelihoods and advices on more appropriate interventions. The indicator based analysis used in the current study cannot be regarded as ultimately adequate in assessing sustainability of the communities under study. A more quantitative sustainability assessment can be achieved by a more interdisciplinary and comprehensive study to derive more accurate reference values for validation purposes. Sustainability assessment studies should be applied to the smallholder cattle production system across the country for comparison and adoption of practices confirmed to be working in other areas. It is also important to test beef quality from cattle fed natural pasture resources found in the areas to identify unique attributes that can be used for its characterisation. Further research on market segmentation is also required to characterise the market that demands beef which conforms to the qualities produced by smallholder cattle producers.

References

Boogaard, B.K., Oosting, S.J., Bock, B.B. & Wiskerke, J.S.C. (2011) The socio-cultural sustainability of livestock farming: an inquiry into social perceptions of dairy farming. *Animal* **5**: *1458–1466*.

Phillips, L. (2012). Certified South African Angus Beef – branding top quality. Farmers weekly.

Thompson, J., Polkinghorne, R., Gee, A., Motiang, D., Strydom, P., Mashau, M., Ng'ambi, J., deKock, R. and Burrow, H. (2010). *Beef Palatability in the Republic of South Africa and the Implications for Niche Marketing Strategies*, Final Report on Project LPS/2008/013, University of New England, Armidale.

Appendix 1: Smallholder cattle producers' questionnaire

A survey on sustainability of smallholder cattle production system and its vertical integration into the formal beef market value chain in South Africa

Enumerator:…… Municipality name:……
Community name:…… Name of respondent:……..…..

A. **HOUSEHOLD DEMOGRAPHICS**

1.	**Age of household head**	*1= <30* ☐	*2= 31-45* ☐	*3= 46-50* ☐	*4= 51-60* ☐	*5= >60* ☐
2.	**Gender**	*1= M* ☐		*2= F* ☐		
3.	**Marital status**	*1= Single* ☐	*2= Married* ☐	*3= Widowed* ☐	4= Divorced ☐	
4.	**What is the size of your household?**	Total ☐	Adults. M ☐ F ☐	Children. M ☐ F ☐		
5.	**What is your household age distribution?**(record number of people	1= <5yrs	2= 5-10	3= 11-20	4= 21-30	5= 31-40
	6= 41-50	7= 60-65	8= >65			
6.	**Highest level of formal education**	*1=No formal education* ☐	*2= Grade 7* ☐	*3= Grade 12* ☐	*4= Tertiary* ☐	
7.	**Religion**	*1= Christianity* ☐	*2=Traditional* ☐	*3= Moslem* ☐	*4= Other* (specify)….....	
8.	**What is your employment status?**	*1= Full-time farmer* ☐	*2= Part-time farmer* ☐	*3= Employed off-farm* ☐	*4= Unemployed* ☐	*5= Pensioner* ☐
	6= Other (specify)……					

9.	**What is your total land size (ha)?** ……
10.	**What type of livestock species do you keep?** (Rank them (1 being the most important species)

Livestock species	**Cattle**	**Goats**	**Sheep**	**Pigs**	**Poultry**	**Donkeys**	**Others (specify)**
Number							
Rank							

11.	**How long have you been farming?**		

12.	**Where did you get capital to invest in livestock farming?**	*1= Borrowed from bank* ☐	
2= Borrowed from family ☐	*3= Borrowed from friends* ☐	*4= Own savings* ☐	
5= State aid ☐	*6= Others* (specify)……		

13.	**Do you have any formal training in livestock farming?**	*1= Yes* ☐	*2= No* ☐
14.	**If yes please specify** ……		

B. SUSTAINABILITY SCORES

15.	**Which score of the following economic indicators do you fall under?** (Tick where appropriate 1= <1000; 2= 1001-2000; 3= 2001-3000; 4= 3001-5000; 5= >5000)					
Economic Indicators	None	1.	2.	3.	4.	5.
Income from cattle/beef sales						
Income from other livestock (sheep, goats, pigs, chickens)						
Income from crops						
Income from other non-farm activities						
Income from social grants and pensions						

16.	**Indicate a score for each of the following environmental indicators according to the following criteria (1= Poor; 2= Fair; 3= Good; 4= Very good; 5= Excellent)**				
	1	2	3	4	5
Rainfall					
Forage biomass availability					
Soil fertility					
Level of agricultural chemical use					
Soil erosion					
Plant biodiversity (species richness)					
Air quality					

17.	**Indicate a score for each of the following social indicators according to the following criteria (1= Poor; 2= Fair; 3= Good; 4= Very good; 5= Excellent)**				
	1	2	3	4	5
Food access					
Household health status					
Access to safe drinking water					
Level of education of household members					
Access to information					
Gender balance					
Cattle herd size					

C. CATTLE PRODUCTION MANAGEMENT AND MARKETING

18.	**What is the composition of your herd?**				
	1.Calves (<1year)	2. Steers (>1 year)	3. Breeding females (>1year)	4. Bulls	Total
Number					

19.	**How did you acquire your cattle?**			
1= Inherited ☐	*2= Given* ☐	*3= Bought* ☐	*4= Other* (specify)……..	

20.	**What cattle breed do you use?**	*1= Nguni* ☐	*2= Bonsmara* ☐	*3= Hereford* ☐
4= Brahman ☐	*5= Africaner* ☐	6= *Mixed breeds* ☐	*7= Others* (specify)……..……	

21.	**What are your reasons for using the breed you named above?** (Tick one or more) (Rank 1 as the most important)	
Reason	**Tick**	**Rank**
High growth rate		
High milk yield		
Has low feed requirements		
Resistant to diseases		
Resistant to parasites (internal and external)		
High fertility (reproductive rates)		
Good meat quality		
Good temperament		

Horns		
Attractive skin colour		
Affordability		
Availability		
Other (specify)		

22.	**How many calves did you get from your herd in 2014?**			
1= None ☐	*2= 1* ☐	*3= 2 - 3* ☐	*4= 4 - 5* ☐	*5= >5* ☐

23.	**How many calves do you wean in 2014s?**			
1= None ☐	*2= 1* ☐	*3= 2 - 3* ☐	*4= 4 - 5* ☐	*5= >5* ☐

24.	**What are your sources of labour for cattle production?**			
Type of employee	*1= Full-Time (FT) hired labour/workers*	*2= Part-Time (PT) hired labour/workers*	*3= Family members*	Total
Number				

25.	**What role(s) does each family member play in cattle production?** (Tick one or more)			
Role	**Adults**		**Children**	
	Male	Female	Boy	Girl
Feeding/supplementation				
Herding				
Fencing				
Kraal construction & maintenance				
Breeding				
Health management				
Milking				
Purchasing				
Slaughtering				
Marketing/Selling				
Other (specify)				

26.	**If you use hired labour/workers, how much do you pay your hired labour/workers?**	*1= P*	*2= T*	3= C
Cash (R/month)				
Other (specify)				

27.	**Do you get access to extension services?**	*1= Yes* ☐	*2= No* ☐
28.	**If yes how many times a week?** ……..		

29.	**Where do you get most cattle management advice?**	*1= Extension officers* ☐
2= Neighbours ☐	*3= Radio/TV* ☐	*4= Corporative manage* ☐ *5= Own records* ☐
6= Publications (newsletters, periodicals e.t.c) ☐	*7= Other (specify)*……	

30.	**How can you best describe cattle production in the past five years?**
1= Improved. If yes, how? ……	
2= Remained the same. If yes, why? ……	
3= Deteriorated. If yes, what is the cause? ……	

31.	**What is your major source of income?**	*1= Salary* ☐	*2= Crops* ☐
3= Livestock ☐	*4= Social grants* ☐		*5= Pensions* ☐

32.	**How many cattle did you sell in 2014?**	*1= None* ☐	*2= 1* ☐	*3= 2-4* ☐	*4= >5* ☐

33.	**How many cattle can you potentially sell per year?**	*1= 1* ☐	*2= 2-4* ☐	*3= >5* ☐

34.	**Which marketing channels do you use to sell your cattle?**(Tick a max of 3 and rank)		
		Tick	**Rank**
1= Abattoirs/Feedlots			
2= Butchers			
3= Hotels/Restaurants/Food shops			
4= Middlemen			
5= Other farmers			
6= Other (specify)……..			

35.	**If you sell to food shops or food chain stores which ones do you use?**
36.	**What are your reasons for using the above-mentioned marketing channel?**

1= Price ☐	*2= Distance* ☐	*3= Convenience* ☐	*4= Other* (specify)……..

37.	**What is the average price for the live mature cattle (or meat per kg) in the above-mentioned marketing channel? R**……..

38.	**Where do you obtain beef price information?**	*1= Retailers* ☐	*2= Newspapers* ☐

3= Radio ☐	*4= TV* ☐	*5= Extension officers* ☐	*6= Word of mouth* ☐	*7= Other (specify)…*

39.	**How do you rate your knowledge in terms of the following?** (Tick where appropriate)		
	1= Poor	***2= Fair***	***3= Good***
Cattle production			
Rangeland management			
Farm business management			
Risk management			
Conflict management			
Record keeping			

40.	**What is the average distance to the market?** …..……

41.	**If transport is required to get to the market who provides it?**	*1= Farmer* ☐	*2= Buyer* ☐

3= Marketing organisation ☐	*4= Middlemen* ☐	*5= Other* (specify) ……

42.	**Which season do you prefer to sell your animals?**

1= Rain season ☐	*2= Dry season* ☐	*4= Other* (specify) ……..……

43.	**Why do you prefer to sell in the above-mentioned season?** ……

44.	**Do you have problems meeting the classes required by abattoir/retailers?**	*1= Yes* ☐	2= No ☐
45.	**If yes what are the problems?:** ……		
46.	**What do you think can be done to meet the grades required abattoirs/retailers?** ……		

47.	**What other marketing constraints do you experience?** ……

48.	**What do you think about the idea of developing a unique natural beef brand?** .....

49.	**Are you willing to participate in developing the brand?**	*1= Yes* ☐	*2= No* ☐

50.	**Do you think there is a market for branded beef?**	*1= Yes* ☐	*2= No* ☐

51.	**What do you think is the best marketing channel for such a beef brand?** ……

52.	**Why do you prefer the marketing channel you mentioned above?** ……

53.	**Do you think you will be able to sell at least 1 animal year?**	*1= Yes* ☐	*2= No* ☐
54.	**If not why?** ……		

55.	**What can be done to meet the animal numbers required by abattoirs/retailers?**			
1= Group marketing ☐	*2= Forward contracting* ☐	*3= Feedlotting* ☐	*4= Other* ……	

56.	**Do you expect a premium when you supply natural pasture-fed animals to abattoirs/retailers**	*1= Yes* ☐	*2= No* ☐

57.	**If yes, how much premium do you expect per kg** ……

58.	**What are the problems that are likely to affect the development of this brand?** .....

59.	**Which income class (R/month) do you fall under?**			
1= <1000 ☐	2= 1001-2000 ☐	3= 2001-3000 ☐	4= 3001-5000 ☐	5= >5000

60.	**Why do you keep cattle?** (Tick one or more) (Rank 1 as the most common use)			
Use	**Rank**	**Use**	**Rank**	
Meat		Sales		
Milk		Status		
Draught power		For lobola (bride price)		
Manure		Savings (bank on hoofs)		
Skin		Ceremonies		
Bones		Other (specify)		
61.	**How many cattle did you slaughter for home consumption in 2014?** ……			

62.	**How much money do you get from cattle sales per annum?** ……

63.	**Indicate months of food adequacy for your family**			**Jan**	**Feb**	**Mar**		
Apr	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**

64.	**How many times did you received medical treatment in the past year?**.....

Appendix 2: Abattoirs questionnaire

A survey to assess the capacity and willingness of abattoirs to support the development of a Natural beef brand for smallholder cattle producers in South Africa

Name of Enumerator…..…….. Municipality name…….…….
Community/city name ……..…….. Name of respondent…..……..
Abattoir name……..…… Position held by respondent……..……

SECTION 1: DEMOGRAPHIC INFORMATION

1.	**Gender**	*1 = Male* ☐	*2 = Female* ☐

2.	**Age** ……..

3.	**Highest level of education**	*1 = No formal education* ☐
2 = Grade 1-7 ☐ *3 = Grade 8-12* ☐ *4=Tertiary* ☐ *specify*……..		

SECTION 2: OPERATIONAL INFORMATION

4.	**Where does your abattoir get cattle for slaughter?**
	Tick
Own beef cattle farms/feedlots	
Contracted commercial farmers	
Non-contracted commercial farmers	
Contracted smallholder farmers	
Non-contracted smallholder farmers	
Middlemen/brokers	
Others (specify)……..….	

5.	**How many cattle did your abattoir slaughter last month?**	

6.	**Of cattle slaughtered last month, how many came from smallholder farmers?**

7.	**How can you describe the following quality parameters for cattle coming from the smallholder sector?**		
	1 = Good	2 = Average	3 = Poor
Age			
Breed			
Weight			
Health condition of the animal			
Body condition of the animal			

8.	**What do you think should be done to improve the parameters you indicated as poor above prior to marketing?** …..……..……

9.	**How many cattle did your abattoir slaughter last month?**	……..……

10.	**Which month does your company record as the month of highest and lowest cattle supply?**	*1 = Highest* …….……	*2 = Lowest* …….....

11.	**Will your abattoir be willing to establish forward contracts with smallholder cattle producers?**	*1 = Yes* ☐	*2 = No* ☐

12.	**If No, why?** .....

13.	**Which of the following markets does your abattoir supply beef?**

	Tick
Food chain stores	
Butcheries	
Hotels	
Restaurants	
Institutions (schools, colleges, universities, hospitals e.t.c)	
Others (specify) ……	

14.	**Give reasons for the most preferred market?**	……..

SECTION 3: BEEF BRANDING INFORMATION

15.	**Does your abattoir sell branded beef?**	*1 = Yes* ☐	*2 = No* ☐

16.	**If Yes, which brand(s) are currently being sold?**
Brand name	**Source/supplier of cattle**

17.	**How much beef of your abattoir's carcasses/beef products is branded?** ……

18.	**Does your abattoir charge premiums for branded beef?**	*1 = Yes* ☐	*2 = No* ☐

19.	**If Yes, what percentage is usually paid as premiums per kg of branded beef?**			
1 = 1-5% ☐	*2 = 6-10%* ☐	*3 = 11-15%* ☐	*4 = 15-20%* ☐	*5 = >20* ☐

20.	**Does your abattoir pay premiums to branded beef cattle suppliers?**	*1 = Yes* ☐	*2 = No* ☐

21.	**If No, why?** ……..

22.	**If No, how could cattle producers benefit from premiums paid for their products?** ……..……

23.	**Is your abattoir willing to form forward contracts with smallholder cattle producers who wish to develop a Natural beef brand?**	*1=Yes* ☐	*2=No* ☐

24.	**If Yes, are you willing to pay a premium to the smallholder cattle producers for the natural pasture branded beef?**	*1=Yes* ☐	*2= No* ☐

25.	**If No, why?**	……

26.	**How do you think the demand for Natural beef will compare to the current beef products that you offer?** ……..

27.	**What problems do you think you are likely to encounter when marketing Natural beef?** ……

28.	**What do you think should be done to reduce the problems you mentioned above?** ……..……

Thank you very much for your time!!!!!

Appendix 3: Beef retailers questionnaire

A survey to assess beef retailers' capacity and willingness to accept Natural beef from smallholder cattle producers in South Africa

Name of Enumerator…..…….. Municipality name……..…….
Community/city name ……..…… Name of respondent…...……..
Company name…… Position held by respondent…….……

SECTION 1: DEMOGRAPHIC INFORMATION

1.	**Gender**	*1= Male* ☐	*2= Female* ☐

2.	**Age** ……..

3.	**Highest level of education**		
1= Primary ☐	*2= Secondary* ☐	*3=Tertiary* ☐	

SECTION 2: RETAILER INFORMATION

4.	**Where does your company buy beef from?**
Abattoir	
Middlemen/Brokers	
Contracted commercial farmers	
Contracted smallholder famers	
Own farms	
Others (specify) ……	

5.	**How much beef (kg) does your company purchase per month?**	…….

6.	**What types of beef products does your company buy?**
Whole beef carcass	
Beef quarters	
Primal cuts	
Shelf-ready beef	
Other (specify) ……	

7.	**Does your company have contracts with its beef suppliers?**	*1=Yes* ☐	*2=No* ☐

8.	**If Yes, how much beef (kg) is purchased from contracted suppliers per month?** ……

9.	**How much beef (kg) did your company sell last month?**	……...

10.	**Which of the following beef products does your company sell?**
Beef quarters	
Beef primal cuts	
Processed/value added beef products	
Stewing beef	
Offals	
Ready to eat beef products	
Other (specify) ……	

11.	**Is your company satisfied with the current beef classification system?**	*1 = Yes* ☐	*2 = No* ☐

12.	**If No, why?** ……..……..

SECTION 3: BEEF BRANDING INFORMATION

13.	**Does your company sell branded beef?**	*1 = Yes* ☐	*2 = No* ☐

14.	**If Yes, which brand(s) does it sell currently?**
Brand name	**Source/supplier**

15.	**How much beef products (kg) does your company sell as branded per month?**		

16.	**Does your company have contracts with suppliers of branded beef?**	*1 = Yes* ☐	*2 = No* ☐

17.	**If No, is the company willing to form contracts with suppliers of branded beef?**	*1 = Yes* ☐	*2 = No* ☐

18.	**Do your company charge premiums for branded beef?**	*1 = Yes* ☐	*2 = No* ☐

19.	**If Yes, what percentage is usually charged per kg of branded beef?**				
1 = 1-5% ☐	*2 = 6-10%* ☐	*3 = 11-15%* ☐	*4 = 15-20%* ☐	*5 = >20* ☐	

20.	**Do beef producers benefit from brand premiums paid by consumers?**	*1 = Yes* ☐	*2 = No* ☐

21.	**If Yes, how?** ……..

22.	**If No, why?** ……..

23.	**What do you think should be done to ensure that beef producers receive premiums paid by consumers?** …….

24.	**Is your company willing to sell a Natural beef brand?** *(Natural beef comes from cattle raised on natural grass and browse species)*	*1 = Yes* ☐	*2 = No* ☐

25.	**If Yes, how do you think the demand for Natural beef will compare to the current beef products?** ……...

26.	**Are you willing to support a group of smallholder cattle producers to develop a Natural beef brand?**	*1=Yes* ☐	*2=No* ☐

27.	**If No, why?**	……..…….

28.	**If Yes, are you willing to pay a premium for natural pasture branded beef?**	*1=Yes* ☐	*2= No* ☐

29.	**What problems do you think you are likely to be encounter when marketing Natural beef?** ……..……..

30.	**What do you think should be done to reduce the problems you mentioned above?** ……

Thank you very much for your time!!!!!!

Appendix 4: Consumers questionnaire

A survey to assess the willingness of consumers, to support the development of a Natural beef brand for smallholder cattle producers in South Africa

Name of Enumerator…..……..Municipality name…….……
Community/city name ……..……Name of respondent…..……..……..…..

QUALIFICATION QUESTION:

Are you the primary person who buys beef in your household?	*1 =Yes* ☐	*2 = No* ☐

If Yes, proceed with the rest of the questions; if No, thank you for your time!

SECTION 1: GENERAL DEMOGRAPHIC INFORMATION

1.	**Gender**	*1= Male* ☐	*2= Female* ☐

2.	**Marital status**	*1=Single* ☐	*2=Married* ☐	*3=Widowed* ☐	*4=Divorced* ☐

3.	**Age**	……

4.	**What is the size of your household?**				
	Total	**Adult males** (>18 years)	**Adult females** (>18 years)	**Male children** (<18 years)	**Female children** (<18 years)
Number					

5.	**Highest level of education**		
1=Primary ☐	*2= Secondary* ☐	*3= Tertiary* ☐	

6.	**What is your major source of income?**	*1 = Salary* ☐	*2 = Crops* ☐	
3 = Livestock ☐	*5 = Social grants* ☐	*= Pensions* ☐	*6 = Other (specify)……*	

7.	**Which income class (R/month) do you fall under?**	*1. < 500* ☐	*2. 501-1000* ☐		
3 = 1001-2000 ☐	*4 = 2001-3000* ☐	*5 = 3001-4000* ☐	*6 = 4001-5000* ☐	*7 = > 5000* ☐	

SECTION 2: BEEF PURCHASING BEHAVIOUR

8.	**Which meat does your household eat the most?**				
1 = Beef ☐	*2 = Pork* ☐	*3 = Chicken* ☐	*4 = Lamb* ☐	*5 = Other (specify)……..*	

9.	**Where do you usually buy your beef from?**	*1 = Supermarket* ☐	*2 = Butcheries* ☐	
3 = Abattoirs ☐	*4 = Local farmers' market* ☐	*5 = Feedlots* ☐	*6 = Others (Specify)……..*	

10.	**Why do you prefer the market you mentioned above?**			
1 = Price ☐	*2 = Value for money* ☐	*3 = Distance* ☐	*4 = Others (specify)……..……*	

11.	**How frequently do you purchase beef for home consumption?**		
1 = Never ☐	*2 = At least once a week* ☐	*3 = 2-3 times a month* ☐	
4 = About once a month ☐	*5 = Less than once a month* ☐	*6 = Other (specify)……..*	

12.	What type of beef do you normally buy?			
		Type	**Quantity (kg)**	**Price**

13.	How many times a week does your household eat beef prepared at home?		
1 = Everyday ☐	*2 = 1 – 2 times* ☐	*3 = 3 or more times* ☐	*4 = Never* ☐

14.	Which five of the following factors do you consider when buying beef?
	Tick
Price	
Beef brand	
Beef cuts	
Lean (muscle) colour	
Fat colour	
Fatness (proportion of fat to lean)	
Nutritional quality	
Perceived safety	
Ethical quality (animal welfare)	
Healthfulness (presence of healthful fatty acids, mineral & vitamins)	
Origin	
Expiry date	
Packaging	
Other (specify)……..……	

15.	Which meat eating quality attributes do you consider important?
	Tick
Tenderness	
Taste	
Aroma	
Juiciness	
Other (specify)……..……	

SECTION 3: BEEF BRANDING INFORMATION

16.	Do you buy any branded beef brands?	*1= Yes* ☐	*2 = No* ☐

17.	If Yes, how frequently do you buy branded beef per week?		
1 = Never ☐	*2 = Once* ☐	*3 = 2 – 3 times* ☐	*4 = Everyday* ☐

18.	If you have been buying branded beef, was a premium charged for the brand?	1 = Yes ☐	2 = No ☐	3 = I do not know ☐

19.	If not, for what reason have you not bought branded beef?	1 = Poor quality ☐	
2 = Lack of availability ☐	3 = Expensive ☐	4 = No interest in the brand ☐	5 = Other (specify)……...

20.	Are you willing to buy Natural beef if it is made available on the market?	*1 = Yes* ☐	*2 = No* ☐

21.	If No, why?	……

22.	**What factors would you consider important when buying Natural beef?**
	Tick
Origin	
Financial benefits for farmers	
Healthfulness	
Ethical quality/animal welfare considerations	
Perceived safety	
Others (specified)	

23.	**Where would you prefer to buy it from?**	*1 = Abattoirs* ☐
2 = Butcheries ☐	*3 = Supermarkets* ☐	4 = Other (specify)……..

24.	**Why do you prefer the market you indicated above?**	……..

25.	**Are you willing to pay a premium for the Natural beef brand?**	*1= Yes* ☐	*2= No* ☐

26.	**If No, why?**	……

27.	**If Yes, how much are you willing to pay as premium per kg?**			
1 = 1-5% ☐	*2 = 6-10%* ☐	*3 = 11-15%* ☐	*4 = 16-20%* ☐	*5 = >20%* ☐

28.	**What information would like to be included on the label of a Natural beef brand?**
	Tick
Price	
Expiry date	
Origin	
Healthfulness	
Percentage premium charged on the beef brand	
Others (specify) ……	

Thank you very much for your time!!!!!!