Declaration

I, **Teofilus Shiimi**, declare that the dissertation hereby submitted for the qualification of Master's Degree in Agricultural Economics at the University of the Free State is my own independent work and that I have not previously submitted the same work for a qualification at/in another university/faculty

Dedication

"*Beginning today I will take a moment to step off the beaten path and to revel in the mysteries I encounter. I will face challenges placed before me with courage and determination. I will overcome what barriers there may be which hinder my quest for growth and self-improvement"*

Penny Jacqueline White

This work is dedicated to:
My dearest father, mother and siblings

Acknowledgments

My sincerest appreciation goes first and foremost to my supervisor, Dr P.R. Taljaard, for his educative and knowledgeable guidance and his frank and critical advice throughout the course of this study.

Secondly, I would like to express my genuine gratitude towards my co-supervisor, Mr H. Jordaan, for his practical inputs, especially in the analytical stages – without his enthusiasm and encouragement, this study would not have been possible.

I would also like to thank Ms M. Engelbrecht for her loyalty and kindness, mostly during the data-collection stages and the editing process. Equally, I would like to sincerely thank the University of the Free State, particularly the Faculty of Natural and Agricultural Sciences, for giving me the opportunity to fortify my knowledge at this institution. Special thanks go to the staff of the Department of Agricultural Economics and the Centre for Agricultural Management for making me feel at home during my study – their assistance and support were the main contributors to my success.

The financial assistance of the SADC (ICART), in collaboration with the European Union, is hereby acknowledged. Additional financial assistance from the Meat Board of Namibia, and the use of the photocopying facilities of the Meat Board of Namibia and the Ministry of Agriculture, Water and Forestry, also made a significant contribution to the success of this study.

I owe a debt of gratitude to all cattle producers and referenced authors for providing much-needed information, since without their informative inputs, this study would not have been possible.

I would like to thank my family, colleagues and friends for their outstanding assistance and unwavering support throughout the duration of this study. Their presence, loyalty and friendship have contributed much towards the success of this study and I thank them all from the bottom of my heart.

Above all, I would like to thank the Lord of all Lords for making everything possible. His care, protection and love accompanied me through all the challenges encountered in the course of this study. Thank you, Lord, for leading me to this point.

Teofilus Shiimi
Bloemfontein
2009

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Transaksiekoste en beesboerdery se besluit van bemarkingskanaal in Noord-sentraal Namibië

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Uittreksel

Ongeveer 70 % van Namibië se bevolking is afhanklik van landbouproduksie om ’n lewensbestaan te maak. Bowendien bly landbou ’n belangrike ekonomiese sektor in Namibië, omdat die nasionale ekonomie regstreeks afhanklik is van landbouproduksie. Twee afsonderlike grondeienaarskap-gebruikstelsels (kommunaal in die noorde en die kommersiële landbou in die suide), word geskei deur die “Veterinary Cordon Fence” (VCF), wat die bemarking van lewendehawe vanaf die noordelike kommunale gebiede bemoeilik. Beesvleisprodusente in die noordelike kommunale gebiede, het die opsie van ’n formele en informele bemarkingskanaal. Hoewel verskeie pogings al aangewend is om die produsente aan te moedig om die formele bemarkingskanaal te gebruik, is daar nie veel verbetering te bespeur nie. In die studie word verskeie faktore geanaliseer om die invloed daarvan op die bemarkingskeuse van beesvleisprodusente te bepaal.

Faktore verantwoordelik vir die bemarkingsbesluit om wel die formele bemarkingskanaal te gebruik, word ge-analiseer met behulp van ’n “Probit-” model. Faktore wat ’n invloed uitoefen op die verhouding van beeste wat op die formele mark bemark word, in gevalle waar die produsent besluit het om daardie mark te gebruik om sy/haar beeste te bemark, word met behulp van ’n “Truncated-” model bepaal. Die toetsing van die “Tobit-” model, teenoor die alternatief

van ’n tweeledige model, word gedoen met behulp van die sogenaamde “Cragg’s-” model. Faktor-analise is verder gebruik om die onderliggende transaksie-kostestruktuur te ontleed.

Die empiriese resultate dui daarop dat probleme met vervoer van diere na MeatCo, verbeterde produktiwiteit, toegang tot markinligting en nuwe inligtingstegnologie, van die faktore is wat verantwoordelik is vir die besluit om wel beeste deur die formele mark te verkoop. Betalingsooreenkomste tussen produsente en MeatCo, dierehantering, toegang tot nuwe inligtingstegnologie, die ouderdom van respondente, asook die tekort aan bemarkingsvaardigheid, is van die faktore wat die verhouding van beeste deur die formele bemarkingskanaal beïnvloed.

Die resultate toon dat aanmerklik meer inligting verkry word deur die bemarkingsbesluite van beesvleisprodusente as ’n tweeledige, eerder as ’n enkelvoudige besluit te modelleer. Faktor-analise het diskontofaktore, afleweringsaspekte en markeienskappe geïdentifiseer as die onderliggende struktuur van die beesvleismark wat transaksiekoste beïnvloed.

Sleutelwoorde: Beesbemarking, besluitneming, formele markte, transaksiekoste

Transaction costs and cattle farmers' choice of marketing channel in North-Central Namibia

By

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Abstract

Approximately 70 % of the Namibian population depends on agricultural activities for their livelihoods. Moreover, agriculture remains an important sector in Namibia, because its national economy is widely dependent on agricultural production. However, two distinct land tenure systems (communal and commercial farming sectors) separated by the Veterinary Cordon Fence (VCF) complicated the marketing of cattle from the Northern Communal Areas (NCA). Cattle producers in the NCA have the option to market their cattle via the formal or informal market. Although efforts have been made to encourage producers to market their cattle through the formal market, limited improvement has been observed. In this study a number of factors were analysed to determine their influence on the decisions made in respect of cattle marketing.

Factors influencing the decision of whether or not to sell through the formal market were analysed using the Probit Model. Factors influencing the proportion of cattle sold through the formal market in cases where the producer has decided to use that market to sell her/his cattle were analysed using the Truncated Model. Testing the Tobit Model against the alternative of a two-part model was done by means of Cragg's Model. Factor analysis was used to study the underlying structure resulting in transaction costs.

The empirical results revealed that problems related to transport to MeatCo, improved productivity, accessibility to market-related information and accessibility to information on new technology are some of the factors significantly affecting the decision of whether or not to sell

through the formal market. Payment arrangements by MeatCo, animal handling, accessibility to new information technology, age of respondents and lack of access to marketing expertise are some of the factors influencing the proportion of cattle sold through the formal market.

The results suggest that substantially more information is obtained by modelling cattle-marketing behaviour as a two-decision-making framework instead of a single-decision-making framework. Factor analysis identified discounting factors, delivery aspects and market features as the underlying structure resulting in transaction costs.

Key words: Cattle marketing, decision-making, formal markets, transaction costs

LIST OF ABBREVIATIONS AND ACRONYMS

BUYERPOWER	- Buyer Bargaining Power
CA	- Communal Area
CBPP	- Contagious Bovine Pleuropneumonia
CFA	- Confirmatory Factor Analysis
CREDACCES	- Access to Credit
DEES	- Directorate of Extension and Engineering Services
DVS	- Directorate of Veterinary Services
EFA	- Exploratory Factor Analysis
EU	- European Union
EV	- Explanatory Variables
FANMEAT	- Farm Assured Namibian Meat Scheme
FAO	- Food and Agriculture Organization
FMD	- Foot-and-Mouth Disease
GAP	- Good Agricultural Practices
GDP	- Gross Domestic Product
GOVINF	- Government-Related Information
GRDEUNCETY	- Grading Uncertainty
HACCP	- Hazard Analysis and Critical Control Points
HANDLING	- Animal Handling
IFAD	- International Fund for Agricultural Development
IT	- Information Technology
ISRD	- Integrated Sustainable Rural Development

IMPRODUCTY	- Improved Productivity
KMO	- Kaiser Meyer-Olkin
LPM	- Linear Probability Model
LR	- Likelihood Ratio
LS	- Least Square
MAWF	- Ministry of Agriculture, Water and Forestry
MRKEXP	- Market Experts
MRKINF	- Market-Related Information
MRKUNCETY	- Market Uncertainty
MSA	- Measure of Sampling Adequacy
NASSP	- National Association of Secondary School Principals
NCA	- Northern Communal Areas
NCR	- North-Central Regions
NCSS	- Statistical and Power Analysis Software
NEPAD	- New Partnership for Africa's Development
NERPO	- National Emergent Red Meat Producers' Organisation
NEWTECH	- New Technology Information
NIE	- New Institutional Economics
NOLIDEP	- Northern Regions' Livestock Development Project
PA	- Parallel Analysis
PAYMENT	- Payment Arrangement
PCA	- Principal Component Analysis
PCR	- Principal Component Regression
PRCEUNCETY	- Price Uncertainty
PTRNSPMEATC	- Problem with Transport to MeatCo

RSA	- Republic of South Africa
SADC	- Southern African Development Community
SACU	- Southern African Customs Union
SCA	- Southern Communal Areas
SSA	- Sub-Saharan Africa
SVCF	- South of Veterinary Cordon Fence
TRANSCOST	- Transport Cost
UK	- United Kingdom
US	- United States
VCF	- Veterinary Cordon Fence

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CHAPTER 1

INTRODUCTION

1.1 Background

Strengthening agriculture is critical in facing the challenges of rural poverty, food insecurity, unemployment and sustainability of natural resources. The World Bank (2007) pointed out that agriculture can work in conjunction with other sectors to produce faster growth, reduce poverty, and sustain the environment. However, there is a need to promote market participation in order to increasingly recognise the effort to bring about agricultural transformation in developing countries (Alene, Manyong, Omanya, Mignouna, Bokanga & Odhiambo, 2007).

Agriculture, along with primary food processing, has been described as the largest job creation mechanism in the world (Botha, 2007). It remains an extremely important sector in the Southern African Development Community (SADC) region, employing on average 60-70 % of the total labour force (Nkonde, 2007). An interesting finding was that policy analyses in the livestock sector all agree that the demand for animal products will rise in line with population growth, especially in view of rapid urbanisation (Kamuanga, Somda, Sanon & Kagone, 2008; Upton & Otter, 2004). This may go hand in hand with an increase in protein consumption, especially in developing countries, and greater consumer awareness of health in developed countries, thus presenting prospects for niche marketing (Bahta & Bauer, 2007; Horsthemke, 2009).

Similar to most other SADC countries, Namibia is not exempted from the importance of agriculture, because its national economy depends widely on agricultural production, which remains the main source of food and employment of rural people. Namibia's secondary sector (industrial processing) is still in an embryonic stage and therefore the country's economy is heavily dependent on the earnings generated from primary commodity exports in a few vital sectors, such as minerals, livestock and fish. Currently, some 70 % of Namibia's population derive their livelihoods from agriculture, either directly or indirectly (Horsthemke, 2009). The development of agriculture throughout the industrialised world has been associated with

technological change. The trend in the adoption of new technology in agricultural production and management has been termed the industrialisation of agriculture (Cuthbert, 2008). Therefore, for Namibia to progress to a state of greater food security and production for export, the development of the sector is critical to accelerate the industrialisation of agriculture. According to Business Namibia (2006) the National Agricultural Policy passed by Parliament in 1995 and recently revised continues to serve as the blueprint for such development. Its aim is to increase and sustain levels of productivity, real farm incomes, as well as national and household food security.

As a semi-arid country well endowed with natural pastures, Namibia is suited for extensive livestock ranching (Ouseb, 2006). Much of the livestock agriculture is subsistence farming, but there is a growing manufacturing sector that deals with meat and fish processing. Historically, livestock from the commercial farming sector has dominated agricultural production in Namibia and this largely still holds true. Cattle, sheep and goats constituted about 80 % of overall agricultural output in 2006 (Hosthemke, 2009).

1.2 Problem statement

Developing countries are generally characterised by the inefficiency of their marketing systems (Zereyesus, 2003). Consequently, developing countries are faced with a vicious circle: if the farmer does not obtain an economic return from the sale of his/her surplus production, he/she will tend to produce at a subsistence level only. On the other hand, a shortage in the supply of a marketable surplus makes the development of an inefficient marketing system extremely difficult (Zereyesus, 2003).

In developing countries, especially in communal areas, it has been found that beef supply is determined only by the cattle marketed (Sartorius von Bach, Van Renen & Kirsten, 1998), with cattle numbers not being adjusted according to environmental factors. However, according to the institutional setup, some producers respond to economic variables such as prices, while others do not. Dovie and Shackleton (2003) argued that communal producers consider their cattle as a store of wealth and they are only sold to meet immediate cash needs. Limited access of communal producers to the high-priced markets means that the problem with low off-take

rate lies not with price responsiveness, but rather with the market (Sartorius von Bach *et al*, 1998).

Düvel (2001) found that livestock producers in the Northern Communal Areas (NCA) of Namibia are particularly disadvantaged as far as livestock marketing is concerned, because of the Veterinary Cordon Fence (VCF). Meat and livestock cannot pass freely over this VCF into the southern zone that is free of Foot-and-Mouth Disease (FMD), which complicates the marketing of livestock. To overcome this shortage, the government of Namibia established MeatCo in 1992 and built eleven quarantine facilities in the NCA (FAO & NEPAD, 2005). MeatCo abattoirs in the NCA were established with the aim of creating marketing opportunities for communal producers in the NCA to benefit from their livestock through the formal market.

Cattle owners in the NCA of Namibia are able to sell their animals to the informal or indigenous market, or to the government-owned parastatal, MeatCo (De Bruyn, De Bruyn, Vink & Kirsten, 2001). For producers in the NCA to sell their cattle through the formal market (MeatCo), it is a prerequisite that their cattle are kept in quarantine camps to be inspected for any diseases for at least 21 days before entering the South African market. A problem associated with this is that the transaction costs involved in the marketing of cattle are high in the formal market, because these cattle often lose weight and grade in the camps due to insufficient feed, resulting in lower prices (Doss, McPeak & Barrett, 2005; FAO & NEPAD, 2005; Kirsten, 2002; NASSP, 2005). Another problem is the long distances over which producers have to transport their animals to the quarantine camps (Arbirk & Vigne, 2002; NOLIDEP, 2002; Sartorius von Bach, 1990). Moreover, many traditional producers regard cattle as a financial buffer mechanism, to be used only when cash shortages are experienced (Dovie & Shackleton, 2003). This leads to low prices being received for these animals, subsequently discouraging producers from marketing their cattle through the formal channels (Mushendami, Biwa & Gaomab, 2006; NASSP, 2005).

Kruger and Lammerts-Imbuwa (2008) argued that the off-take rate of cattle through the formal market in the NCA remains low at 2 % compared to an estimated 20 % off-take for the rest of the country. The key issue is that when the meat-processing abattoirs are not operating at their optimum capacity, they are not minimising their operating costs and are facing a cost

disadvantage, which makes them less competitive in the global or regional meat market (Negassa & Jabbar, 2007).

This problem has been researched, although most researchers have considered the marketing decision as a single, isolated decision. No studies have thus far considered that different factors may influence the decision made in respect of cattle marketing, and thus the decision must be modelled as two separate parts: (i) The decision of whether or not to make use of the formal market, and (ii) The decision in respect of the proportion of cattle to be sold through the formal market, given that the decision has been made to make use of the formal market to sell the cattle. Presuming this to be a single decision while it is actually be two separate decisions may cause the focus to fall on factors that are not really contributing to the effort to convince producers to market their cattle through the formal market.

1.3 Objectives of the study

The objectives of the study are based on two hypotheses: (i) The farmer's decision to market his/her cattle through the formal market is significantly affected by transaction costs, and (ii) Marketing behaviour must be analysed within a two-decision-making framework.

The primary aim of this study was to investigate the factors that influence the marketing behaviour of cattle producers in the study area so as to gain an understanding of the factors restricting them from using formal marketing channels to market their cattle. In order to achieve this primary objective, the following secondary objectives were set:

- To determine the factors that influence the cattle producer's decision on whether or not to use the formal marketing channel.
- To determine the factors that influence the proportion of cattle marketed through the formal market **in cases where the producer has used the formal market to sell his cattle**.

- To formally test whether it is sufficient to model marketing behaviour as a single decision, as done by other researchers, or whether the marketing decision should be separated into a two-decision-making framework.

- To investigate the underlying structure of factors causing transaction costs.

1.4 Motivation

Livestock production is the main enterprise of the majority of traditional producers in the NCA. For producers to maximise the benefits derived from their cattle, proper marketing integration with appropriate marketing structures and correct pricing of cattle in the sector are crucial.

More than half of all cattle in Namibia are located north of the VCF on about 16 % of the total land area of the country (MAWF, 2006) which typically results in large-scale degradation of rangeland and increased vulnerability of livestock producers to periodic dry periods and recurring drought. Stock numbers have increased over the years, and the current stocking rate exceeds the carrying capacity of the rangelands (MAWRD, 2004).

The North-Central Regions (NCR) have a large livestock population performing multiple functions in the economy, but the potential contribution of the sector to the mainstream national economy is not being fully exploited due to problems related to the choice of marketing channel. Hence, the aim of this study was to unlock the potential wealth encoded in the abundant livestock in the area by encouraging producers to sell through the formal market. It is understood that this will transform producers from the traditional way of keeping cattle for status, and they must therefore become responsive to factors that influence meat prices, e.g. drought preparedness and management, consumer preferences and attitudes, commercial enterprise, and financial management. This will subsequently contribute towards the achievement of the Millennium Development Goals, Vision 2030, and the objectives of the National Agriculture Policy. Achieving these objectives will be of significant economic importance for the historically underprivileged groups in the country.

It has long been understood that with increasing economic growth, small farm production systems could not remain static and would need to gear themselves towards some degree of commercialisation if they are to survive (Pingali, Khwaja & Meijer, 2005). On the consumer side, the delivery of livestock products through informal markets tends to serve poor consumers, creating an even tighter focus on the poor (Rich, Baker, Negassa & Ross, 2009). Thus, the intention of this study was to address and counteract the factors hindering the effort to encourage producers in the NCR to market substantial numbers of cattle through the formal market – an achievement that is envisaged to bring about numerous benefits not only for the cattle producers and MeatCo, but for the entire country.

This study has identified and proposed further actions essential to bring about improvement to the existing marketing system. The findings and the recommendations of the study give guidelines for development in other regions and will consequently be superlatively useful to policymakers.

1.5 Outline of the study

The remaining chapters of the study are organised as follows:

Chapter 2 provides an overview of the study area and a review of the relevant literature in order to provide a better understanding of the problem. **Chapter 3** covers a discussion of the questionnaire design and data gathering process, as well as a brief description of the respondents and the methodology used to achieve the objectives of the study. **Chapter 4** is devoted to the results and the discussion thereof. **Chapter 5** concludes the study and contains recommendations for further proposed research topics aimed at making a significant contribution to the improvement of cattle marketing in North Central Namibia.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of the study area in terms of cattle production and marketing in Namibia. The status of the people of the region and the current situation provide the foundation for the principles used in approaching the study area. A theoretical framework for analysing cattle marketing in the North-Central Regions (NCR), as well as related research, form part of this chapter.

2.2 Overview of the study area

2.2.1 Background

The NCR, as shown in Figure 1 and Figure 2, is a fascinating place: a myriad of landscapes, home to half the country's population engaged in a diversity of activities. The people, victims of a protracted recent war, are also the beneficiaries of a long and rich history that produced a society of traders, entrepreneurs, political leaders and any number of other dynamic characters (Mendelsohn, Obeid & Roberts, 2000). This community consists of producers, most of whom are still using their land to grow crops and keep livestock (Mendelsohn *et al.*, 2000). The selected study area comprises four regions, namely Omusati, Oshana, Oshikoto and Ohangwena. The NCR of the country is the most densely populated area, with an average population density of 26 people per km^2, which is more than ten times the national average (Namibia Tourism Board, 2006). These regions occupy 84,600 km^2 or 9.7% of the land surface (Araki, 2005). The majority of the population of the NCR are transhumant pastoralists, whose traditional subsistence strategy is based around two principal activities: livestock farming supported by migratory seasonal grazing, and rain-fed crop production (Tapscott, 1990).

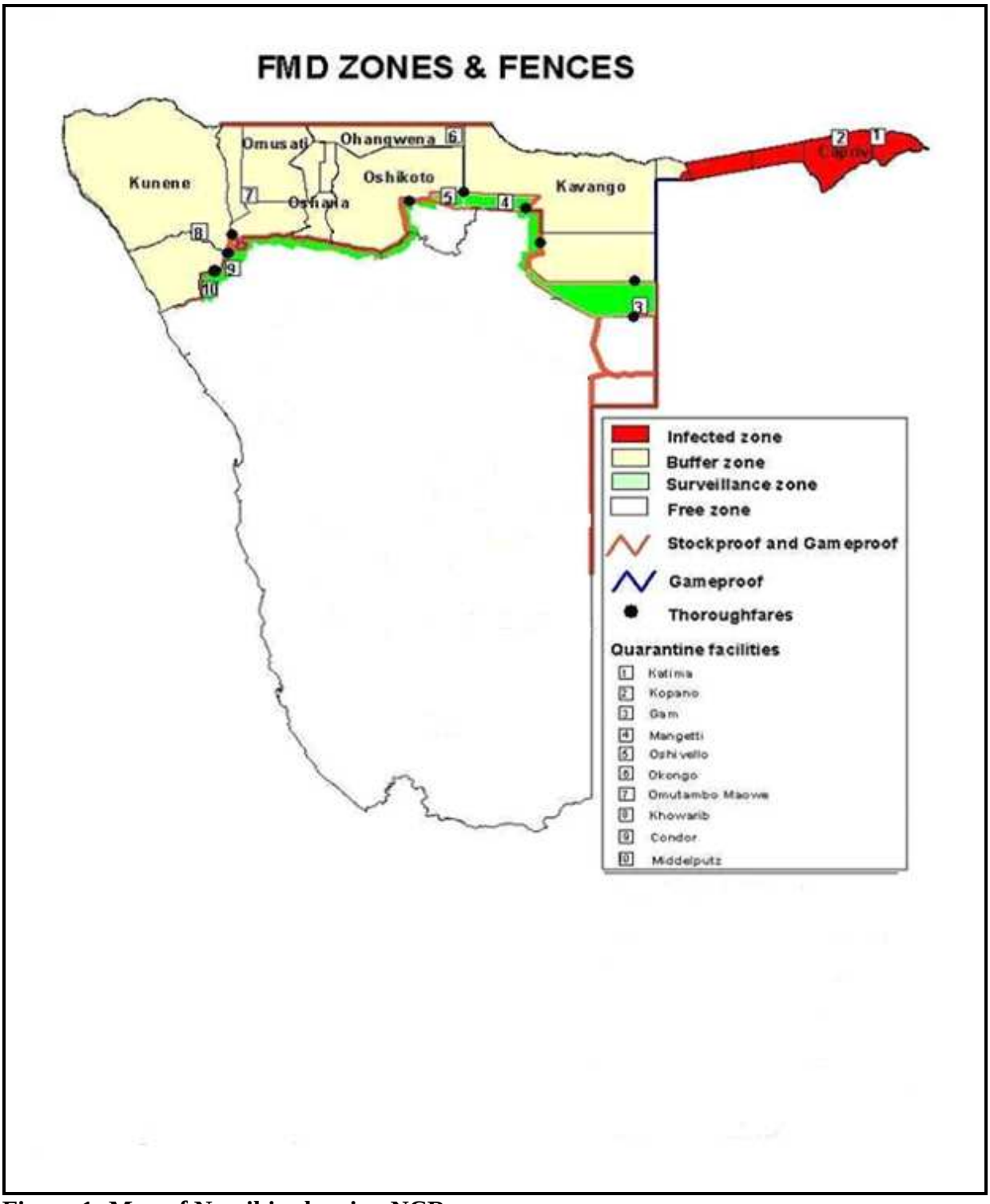

Figure 1: Map of Namibia showing NCR

Source: MAWF (2009)

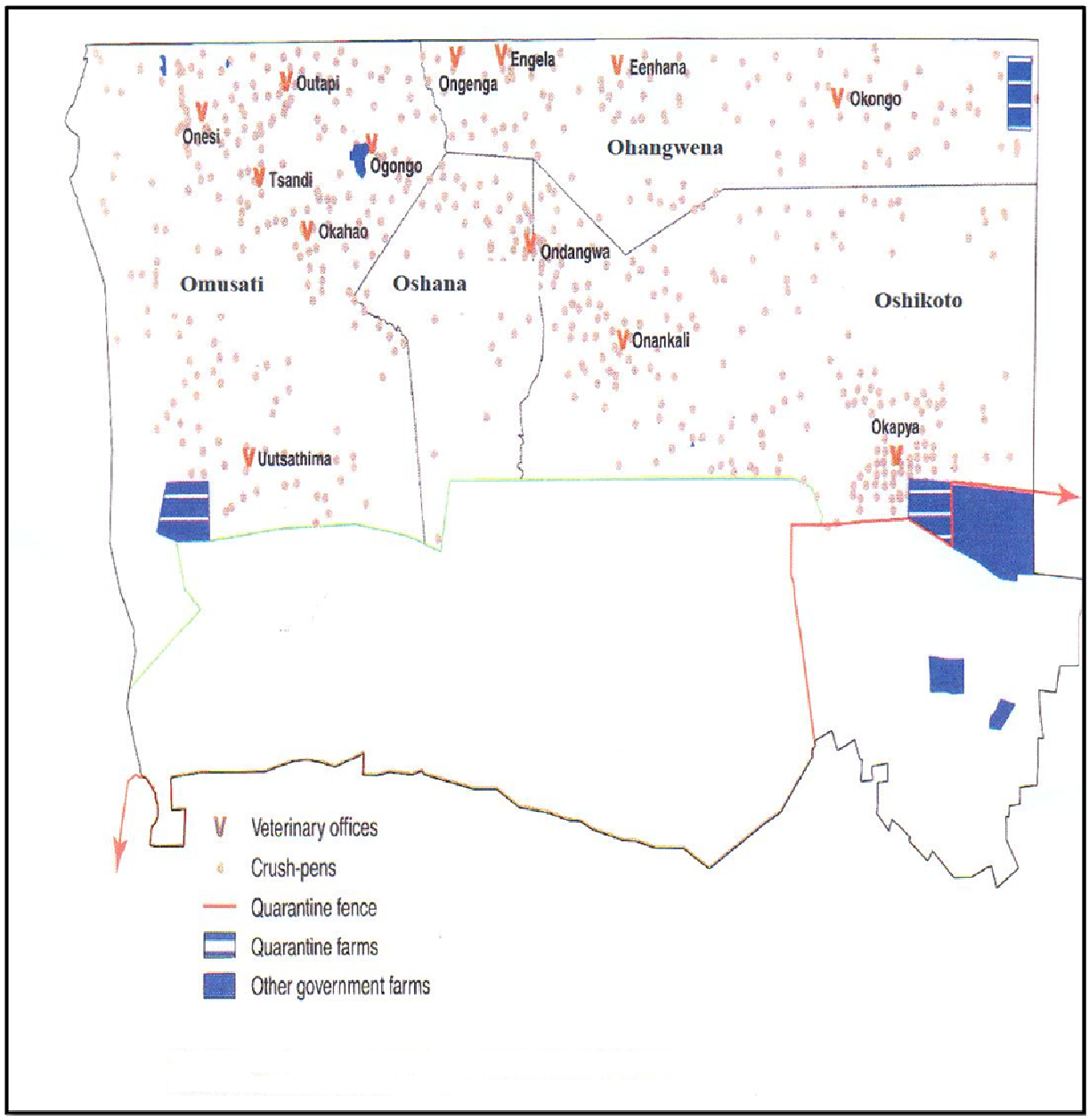

Figure 2: Veterinary offices and quarantine camps in NCR (study area)

Source: Mendelsohn *et al.* (2000)

Araki (2005) and Mendelsohn *et al.* (2000) described the area as appearing at first sight to be topographically very flat and almost featureless, with the exception of two remarkable features: the Cuvelai Delta and the Etosha Pan. Unlike other river systems, the sprawling Cuvelai network of draining channels first spreads out across southern Angola and then, on crossing the

Namibian border, converges through hundreds of meandering oshanas (shallow depressions) into the Etosha Pan.

About 70 % of the region is used for agriculture (consisting of 30 % small-scale farming, 20 % communal grazing, 9 % large farms in the Tsumeb area, 11 % land used by the Mangetti producers and people who have fenced off large 'informal' farms in the NCR), while the remaining approximately 30 % is used for conservation (Mendelsohn *et al.*, 2000). Common property resources, such as grazing pastures, are diminishing as a result of increasing competition and because they are being enclosed within fenced farms. Certain urban areas are growing rapidly, but most people living in towns in the NCR retain close links and rights to farming resources in rural areas (Mendelsohn *et al.*, 2000). Land rights are some of the most important constraints hindering development in animal production, also with regard to land tenure – in particular the common ownership of grazing land (Orskov, 1993). Many professionals and businesspeople living in urban areas own animals that are grazed together with those of their rural relatives. The prevailing perceptions are that the resources of common land are unlimited and that animals raised there are raised on cheap fodder (Orskov, 1993). Orskov (1993) argued that the problem with this in the long run is the destructive effect of overgrazing on the frail and arid ecosystem, leading to desertification – the situation currently being experienced in the NCR.

2.2.2 Brief historical background to NCR

Perspectives on current conditions in the NCR (previously known as Ovambo) are often coloured by assumptions that the liberation war had a major effect on settlement patterns, economic activities, migration and demographic patterns, and environmental conditions. The war clearly hindered the development of communal farming and the expansion of settlements into unoccupied areas. According to Mendelsohn *et al.* (2000) development was slow during the war, but many development projects have focused their activities there since independence, with the same being true for the provision of other services.

The population of the NCR is divided into seven principal ethnic subgroups, namely the Ndonga, Kwanyama, Ngandjera, Mbalantu, Kwambi, Kwaludhi and Kolokadhi. In the past there were significant differences in the culture and customs of these subgroups. However, with the effects of the war, modernisation, and greater economic and social integration of the regions, these differences have diminished (Tapscott, 1990). Thus, apart from variances in vernacular and a number of minor social practices, the Oshiwambo-speaking people can, for development purposes, be considered to be relatively culturally homogeneous (Tapscott, 1990). Mendelsohn *et al.* (2000) indicated that the history of the area goes back to before the 19th century, when trade arose because the economy had developed to such a degree that surplus commodities were available for sale.

2.2.3 Household economies

Diversity and vigour are the main features of the region's economy, now evident in the ever-increasing number of business, entrepreneurial and trading activities (Mendelsohn *et al.*, 2000). The outputs and objectives of livestock ownership in communal areas are much more diverse than in commercial livestock production and include draft power, milk, dung, meat, cash income and capital storage, as well as socio-cultural factors (Bennison, Silverside & Barton, 1998; Sweet, 1998). Hoffmann (2009) observed that livestock provide security, dowries for marriages, as well as a means of paying a fine when someone has committed a crime against another. The herds and flocks accumulate a surplus in good years and provide reserves for use or sale in drought years.

Although rural financial and insurance markets are not well developed, livestock enable farm families to smooth variation in income and consumption levels over time and also to accumulate capital and diversity, thus serving a range of socio-cultural roles related to status and the obligations of their owners. Most households are now engaged in a variety of economic activities, with incomes from subsistence, employment and diverse business activities contributing to most. However, there are major disparities in wealth between households, since rich household have greater diversity of income, more labour, more livestock, larger fields, and therefore greater access to cash than poor households (Mendelsohn *et al.*, 2000).

2.2.4 Farming

According to NOLIDEP (2002) the environment in the NCR is highly variable and this has led to people adapting to different activities in order to sustain themselves. Mahangu (*pearl millet*) and sorghum (*sorghum bicolour*) are the most important crops, while livestock numbers are dominated by cattle followed by goats, donkeys and poultry (Araki, 2005; Mendelsohn *et al.*, 2000). The production systems in the NCR are based on pastoralism and agro-pastoralism, with the majority of households practising subsistence-based and labour-intensive agriculture and having limited use of technology and external inputs. Labour is the most important input to crop cultivation, especially in terms of having adequate labour during critical periods when fields are ploughed, planted, weeded and harvested (Mendelsohn *et al.*, 2000). Stock numbers tend to be less evenly distributed between individuals in communal areas than south of the Veterinary Cordon Fence (SVCF). There is a tendency for high concentrations of people and livestock to be located near permanent water sources, while other areas remain underutilised due to a lack of water. Animal numbers tend to be geared more to the quantity of reliable water than to the reliable quantity of forage – hence the effects of drought tend to be more severe in communal than in commercial areas (Sweet, 1998).

Mixed livestock ownership is more common in the NCR than in freehold areas. Mainly indigenous breeds of cattle (dominated by the Sanga breed) and goats, followed by sheep to a lesser extent, are the generally preferred livestock species and are widely distributed in the NCR. The pig and poultry breeds found in the area are also generally indigenous. In the northern communal areas (NCA), many larger herd owners have "cattle posts" away from the village and crop lands where they maintain most of their animals, keeping only the milk and draft animals at the village during the wet season (Sweet & Burke, 2006). Those animals kept at the village at night are brought into an enclosure at the homestead, where the accumulated dung serves as manure and domestic fuel. In the wet season, during the day, the animals are often herded by children, but now that the children are in most cases required by law to attend school, large groups of animals, belonging to several producers, may be grazed together (Mendelsohn *et al.*, 2000).

2.2.5 Livestock diseases and the control thereof

Livestock diseases occurring in the region have two quite different effects on livestock. The first and most obvious effect is on the health of the animals, especially by reducing their growth and reproductive rates and causing death. The second relates to the restrictions placed on the movement of livestock and people's ability to market livestock products outside the region. These limits are largely enforced through the quarantine system: the Veterinary Cordon Fence (VCF) and the quarantine camps. Foot-and-mouth disease (FMD) and lung sickness must be kept out of the commercial areas, since Namibia's ability to export beef relies on the animals being disease free.

Mendelsohn *et al.* (2000) explained that in addition to the quarantine measures, the Directorate of Veterinary Services (DVS) conducts annual vaccination campaigns during which cattle are vaccinated against FMD, anthrax and lung sickness. Cattle in the NCR are vaccinated against lung sickness, while anthrax vaccinations are only provided in areas where the disease is most prevalent. Because FMD is suspected to come from Angola and there have been no outbreaks in recent years, only cattle in a strip along the northern border are vaccinated. The only major outbreaks of this disease in the NCR occurred in 1946, 1958, 1962, 1967, 1969 and 1970 (Mendelsohn *et al.*, 2000).

2.2.6 Land and governance

To participate in agricultural markets, secure a livelihood in subsistence farming and compete as an entrepreneur in the rural non-farm economy, it is a prerequisite that a farmer must have three core assets, i.e. land, water and human capital (World Bank, 2007). The resource and environmental components of livestock systems, and local and regional competition for them, complete the picture of a highly complex setting for development interventions (Rich *et al.*, 2009). The high value attached to land also means that there are strong demands for land, due mostly to the growing population, with more and more people needing a place to live and to produce food for subsistence purposes. Thus, the many different levels of authority and users complicate the use and control of much of the land. At the tribal level, each area is ruled by a

chief, who is served by a number of sub-chiefs and headmen (Araki, 2005; Tapscott, 1990). Households acquire the right to use arable land in their own tribal areas through the head of the household who makes a payment to the local headman or chief. Yet the assets of the rural poor are often squeezed by population growth, environmental degradation, expropriation by dominant interests, and social biases in policies and in the allocation of land.

2.3 Livestock production and marketing in Namibia

Discussed in this section is livestock production in Namibia in general, and cattle production in particular. Moreover, the marketing of cattle in Namibia in general and in the NCA in particular is also discussed in this section.

2.3.1 Livestock production in Namibia

Table 1 shows that 61 % of the entire cattle population can be found in the communal area, of which 44 % is located in the NCA. Although only 10 % of all sheep in the country are found in the communal areas, just over 65 % of all goats are found in the communal areas (Kruger & Lammerts-Imbuwa**,** 2008).

Table 1: Livestock numbers for different sectors in Namibia, for the 2006 calendar year

	Cattle: Numbers	Cattle: %	Sheep: Numbers	Sheep: %	Goats: Numbers	Goats: %
NCA	1 039 309	44	25 895	1	774 195	38
SCA	394 475	17	226 963	9	566 734	27
TOTAL CA	1 433 784	61	252 858	10	1 340 929	65
COMMERCIAL AREA	950 176	39	2 407 394	90	720 474	35
TOTAL	**2 383 960**	**100**	**2 660 252**	**100**	**2 061 403**	**100**

NCA= Northern Communal Areas, SCA = Southern Communal Areas, CA= Communal Areas

Source: MAWF (2008)

The commercial farming sector, which is almost exclusively based on livestock farming, is the largest employer in Namibia, providing employment to between 25 000 and 30 000 agricultural labourers and their dependants (Kruger & Lammerts-Imbuwa**,** 2008). According to Kirsten (2002), Ouseb (2006) and Sartorius von Bach (1990), Namibia has been a producer and net exporter of fine-quality livestock and livestock meat for well over a century and is progressively operating within a world market where sophisticated clients require sophisticated products and services. Hoffmann (2009) indicated that Namibia is the largest exporter of lamb and mutton in Sub-Saharan Africa (SSA). During 2007, meat from as many as 1 277 000 sheep and lambs, including live animals, was exported mainly to South Africa, while 350 000 goats are exported to KwaZulu-Natal annually (Hoffmann, 2009).

According to the Ministry of Land and Resettlement (2004/2005), Namibia's agriculture has dualistic features that result in two distinct land tenure systems, namely:

- **The commercial farming sector** (63 million ha) occupying 57 % of agriculturally usable land. Under this system the land is privately owned, and fenced off. This sector is capital intensive, well developed and export oriented (Sweet, 1998).

- **The communal areas** (27 million ha or 43 % of the available agricultural land). Under this system the land is state owned with common grazing lands, which restrict the scope for improved management practices.

2.3.2 Cattle production in Namibia

Namibia is an ideal cattle ranching country and its beef products have long been preferred for their taste worldwide (Nevil, 2004). As shown in Figure 3, it is estimated that there is almost one million more cattle than people in the country and it is observed that the per capita daily calorie intake from beef in Namibia is twice that in Kenya, nine times that in Nigeria, and almost equal to that in Canada (Christian Science Monitor, 2008). This indicates that cattle ranching is the main agricultural production sector in the country, with the value of production in 2005 being estimated at N$900 million (FAO & NEPAD, 2005).

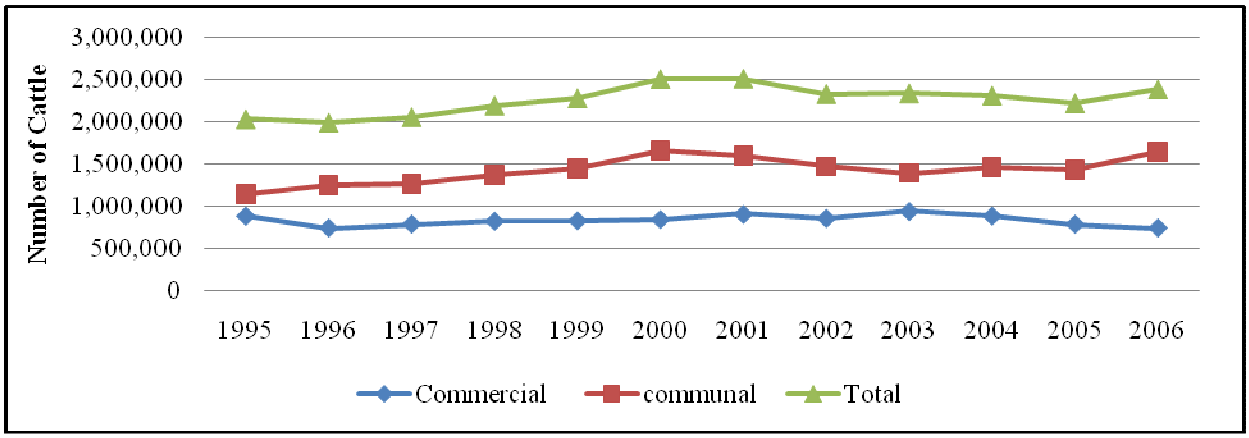

Figure 3: National cattle numbers
Source: MAWF (2008)

The basic aim of the natural beef production system is to improve beef cattle for the optimum production of the desired quality beef. The most important traits contributing to the economic production of desired beef under Namibia's rigorous ranching conditions are pre-weaning growth rate, post-weaning growth rate, efficiency of feed use, carcass composition and quality, reproductive ability, and low mortality rate (Sartorius von Bach, 1990).

2.3.3 Marketing of cattle in Namibia

MeatCo is the largest meat processor in Namibia, with abattoirs and beef-processing facilities forming the core of the Corporation's business activities. MeatCo's abattoirs utilise the latest technologies, meeting the highest international standards in terms of traceability, product yields, stock and financial controls. The corporation is HACCP and ISO9002 certified and the systems ensure that all necessary precautions are taken to guarantee that all products are safe for human consumption. This is part of the concept of "doing things right the first time", by shifting the emphasis from end-product testing to a continuous, planned hygiene and quality control system throughout the entire production chain (MeatCo, 2009).

Namibia's main export markets are South Africa and the European Union (EU), with 80 % and 20 % of total export volumes respectively (Business Namibia, 2006; Kirsten, 2002). Namibian

beef is exported primarily to the EU as deboned beef and to South Africa on hoof (mainly weaners) (Mushendami *et al.*, 2006). The South African market has traditionally been described as the main destination for Namibian beef due to its proximity, historic political links and the preferential market access enjoyed by Namibia's producers under the Southern African Customs Union (SACU) agreement (Kirsten, 2002).

MeatCo has four abattoirs, two of which are approved for export to the EU. The other two, namely the Oshakati and Katima Mulilo abattoirs, which are situated in the northern part of the country, are used for the slaughter of cattle destined for the South African markets. MeatCo also operates a tannery to maximise local value-adding to its hides. MeatCo is the key player in the industry and ensures that its viable and internationally accepted operations are major contributors to the country's economy whilst having a stabilising effect on the industry as a whole.

The two abattoirs approved for export to the EU are centralised in Okahandja and Windhoek, since these are the two plants certified to export processed meat products to international markets. Namibia's cattle are generally slaughtered at the age of approximately 20 to 30 months at an average carcass weight of 350 kg (Sartorius von Bach, 1990). Beef producers are remunerated according to a carcass grading system. A well-established beef carcass grading system is used whereby beef is classed according to age, fat content and condition. The classifications A, B and C are indications of age, while the grades 1, 2, 3 and 4 indicate the fat content or conformation of the beef (Sartorius von Bach, 1990).

According to IFAD (1997), beef is a perishable, relatively high-value luxury product. For such a product, marketing functions like quality control, hygiene standards, storage and packaging play an important role, especially in the preference market and the processing of beef. Hence, the marketing of cattle in Namibia is regulated by three controlling bodies, which ensure that Namibian meat products are of the highest standard. IFAD (1997) identifies these controlling bodies as (i) the Meat Board of Namibia, a statutory authority, (ii) MeatCo, a national corporation involved in livestock slaughter and marketing, and (iii) the DVS within the Ministry of Agriculture, Water and Forestry (MAWF).

These three bodies work together towards the common goal of ensuring the sustainability of the existing markets and acquiring new ones. IFAD (1997) explained that in commercial areas, farmers who intend to export livestock, or to supply slaughter stock to MeatCo abattoirs, must register with the Meat Board and apply for an export permit. The Meat Board of Namibia links the industry with its customers and is responsible for the development of the industry.

2.3.4 Marketing of cattle in the Northern Communal Areas (NCA)

Cattle purchased by MeatCo from the NCA regions of Kunene North, the NCR and the Kavango region are slaughtered at the abattoir at Oshakati, while cattle from the Caprivi region are slaughtered at the Katima Mulilo abattoir. However, the marketing of cattle from the NCA is restricted by the VCF, as livestock producers north of the VCF are not allowed to freely market their animals to the SVCF due to FMD and Contagious Bovine Pleuropneumonia (CBPP) restrictions (Düvel, 2001). These restrictions are in line with requirements on animal disease control imposed by the major export markets, namely South Africa and the EU. The relatively lucrative export market for weaners to feedlots in South Africa is therefore not accessible (due to VCF policy) for northern communal producers (NASSP, 2005). Namibia had been exporting beef products from the northern communal abattoirs to South Africa after quarantining cattle for 21 days, up until the last quarter of 2008, when South Africa stopped importing beef from the north of Namibia due to an FMD outbreak in the Caprivi and North-Eastern Kavango regions. This prompted the industry to lift the usage of the quarantine system in the NCR pending negotiations to resume the exportation of meat products to South Africa from the NCA. Nevertheless, in the meantime, Namibia has negotiated an alternative market in Angola, to which it sells beef products from the Oshakati abattoirs without quarantining cattle from the NCR. However, the quarantine system in the North-Eastern Kavango and Caprivi regions is still in operation.

MeatCo's procurement of cattle from the NCA for slaughtering purposes started in 1992 with the purchasing of live animals in the veldt at various collection points, with producers receiving cash on the spot. The process gradually evolved into a "self-quarantining" system, after a training and mobilisation process that saw almost 78 % of producers becoming empowered to

market through such a self-quarantining process. The remaining cattle were procured through speculators, which resulted in a decline in animals marketed through formal markets (Kruger & Lammerts-Imbuwa, 2008).

Communal producers have been known to criticise the way in which MeatCo approaches the marketing of livestock, namely the low prices paid by MeatCo, the absence of competitors, and the lack of access to meat markets of the SVCF, which are deemed to be the major constraints to increasing their livestock sales (Arbirk & Vigne, 2002).

Arbirk and Vigne (2002) acknowledged the generally poor condition of the animals delivered to the abattoir and the long distances over which producers must transport the animals to the abattoir. Producers in Oshana and the North-West area of Oshikoto must transport their animals over distances of more than 200 km to reach the abattoir (NOLIDEP, 2002). Research has shown that cattle lose 2.5 % of their mass during the first 24 hours of travel and thereafter 0.5 % every hour (Sartorius von Bach, 1990). With such long travelling distances, loss of beef quality occurs due to bruising, since stress during transport tends to cause dark-cutting beef, which is undesirable.

Keeping in mind the brief background above, MeatCo's abattoir in Oshakati, which is supplied with cattle from the NCR, where the producers are supposed to slaughter 280 cattle per day, operates at only 40 % capacity (FAO & NEPAD, 2005). The production process requires meat-export abattoirs to ensure a consistent and continuous supply of meat in order to meet the demand of customers in the importing countries (Negassa & Jabbar, 2007). Figure 4 shows the cattle marketing figures applicable to the NCA, export abattoirs, butchers, and South Africa. The figure also illustrates the low number of cattle marketed from the NCA compared to the number of cattle in the communal area as shown in Figure 3 above.

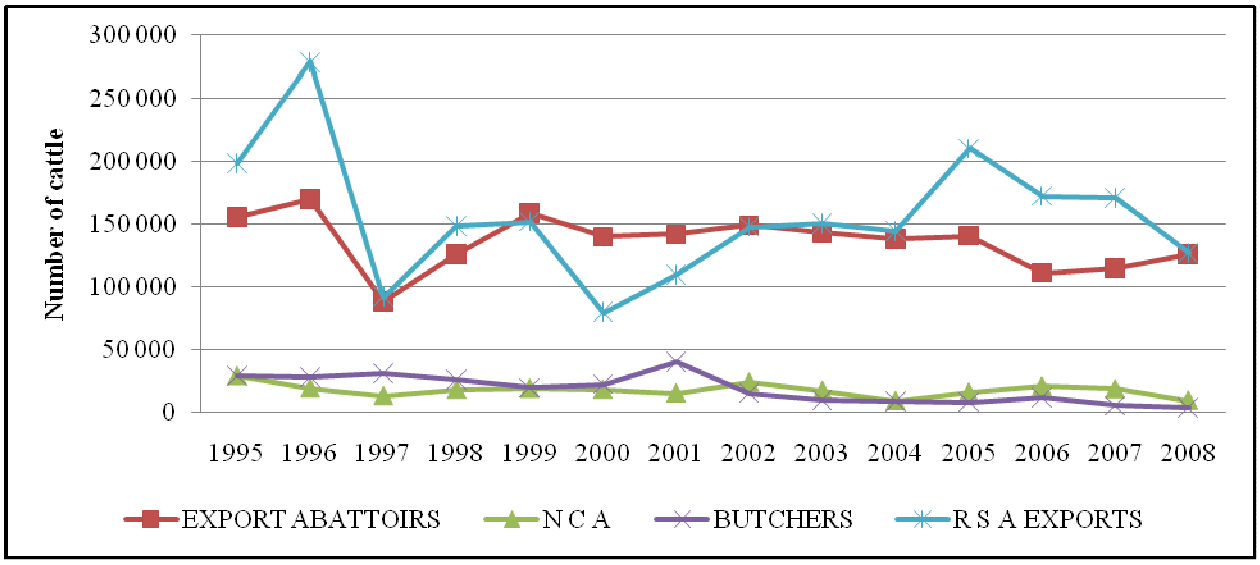

Figure 4: Marketing of total production of cattle (numbers)
Source: Meat Board of Namibia (2008)

2.4 Theoretical framework for analysing cattle marketing in the NCR

2.4.1 Introduction

The analysis of this study is based on the transaction costs as a framework used to generate an understanding of the marketing behaviour of cattle producers in the NCR of Namibia. In light of this, the following subsections are briefly discussed below: transaction cost economics and communal livestock production; the definition of transaction costs; transaction cost theory; sources of transaction costs; the measuring of transaction costs; and the reduction of high transaction costs.

2.4.2 Transaction cost economics and communal livestock production

In many of the poorest countries, livestock farming is one of the most important industries to develop, not only for economic growth but also for poverty reduction and environmental protection (Iimi, 2007). Livestock systems represent a potential pathway out of poverty for many smallholders in the developing world (Rich *et al.*, 2009). Coetzee, Montshwe and Jooste (2005) identified livestock farming as the agricultural enterprise with the most likely chance of improving household food security and addressing poverty alleviation in communal farming

areas. The so-called livestock revolution has been an important feature of both developed and developing countries. Furthermore, livestock and meat products have been among the fastest growing components of the global agriculture and food industry (Morgan & Tallard, 2006; SARD, 2007). Moreover, livestock systems are characterised by long marketing chains featuring great distances, numerous phases of weight gain and feeding regimes, multiple levels of traders and transactions, a multitude of steps and stages of processing, and a variety of employment-creating services and inputs (Rich *et al.*, 2009).

Southern African countries should have been able to realise their full potential to increase beef production and exports and thus stimulate economic growth and increase export earnings. However, several factors have limited their ability to realise this potential. Sartorius von Bach *et al* (1998) identified the factors hindering the full production potential of livestock in communal areas as low off-take rates and a land tenure system that is not conducive to producers conserving the grazing resources and genetically improving their herds. Furthermore, Pingali *et al.* (2005) stated that in the case of small-scale farmers, there are certain difficulties hindering them from commercialisation, which arise from a lack of public goods, which hampers market exchange, as well as the new set of transaction costs that emerged from dealing with the food system. Commercialisation and market expansion are essential for exploiting the potential of any commodity in the economic development process (Jabbar, Benin, Babre-Madhin & Paulos, 2006). Many small-scale producers are locked into traditional modes of production, too far removed to meet the requirements of modern food systems, and transaction costs have therefore tended to become prohibitive.

Alene *et al.* (2007) and Matungul, Lyne and Ortmann (2001) explained that smallholders in Africa often face high transaction costs in the production and marketing of agricultural outputs owing to the nature of their products and the institutional environment in which they operate. In the African context, poor road and logistic conditions are a common bottleneck to increased intra-regional trade. Furthermore, inadequate market information flows and high illiteracy rates among market operators also hamper livestock marketing (Iimi, 2007). Transaction costs mean different things to different groups of people, and thus all risks have to be understood within the larger social, cultural and economic context (Doss *et al.*, 2005). By understanding these

subjective perceptions of transaction costs, better policies can be designed that address objective sources of transaction costs while helping individuals and cattle producers to develop better methods of coping with such costs.

2.4.3 Definition of transaction costs

There is no standard definition of the term 'transaction costs', since the literature contains various definitions thereof. According to Singh (2004) the term can be broadly interpreted to include costs associated with market exchange, including the cost of searching for options, negotiating contracts and enforcing agreements. Hobbs (1997) and Matungul *et al.* (2001) defined 'transaction costs' as those costs involved in exchange or trade (e.g. marketing costs), the cost of intangibles (e.g. search for exchange partners), as well as the cost of contract monitoring and enforcement. Walter and Boeckenstedt (2007) defined transaction costs as logistic costs, including cash payments and amortised costs associated with post-production handling, packaging, storage, inventory carrying and transportation. Alene *et al.* (2007) and Pingali *et al.* (2005) defined transaction costs as the embodiment of barriers to market participation by resource-poor smallholders, which has been used as a definitional characteristic of smallholders and the factors responsible for significant market failures in developing countries. Jabbar *et al.* (2006), Jabbar *et al.* (2008) and MacInnis (2004) specified physical marketing costs, e.g. transport and storage and transaction costs, arising from the co-ordination of the exchange among relevant market agents, including the cost of obtaining and processing market information, negotiating contracts, monitoring agents, and enforcing contracts.

Nkhori (2004) cited Jaffee (1991) in his definition, separating transaction costs into the following categories:

- **Search costs –** These are the costs associated with identifying and contracting potential buyers and sellers, and the quality of resources in which they have property rights. Search costs such as information costs and communication costs arise *ex ante* from an exchange. Moreover, given livestock systems' employment and value addition multipliers, as well as its susceptibility to external shocks such as climatic

events and politically motivated trade barriers, the impact of interventions could be counterintuitive and difficult to determine (Rich *et al.,* 2009).

- **Bargaining costs** – These are the costs involved in gathering price information on other transactions and other factors that might influence either party's willingness to bargain.
- **Monitoring costs** – These costs include the costs associated with monitoring the contract agreement to ensure that its conditions are fulfilled. Monitoring costs occur *ex post* to a transaction.
- **Enforcement costs** – These are the costs of enforcing the exchange agreement. Enforcement costs occur *ex post* a transaction and include the costs associated with default provisions in contracts, i.e. the collection of damages when a partner fails to observe the contractual obligations.

Nkhori (2004) pointed out that such a list of transaction costs affecting the exchange of agricultural and livestock products is non-exhaustive. Jaffee and Mortan (1995), cited in Nkhori (2004), added two categories of transaction costs involved in the marketing of agricultural products, namely:

- **Transfer costs** – These refer to the costs of marketing services performed in the physical handling of the commodity, such as transport, storage, retailing and wholesaling. Examples of such costs are transport costs, costs associated with the risk attitude of producers, and administrative costs.
- **Screening costs** – These are costs that are associated with gathering information about the reliability or trustworthiness of a particular party and the quality of goods being transacted.

2.4.4 Transaction cost theory

Transaction cost theory is a powerful and generally theoretical framework that seeks to explain institutional development and organisational efficiency (Bartle, 2002). Chen, Chang, Huang and Liao (2006) recommended that transaction cost theory be seen as a viable means of explaining the acquisition decision in marketing channels. Singh (2004) observed that if transaction costs

are high enough, the market does not exist in the sense that the quantity exchanged is zero. Musemwa, Mushunje, Chimonyo, Frazer, Mapiye and Muchenje (2008) explained that transaction costs are considered to be barriers to the efficient participation of producers in different markets. Thus, producers will not use a particular channel when the value of using that channel is outweighed by the costs of using it (Musemwa *et al.*, 2008). Transaction costs, which are distinct from physical marketing costs such as those for transport and storage, arise from the co-ordination of exchange among market actors (Gabre-Madhin, 2001). De Bruyn *et al.* (2001) argued that market transactions do not occur in a frictionless environment. Transaction costs are economically equivalent to frictions in physical systems (MacInnis, 2004). Reflecting frictions in the economic environment, transaction costs vary in type and magnitude regarding the characteristics of the market where the transaction occurs. The terms on which transactions take place are complex and diverse, and may be strongly structured by ideological and social factors (Matungul *et al.*, 2001). Chen *et al.* (2006) observed that differences in the character of exchange levels, such as uncertainty, frequency and asset specificity, can influence the transaction costs. Uncertainty can arise within a multitude of domains, and can also be attributable to a number of different causes (Joshi & Stump, 1999). Consequently, Gabre-Madhin (2001) and Jabbar *et al.* (2008) explained that transaction costs are unique and specific to individual agents, and therefore each agent in the market conducts transactions on the basis of his/her own costs. Some transaction costs are fixed, as they are invariant with quantities of exchange, while others are variable, as they vary with quantities of exchange. Transaction costs can explain why some producers participate in markets while others are simply self-sufficient. Differences in transactions costs, as well as differential access to assets and services to mitigate these transaction costs, are possible factors underlying heterogeneous market participation among smallholders (Alene *et al.*, 2007).

Agricultural production and marketing is an expensive venture to undertake, because producers operate in an environment in which they face a number of transaction costs. In African economies that are only partly commercialised, communal producers are having greater difficulty than commercialised producers in adopting and profiting from new opportunities (Dovie & Shackleton, 2003; Nkhori, 2004). It is a well-known fact that most livestock in communal areas are grass-fed and are typically slaughtered at lower weights than their grain-fed

counterparts due to slower growth rates, and they consequently yield carcasses that are inferior in terms of marbling and tenderness, as well as taste-panel palatability ratings (Evans, Brown, Collin, D'Souza, Rayburn & Sperow, 2008). Thus, producers require reliable information on cattle prices, the optimum selling time (depends on the market cycle in a given area), the channels available, and the breed, age and condition of the cattle that render the highest returns.

The decentralisation of livestock markets and the wider dissemination of well-updated market information to the small-scale producers by the government and other stakeholders involved in agriculture can play a role in improving small-scale producers' access to formal cattle markets. Musemwa, Chagwiza, Sikuka, Fraser, Chimonyo & Mzileniet (2007) found that the provision of market information will strengthen producers' negotiating ability during transactions with individual speculators and consequently prevent the possible exploitation of producers by better-informed buyers. The principle behind transaction costs is that people prefer to conduct transactions in a way that minimises their transaction costs. Transaction costs have no value for either the buyer or the seller (Chen *et al.*, 2006).

2.4.5 Sources of transaction costs

Transaction costs arise from the performance (efficiency) of the marketing system, which depends on the structure and conduct of the market. Thus, transaction costs result from information inefficiencies and institutional problems such as the absence of formal markets and appropriate practices to address certain problems. Jabbar *et al.* (2008) acknowledged that contract violations may be common, especially in cases of credit transactions where there is no established institutional mechanism to easily resolve conflicts arising from contract violations in the case of credit transactions in the short term, and the risk of default may be considered by traders as a factor in price negotiations. Thus, the presence of transaction costs is often reflected by the difference or discrepancy between perceived buying and selling prices (Madola, 2008). In the market for fruits and vegetables, in particular, transaction costs include costs associated with complying with phytosanitary procedures, such as treatment, inspection, and storage during quarantine (Gauthier, 2000). Food safety and environmental regulations in general also add costs to the process of bringing a product from the point of production to the point of

consumption. According to Madola (2008), market failures are caused by, amongst other things, asymmetric information and high transactional costs. These market deficiencies tend to be widespread and severe in the poor rural areas of Africa characterised by insufficient hard (roads) and soft (telecommunications) infrastructure. Discussed further in this section are the four types of costs that are believed to be the source of transaction costs, namely information costs, negotiation costs, monitoring costs, and product nature costs.

2.4.5.1 Information costs

Information costs arise prior to a transaction. Before making a decision on how to market a certain product and to whom that product will be sold, the cattle producer must first determine the price that he expects to receive. Hobbs (1996) argued that economic agents face costs in the search for information about products, prices, inputs, and buyers or sellers. The cost of obtaining price information depends on the extent to which there is readily available information on market prices (Hobbs, 1997). Crase and Dollery (1999) argued that the limitations of humans may be such that they lack the skills, knowledge and intelligence to process information on products even within a bounded rationality framework. Hence, the more time and energy spent on searching for market information, the higher the information costs (Gong, Parton, Cox & Zhou, 2007). These informational bottlenecks may be aggravated by an inadequate or poor rural road network, which hinders the flow of information. Households living in places where roads are impassable may not have easy access to up-to-date information about the markets and market prices (Nkhori, 2004). Ayars (2003), Bartle (2002) and Li (2008) described the important elements of transaction cost economics as being **bounded rationality** and **opportunism**, which are referred to as behavioural assumptions underpinning transaction cost analysis.

Bounded rationality refers to the fact that individuals are bounded by the limits of their own knowledge. Human beings are unable to make rational decisions due to their finite capacity to absorb, process, and obtain information (Ayars, 2003). That is, people might not make a rational decision based on the information that is available to them, because that information might be too complex for them. Hobbs (1997) argued that although cattle producers can predict

general price trends at an auction sale, they cannot know the actual price that the cattle will fetch before the auction takes place. Uncertainty exists when decision-makers do not have enough information to make rational decisions, but individuals may also be bounded in their rationality when they have too much information (Chen *et al.*, 2006; Li, 2008). High levels of uncertainty and complexity thus result in higher transaction costs as the exchanging parties try to minimise bounded rationality (Anding & Hess, 2002).

Opportunism is a consequence of using a situation to one's best advantage (Li, 2008). Economists contend that asymmetric information arises when exchanging parties have different degrees of information, with the more informed party then using his/her position in his/her best interest (Bartle, 2002). Opportunism with information asymmetry leads to moral hazard and adverse selection, because it is not possible to determine which parties, if any, will act opportunistically (Ayars, 2003). Therefore, transaction costs are incurred in exchange under asymmetric information when the less-informed party tries to reduce the problem of opportunism. Thus, certain transactions are more risky if the parties involved are not fully informed about one another's preferences or capabilities (Katja, 2002).

2.4.5.2 Negotiation costs

Negotiation costs arise from the physical act of the transaction and are influenced by the way in which the transaction is carried out. As an example, Hobbs (1996) identified the opportunity cost of the time taken by procurement staff to locate supplies of cattle as being a negotiation cost. The cost of transporting cattle to the marketplace is often considered in traditional analyses of marketing costs (Hobbs, 1997). However, such costs can also be transaction costs if they are specific to that marketing channel. In order to use the formal marketing channel in the NCA, the cattle must be transported from the farming area (cattle post) to the quarantine camp and from the quarantine camp to the slaughterhouse. Acharya (2006) observed that if there are long distances involved in reaching a market, this serves as a disincentive for most producers with a small surplus to sell. Transport and transportation costs are the most prominent sources of transaction costs. These costs increase with distance from the market, as well as unavailability of transport. When the condition of the roads is poor, transporters increase their fees to

compensate for the damage to their vehicles emanating from the use of such roads (Dovie & Shackleton, 2003).

2.4.5.3 Monitoring costs

Monitoring or enforcement costs arise after a transaction. It may be necessary to monitor the quality of goods from a supplier or to monitor the behaviour of a supplier (or buyer) to ensure that all pre-agreed terms of the transaction are complied with (Hobbs, 1996). Producers may accrue monitoring costs in ensuring that the cattle are handled correctly during transportation to the quarantine camp and to the buyer's premises. If there is a concern among buyers that the cattle are highly stressed or have been bruised as a result of additional handling and transportation, they may discount the prices that they are prepared to pay for the cattle.

2.4.5.4 Product nature costs

Chen *et al.* (2006) explained that human nature and the environment of exchange can cause market failure due to unacceptably high transaction costs in transaction processes, while differences in the character of exchange level – such as uncertainty, frequency and asset specificity – can also influence the transaction costs. Gong *et al.* (2007) observed that when selling live animals directly to processors, cattle producers may face grade uncertainty, which is determined only after the animal has been slaughtered. Although a price is agreed upon before the cattle leave the farm, the producer's return may be lower than expected if the cattle do not grade as expected.

A farmer may deliver his or her produce to market and discover that it fetches a much lower price than expected. It may be impossible for a farmer to determine whether the lower price is due to random shocks to the supply or demand function, and to know what to do differently next time (Grosh, 1994). This leads to high transaction cost sensitivity, which indicates less differentiation in that the seller needs to put in higher differentiation costs to reduce the effect of transaction costs. However, this constitutes a lower seller margin, as both the producer and the buyer are leaders (Chen *et al.*, 2006).

2.4.6 Measuring transaction costs

The effects of transaction costs in the marketing of agricultural products have been thoroughly studied in transitional and developing economies where markets are thin and fledging, and where the necessary infrastructure is missing or embryonic (MacInnis, 2004). As described by Hobbs (1997), transaction cost economics, unlike traditional neoclassical economic theory, recognises that commercial activity does not occur in a frictionless economic environment. Transaction costs are not available on financial records and are inherently difficult to measure or quantify (Jabbar *et al.*, 2006; MacInnis, 2004). The New Institutional Economics (NIE) approach finds that the unit of analysis is the transaction rather than the price (Gabre-Madhin, 2001).

Despite the measurement difficulties, there have been a number of empirical studies on the effect of transaction costs on agricultural marketing. Quantifying transaction costs can be accomplished by ranking the preferences of different observers, in this case cattle owners. De Bruyn *et al.* (2001) found that if *ceteris paribus* a particular type of transaction cost is higher in situation **A** than in situation **B**, and different individuals consistently specify the same ranking whenever the two situations are observed, then transaction costs are measurable.

Nicholas (1987) contended that the specification of transaction cost functions is not an easy matter, and the specification of the cost of alternative institutional arrangements has not progressed by much. Jabbar *et al.* (2008) observed that most trading practices are observable and measurable in some form, but some transaction costs may not be observable and measurable. Despite MacInnis (2004) confirming the difficulty of obtaining data on transaction costs, Hobbs (1997) applied a two-limit Tobit Model to estimate the relative importance of various transaction costs and farm characteristics on channel selection.

Vakis, Sadoulet and De Janvry (2003) argued that, although transaction costs are difficult to measure, understanding their impact on behaviour is crucial, as it can inform policy design aimed at reducing those costs. Contrary to previous work in this regard, transaction cost analysis provides a superior theoretical foundation in that it avoids mechanistic processes of increasing commitment and relies on realistic behavioural assumptions and firm-specific factors (Klein,

1989). According to Frauendorf, Gnoth and McCole (2005), transaction cost theory can be considered as the basic theoretical framework that analyses the relationship between the cattle producer and the cattle buyer; thus, the theory embeds and governs both sides of the process. It is an approach with which many marketing theorists are becoming familiar. Chen *et al.* (2006) argued that transaction cost theory has been applied to analyse many issues such as the strategic impact of information systems, as well as resource allocation and outsourcing decisions; however, little attention has been paid to the structure of the marketing channel. Nicholas (1987) confirmed that, despite these empirical problems, the transaction cost model has gained widespread acceptance among economists and business historians interested in international business. Therefore, transaction cost explanations are increasingly being cited in the marketing literature, dealing with structural as well as behavioural issues. This theory was used by Jabbar *et al.* (2008) to measure the influence of market institutions and transactions on trader performance in live animal marketing in rural Ethiopian markets; by MacInnis (2004) to measure the transaction costs involved in the marketing of organic produce in the USA; by Nicholas (1987) to conduct an empirical test of the transaction cost model in terms of the evolution of the pre-1939 British manufacturing multinational; by Klein (1989) to explain the analysis of transaction costs in terms of vertical control in international markets; and by Chen *et al.* (2006) to develop a transaction cost linear demand function to investigate channel decision-making when transaction costs exist (a game-theoretic analysis). Nkhori (2004), in turn, identified the transaction cost factors and household characteristics that influence the producer's choice of cattle marketing channel in the Mahalapye district of Botswana.

2.4.7 Reducing high transaction costs

This section briefly explains the strategies that may be used to reduce transaction costs. It is important to mention that transaction costs cannot be eliminated completely from the system, but can only be reduced. This section discusses how transaction costs can be reduced through the use of information technology; how transaction costs may be reduced by instilling trust between the two parties involved in the transaction; and how the provision of education can be used to reduce transaction costs.

2.4.7.1 Transaction costs and information technology

Although the virtues of Information Technology (IT) have sometimes been exaggerated almost to the point of mania, one can assert without too much fear of contradiction that IT has a significant impact on the lives of people in industrialised countries (Singh, 2004). The use of IT can dramatically increase the ability to share information, which affects the economics of private and public provision of information, goods and services. Singh (2004) stressed that IT can improve efficiency, thus making firms in developing countries more globally competitive and bringing many benefits to their wealthy consumers, whose consumption patterns closely resemble those of consumers in the developed world. Thus, IT is a tool of the rich, and is of limited relevance to the poor masses in developing countries where they are deprived of basic healthcare, sanitation and education. Therefore, Singh (2004) argued that IT can significantly reduce the high transaction costs faced by poor consumers, which can have a long-lasting positive impact on economic development. The possibilities for interactivity with IT-based educational materials illustrate the advantages of IT over older technologies based only on recording and duplication. Long-distance interactive communication in an educational context can also be considered as a means of reducing transaction costs, since physical travel is eliminated or reduced. A study on transaction costs and market efficiency done by Gu and Hitt (2001) found that as transaction costs decline, individuals increase their use of the market, which results in an increase in the overall degree of ignorance of the individuals accessing the markets directly.

A study done in the United States (US) by Tronstad (1994) to compare livestock marketing alternatives found that electronic marketing methods may hopefully increase the number of legitimate buyers by decreasing the transaction costs and translating into a higher net price for the producer and lower costs for the buyer. However, the extent to which transaction costs will decrease depends greatly on information, volume, location, and trucking costs.

2.4.7.2 Trust

A lack of trust among vertically related members of the supply chain is one of the underlying challenges in a commodity system (Lawrence, 2002). Trust and reputation are therefore essential to a long-term business partnership. However, building trust and reputation is a gradual and interactive process, as well as time- and resource-consuming (MacInnis, 2004). The existence of trust has been found to reduce transaction costs by avoiding costly negotiations and contracting and may also enhance alliance revenues by facilitating a more complete interaction of the alliance partners' resources (Madola, 2008). Here parties recognise that they need each other and rely on this need to maintain the relationship and guide the contract. Trust reduces transactions costs, because it acts as a counterbalance to opportunistic behaviour (Ayars, 2003).

2.4.7.3 Provision of education

The provision of physical and legal infrastructure, information and education through extension and agricultural research may further reduce transaction costs. Government policies, education, knowledge, and access to capital are important factors in market participation by small-scale producers in Third World countries (Matungul *et al.,* 2001). Better infrastructural development and effective support services such as research, coupled with more secure access to land, is essential if transaction costs are to be reduced.

2.5 Related research

This section examines the related research conducted on livestock marketing in the Namibian context. The purpose of this section is to ensure a good understanding of the background to livestock marketing in Namibia in general, signifying a directional guide to this study.

Due to access difficulties, very little research relating to the marketing of cattle in Namibia was found for purposes of this study. However, of the few research studies available, the following proved informative:

- Düvel (2001): “Livestock marketing in northern Namibia: Cultural versus economic incentives”, aimed at analysing the perceptions of livestock producers with regard to the marketing of cattle, found that decision-making is significantly influenced by numerous socio-cultural considerations, which in many cases even overshadow the economic considerations.

- FAO and NEPAD (2005): “Livestock improvement”, which found that although much has been done to create the necessary marketing infrastructure to overcome marketing constraints in communal areas, much more still needs to be done. The study revealed that only 10.2 % of cattle slaughtered at MeatCo (Oshakati) are young (under the age of 36 months), while 51.1 % are adult animals. In addition, it was found that average carcass weight of cattle slaughtered at Oshakati is 170 kg, approximately 33 % lower than the 240 kg observed in the commercial areas of Namibia.

- Mushendami *et al.* (2006): “Unleashing the potential of the agriculture sector in Namibia”, which acknowledged that the 2004 decline in the number of cattle marketed could be ascribed to the good rainfall at the time, which resulted in producers holding their cattle for restocking.

- Nambundunga-Xulu, Shikongo-Kuvare and Masaire (2008): “Improvement of slaughter data collection and hygiene standards in informal meat markets of Namibia’s communal area (NCA) North of the Veterinary Cordon Fence (VCF)”, which had the two independent objectives of improving the capturing of off-take estimates resulting from livestock slaughtering, and influencing national efforts towards improving meat safety.

- Ouseb (2006): “An investigation into the implementation of the FANMEAT Scheme among the Grootberg area communal producers of North-Western Namibia”, which elaborated on FANMEAT being at the forefront of ensuring that the highest animal welfare standards are maintained and that the production of meat products adheres to environmentally friendly principles.

The Tobit Model developed by Tobin in 1958 has been widely used to deal with censored observations (dependent variable with data that is partially observed) (Anastasopoulos, Tarko & Mannering, 2008; Zhang, Huang & Lin, 2006). Gong *et al.* (2007) used the model to examine key factors affecting cattle farmers' selection of marketing channels and to draw implications for the development of China's beef supply chain. Hobbs (1997) used the Tobit Model to measure the importance of transaction costs in cattle marketing in the US, whereas MacInnis (2004) applied the same model to measure transaction costs in the marketing of organic corn and soybeans in the US. However, these researchers modelled the marketing decision by assuming it to be a single-decision framework without considering that this model is highly restrictive. Lin and Schmidt (1983) detected a problem with the Tobit Model in that it links the shape of the distribution of the positive observations and the probability of a positive observation. They further found that the shape of the distribution of the positive observations would have to resemble the extreme upper tail of a normal, which would imply a continuous and faster-than-exponential decline in density as one moves away from zero. Conversely, when zero occurs less than half of the time, the Tobit Model necessarily implies a non-zero mode for the non-zero observations (Lin & Schmidt, 1983). According to Zhang *et al.* (2006), the Tobit Model has been shown to be inadequate in characterising the two processes in market behaviour.

Bellemare and Barrett (2005) presented an ordered Tobit estimator – a two-stage econometric model determining marketing behaviour, highlighting the implications of different assumptions about a household's (discrete) participation and (continuous) volume decisions, based on evidence from Kenya and Ethiopia. Ehui, Benin and Paulos (2009) applied a two-step procedure to provide an empirical basis for identifying options to increase participation and sales of smallholder producers in livestock markets in Ethiopia. However, these researchers did not test whether it is sufficient to model the analysis as a double-hurdle model.

Apart from using a double-hurdle model to (i) determine the factors influencing the producer's decision on whether or not to use the formal marketing channel, and (ii) determine the factors influencing the proportion of cattle marketed through the formal market, this study also encompassed the formal testing of whether it is sufficient to model the analysis as a one-

decision-making model or as a two-decision-making model, using Cragg's Model. Hence, as far as is known, this study is the first of its kind to focus on livestock marketing behaviour.

This concludes Chapter 2, which extensively explored the background to the study area and also thoroughly reviewed and incorporated related research on cattle marketing in Namibia, in order to lay the foundation for the study and impart the necessary understanding. Lastly, a theoretical framework for the analysis of cattle marketing in the NCR, and the uniqueness of the study in relation to other such studies, was briefly discussed.

CHAPTER 3

DATA AND METHODOLOGY

3.1 Introduction

The development of the questionnaire, the data collection method and other procedures used to meet the objectives of the study are discussed in this chapter. The chapter consists of two sections: Section one is presented in the form of three sub-sections, namely the questionnaire, the sampling procedure, and the survey. Section two discusses the characteristics of the respondents, the simplicity of dependent variables in the regression of the cattle marketing decision, and the simplicity of explanatory variables in the regression of the cattle marketing decision.

3.1.1 Questionnaire design

In order to identify the important factors affecting producers' marketing decisions, a structured questionnaire was used to gather primary data (see Appendix **A**). It was designed to capture and identify factors (such as respondents' characteristics, monitoring cost variables, negotiating cost variables, inspection costs and productivity variables) that could influence the producers' marketing behaviour. The questionnaires of Gong *et al.* (2007), Hobbs (1997), Laubscher, Spies, Rich, Taljaard, Jooste, Hoffman, Baker and Bonnet (2009), MacInnis (2004) and Nkhori (2004) were used as guidelines in structuring the questionnaire used in this study. The questionnaire was designed to gather information on a wide range of potential transaction cost variables. However, since not all the variables were used in the analysis, a check was conducted on the variables considered to have a potential influence on cattle-marketing behaviour in the study area.

3.1.2 Sampling procedure

Four regions (Omusati, Oshana, Ohangwena and Oshikoto) were sampled with an average of thirty respondents per region. A random sampling method was used, provided that a producer had sold or purchased cattle at least within the 12 months prior to the survey date. The survey was conducted with the assistance of extension officers, who were asked to identify suitable respondents in the various constituencies.

3.1.3 Survey

The survey was conducted between June and August 2009 amongst 121 respondents from the four selected regions. The questionnaires were completed in the form of personal interviews in order to ensure adequate responses and accuracy. The majority of the producers were visited individually on their homesteads or in their production area (cattle post), or at their respective business areas, with appointments made two days in advance. The remaining respondents were interviewed during meetings organised by extension officers at their respective gathering points. Although the questionnaire was designed in English, producers were asked the questions in their local language (Oshiwambo) and information was directly entered into the questionnaire and afterwards captured on computer.

3.2 Characteristics of respondents

3.2.1 Simplicity of dependent variables in the regression of the cattle-marketing decision

The general postulation upon which this analysis is based is that a farmer's choice of cattle marketing channel is influenced by a number of transaction cost variables, but may also be influenced by the characteristics of the farmer. The choice to sell through the formal market is the key variable of interest in this analysis. Cattle producers in the study area have the option to sell through either the formal market (MeatCo) or an informal market. The choice of marketing strategy was determined by means of a questionnaire in which respondents were asked to indicate the number of cattle sold through MeatCo and the number sold through an informal market. The dependent variable was a binary choice, with a value of 1 given to those

respondents choosing to sell their cattle through MeatCo and a value of 0 given to those using only informal markets. Twenty-two (18 %) respondents indicated that they had never marketed their cattle through the formal market, while eight (7 %) respondents revealed that they had never used an informal market, and ninety-one (75 %) respondents claimed to have used a combination of the two available markets. Marketing through the formal market in the area is highly monopolised by MeatCo, which slaughters, processes and packs the meat products for export. Cattle sold through the formal market are paid for according to the grade and weight of the carcass, which can only be determined after the animal has been slaughtered.

The dependent in the second analysis is the proportion of cattle marketed through the formal market. The higher the proportion marketed through the formal market, the lower the proportion marketed through an informal market will be, and vice versa. In this analysis, the dependent variable is a continuous variable and is the percentages of the cattle sold through the formal market. The overall average proportion of cattle marketed through the formal market by the total sample of the interviewed cattle producers in the study area was 39 %. Thus, this analysis investigates the factors influencing a cattle producer's decision regarding the proportion of cattle to be sold through the formal market.

3.2.2 Simplicity of explanatory variables in the regression of the cattle-marketing decision

The independent variables in this study can be classified into five categories:

- The first part, which involves the socio-economic characteristic of the cattle producer
- The second part, which involves the information cost variables
- The third part, which is related to negotiating costs
- The fourth part, which is devoted to monitoring costs
- The fifth part, which involves productivity uncertainty

The next section presents the variables within the above-mentioned categories in detail.

3.2.3 Hypothesised explanatory variables

Table 2 summarises the explanatory variables that are hypothesised to have an influence on the decision of whether or not to sell through the formal market. A brief description of each variable and the expected direction of the influence of the hypothesised variable on the marketing behaviour of the cattle producer is given in Table 2 below. It is further hypothesised that the same variable is expected to have the same directional influence on both investigations, i.e. the decision of whether or not to sell through the formal market and the decision on the proportion of cattle to be sold through that market **in cases where the producer has decided to make use of the formal market to sell his/her cattle**.

Table 2: Explanatory variables hypothesised to influence the decisions made in respect of cattle marketing and the proportion sold in the NCR

Variable Description	Variable Name	Measurement Value	Expected Sign
Socio-economic characteristics			
Age of respondent	AGE	Age of respondent (Number)	+/-
Marketing experience	EXPERIENCE	Number of years engaged in agricultural activities (Number)	+
Information costs			
Lack of market experts	MRKEXP	How do you rate the accessibility of cattle marketing experts? (1-5)[a]	+/-
Access to market-related information	MRKINF	How easy/difficult is it to access market -related information? (1-5)[b]	-
Access to government-related information	GOVINF	How easy/difficult is it to access government-related information? (1-5)[b]	-
Access to new technology information	NEWTECH	How easy/difficult is it to access new technology information? (1-5)[b]	+/-
Market uncertainty	MRKUNCETY	Rank market access in order of importance as a constraint (1-5)[c]	+/-
Negotiation costs			
Transport problem to MeatCo	PTRNSPMEATC	Do you have a transport problem to MeatCo? (1-2)[d]	-
Transport costs	TRANSCOST	How much do you pay to transport one head of cattle to market? (N$)[e]	-
Buyer bargaining power	BUYERPOWER	Do you have bargaining power to influence selling price? (1-2)[d]	-
Payment arrangements	PAYMENT	Have you experienced payment delays with MeatCo? (1-3)[f]	+
Monitoring costs			
Price uncertainty	PRCEUNCETY	Have you experienced problems with weight loss during transportation? (1-3)[f]	-
Animal handling	HANDLING	Have you experienced problems with carcass/hide damage during transportation? (1-3)[f]	+/-
Grading uncertainty	GRDEUNCETY	Rate age as a quality attribute that buyers consider when purchasing cattle. (1-3)[f]	-
Productivity uncertainty			
Improved productivity	IMPRODUCTY	Have you experienced higher animal productivity over the last 5 years? (1-2)[d]	-
Access to credit	CREDACCES	Rank, in order of importance, credit access as a constraint. (1-5)[c]	+

[a] Possible answers were: 1= Very poor, 2= Poor, 3= Moderate, 4= Good, 5= Very good

[b] Possible answers were: 1= Very easy, 2= Easy, 3= Moderate, 4= Difficult, 5= Very difficult

[c] Possible answers were: 1 = Most important, 2= Important, 3= Moderate, 4= Not important, 5= Least important

[d] Possible answers were: 1= Yes, 2 = No

[e] Possible answers were: In Namibian Dollars
[f] Possible answers were: 1= Never, 2= Sometimes, 3= Always

3.2.3.1 Socio-economic characteristics

Personal characteristics such as age (AGE) and marketing experience (EXPERIENCE) have a direct impact on transaction costs. Older people are perceived to be less educated and thus tend to face higher transaction costs than younger, educated producers, because the former are unable to access information that will lower costs (Matungul *et al.*, 2001; Nkhori, 2004).

- **Age**

Pingali *et al.* (2005) argued that age can often be indicative of farming experience, which makes certain informational and search costs easier and cheaper, indicating a positive influence on the decision to sell through the formal market. However, Musemwa *et al.* (2007) argued that the older the farmer, the less likely he will be to sell his cattle through the formal market. Most older producers are uneducated and lack information on cattle marketing (prices) and are reluctant to base their decisions on the risk-taking attitude of younger producers (Alene *et al.*, 2007).

Contrary to the line of argument in the previous paragraph, De Bruyn *et al.* (2001) hypothesised that older producers are believed to have larger herds of cattle, thus implying an increase in the propensity to sell large numbers of cattle at once through the formal market. Therefore, as a result of the different views hypothesised by different authors, the direction of the impact of age on the decision of whether or not to sell through the formal market is vague. The same arguments hold for the proportion of cattle sold through the formal market.

Respondents were asked to indicate their age. As shown in Table 3 below, the average age of the cattle producers interviewed was 57 years, with the minimum and maximum ages ranging between 24 and 94 years. On average, the cattle producers interviewed were of a relatively older age, implying that the interviewed producers were generally retired or about to retire from full-time jobs and committed to cattle farming.

- **Marketing experience**

Experience can be as critical if not more critical than age in explaining innovativeness or modernism and is invariably correlated with age (Düvel & Stephanus, 1999). Thus, marketing experience is proxied by the number of years of experience farming with livestock. A longer duration of farming experience is hypothesised to increase social standing and lower transaction costs in informal markets (Fenwick & Lyne, 1999). It also indicates that the more years spent in agricultural activities, the more this is expected to positively influence the decision to sell through the formal market. The hypothesis is that this variable will also positively influence the decision on the proportion of cattle to be sold through the formal market.

To quantify marketing experience, respondents were asked to state the number of years they had been engaged in agricultural activities. The average number of years spent in agricultural activities was 27. This may indicate that on average, the producers had been engaged in agricultural activities over a long period of time, thus having gained marketing experience and had abundant time to judge the marketing alternatives in their areas.

Table 3: Respondents' personal information

Characteristics	**n=121**		
	Min	**Ave**	**Max**
Age (years)	24	57	94
Years engaged in farming activities	3	27	75

3.2.4 Transaction cost variables

This section exclusively discusses transaction cost variables that are hypothesised to influence the marketing behaviour of cattle producers in the North-Central Regions (NCR). Table 2, which can be found earlier in this section, reflects the expected sign and a brief description of each variable.

3.2.4.1 Information costs

Smallholder producers in Sub-Saharan Africa face a range of marketing and exchange problems, amongst which informational constraints are commonly cited (Magingxa, Alemu & Van Schalkwyk, 2006). Crase and Dollery (1999), Nkhori (2004) and Rich *et al.* (2009) argued that transaction costs arise when market information is asymmetric, especially where livestock are sold directly to processors. Since a producer might sell livestock only once or twice per year, the information base available to such producers may be significantly lower than that available to buyers. This is related to the availability of market experts (MRKEXP) and their accessibility in obtaining the following, which are hypothesised to influence marketing behaviour:

- Market-related information (MRKINF)
- Government-related information (GOVINF)
- Information on new technology (NEWTECH) and market uncertainty (MRKUNCETY)

- **Market experts**

Access to market information is an ordinal variable, indicating the degree of difficulty that small and individual cattle producers face in acquiring market information (Gong *et al.*, 2007). The availability and accessibility of market experts can influence the marketing behaviour of cattle producers, depending on the type of information supplied to the producers. However, the decision on whether or not to sell through the formal market, as well as the decision on the proportion of cattle to be sold through that market, depend on how the individual perceives the marketing arrangement through the available marketing choices. Hence, the expected influence of these variables on the decision of whether or not to sell through the formal market, as well as the proportion of cattle to be sold through that market, is unresolved at this stage.

Respondents were asked to rate the accessibility of marketing experts (advisors) in their respective areas. A score of 1 indicates very poor accessibility to cattle-marketing advisors, while a score of 5 indicates very good accessibility. As shown in Table 4 below, of the

interviewed respondents, 26 % rated the accessibility of cattle-marketing advisors to be very poor and 27 % were satisfied with the accessibility, thus giving this aspect a very good rating. This means that less than half the respondents had nobody to approach for advice, while the other half were satisfied with the accessibility of marketing experts through the Directorate of Extension and Engineering Service (DEES) within the Ministry of Agriculture, Water and Forestry (MAWF), thus creating information asymmetry.

- **Market-related information**

Information risk is associated with uncertainty about the quality and quantity (i.e. the grading and dressing percentage respectively) of saleable beef products from individual live slaughter cattle (Fausti & Feuz, 1995). When one party in a transaction has more or better information than the other, the possibility of opportunistic behaviour presents itself (Bartle, 2002). Information differences between marketing alternatives generate uncertainty, which in turn affects the behaviour of market participants (Fausti & Feuz, 1995). Parties might incur costs to gather additional information, or may proceed into the transaction hoping for the best. Information problems are clearly more acute when the parties involved have little trust for each other. Fenwick and Lyne (1999) observed that the lower the degree of information uncertainty, the lower the transaction costs become. De Bruyn *et al.* (2001) confirmed that the cost of acquiring price information has an extremely negative effect on the proportion of cattle sold to formal markets. Therefore, it is hypothesised that inaccessibility of suitable market-related information would negatively influence the decision to sell through the formal market. The same applies to the proportion of cattle sold through the formal market.

Respondents were asked to describe how easy/difficult it was for them to obtain market-related information. A score of 1 indicates that the respondent found it very easy to access information, while a score of 5 indicates that the respondent found it very difficult to access information. As shown in Table 4, of the interviewed respondents, 28 % found it very easy to access market-related information, with only 14 % finding it very difficult.

- **Government-related information**

Producers on communal land generally have no idea of the extent of the grazing resources to which they have access or the degree to which such resources are utilised. In most cases, these producers do not have any grazing control methods in place (NERPO, 2009). Smallholders are often disadvantaged due to poor access to information and market-precipitating services such as extension visitation and credit assistance, and these impediments often give rise to low rates of adoption of improved technologies that could potentially increase productivity (Lapar, Holloway & Ehui, 2003). Entrepreneurial skills, recordkeeping, livestock marketing and nutrition are regarded as the major areas of assistance that are required from the extension officers. Unfortunately, the challenge is exacerbated by the fact that the extension officers do not have adequate farming experience and are not updated on the latest marketing trends and production technologies that could be employed by the producers (NERPO, 2009). The fact that extension officers in the study area are in most cases constrained by limited resources in their efforts to reach producers in their respective areas gave rise to the hypothesis that government-related information has a negative influence on the decision to sell through the formal market, as well as the proportion of cattle to be sold through that market.

Respondents were asked to describe how easy/difficult it was for them to obtain government-related information. A score of 1 indicates that the respondent was finding it very easy to access such information, while a score of 5 indicates that the respondent was finding it very difficult to access such information. As shown in Table 4, of the interviewed respondents, 31 % indicated that they were finding it very easy to access government-related information, while only 13 % indicated that they were finding it very difficult.

- **Information on new technology**

The extent of technological intervention in breed improvement can be assessed through the compositional changes in livestock population over time (Kumar, Staals, Elumalai & Singh, 2007). It has been noted that inadequate technology and extension may result in poor efficiency in beef cattle (Suppadit, Phumkokrat & Poungsuk, 2006). Accessibility of information on new

technology results in producers being able to receive information for the purpose of adopting new and relevant technologies at the right time (NERPO, 2009). The fact that there are few livestock research stations in the NCR ignites doubts on the flow of information on new technology within the NCR. This makes it a complex matter to hypothesise the influence of information on new technology on the decision of whether or not to sell through the formal market, as well as the proportion of cattle to be sold through that market.

A score of 1 indicates that the respondent found it very easy to access information on new technology, while a score of 5 indicates that the respondent found it very difficult. As shown in Table 4, only 16 % indicated that they found it very easy to access such information, whilst a total of 34 % indicated that they found it very difficult.

Table 4: Accessibility of information, ranking from 1 (very easy) to 5 (very difficult)

	Ranking (%)				
Constraints	**1**	**2**	**3**	**4**	**5**
Market experts	26	24	13	10	27
Market-related information	28	21	27	10	14
Government-related information	31	26	19	11	13
Information on new technology	16	8	12	30	34

- **Market uncertainty**

Over the years, transaction costs have been applied to analyse numerous issues, such as the strategic impact of information systems, resource allocation and outsourcing decisions. However, little attention has been paid to the marketing channel (Chen *et al.*, 2006). Transaction and information costs also affect access to all markets and play an important role in discouraging the demand and supply of financial services (Jabbar *et al.*, 2008; Matungul *et al.*, 2001 Formal markets are perceived to be sophisticated and with investment levels way beyond the immediate financial and economic capacity of existing participants in the informal markets (Nambundunga-Xulu *et al.*, 2008). Jabbar *et al.* (2006) indicated that a well-functioning market

facilitates easy conversion of products to cash, which further facilitates other exchanges of goods and services required for increased production and consumption.

A very interesting reason given by cattle producers in the region regarding choice of market was that they preferred selling their cattle through the formal market because they did not wish to see their cattle in the area after having sold them (Düvel, 2001). However, some cattle producers' satisfaction with certain selling arrangements is bound to be influenced by the prices they expect to received. Due to the different views expressed in the literature on transaction costs, the influence of market uncertainty on the decision of whether or not to sell through the formal market, as well as the proportion of cattle to be sold through that market, is unresolved at this stage.

Respondents were asked to rank the constraints to market access in order of importance, with a score of 1 to be assigned to the most important constraint and a score of 5 to the least important. Market access was ranked by the majority of respondents (27 %) as the most important constraint requiring immediate attention, while it was ranked as important by 24 %, as moderately important by 23 %, as less important by only 12 %, and as the least important constraint by 14 % of respondents.

3.2.4.2 Negotiation costs

Negotiation costs involve problems with transport to MeatCo (PTRNSPMEATC), transport costs (TRANSCOST), buyer bargaining power (BUYERPOWER), and payment arrangements (PAYMENT).

- **Problems with transport to MeatCo and transport costs**

Aklilu (2002) stated that transport remains a critical factor in the profitability of livestock trading, possibly even constituting between 25 % and 40 % of the total price of a head of cattle. Acharya (2006) argued that the long travelling distances involved in reaching a marketplace constitute a disincentive for most producers. The further away the farmer is from the market, the

higher the transport costs incurred (Musemwa *et al.*, 2008). Transport costs consist of the opportunity cost of the producer's time and effort in organising transportation to the market, plus the monetary value of the transportation cost (Hobbs, 1997; Montshwe, 2006). In addition, Musemwa *et al.* (2008) observed that producers incur extra transport costs in securing transporting and selling permits from police stations and veterinary offices respectively. Hence, distance and the cost of transport can be thought of as negative supply shifters in market penetration (MacInnis, 2004). Therefore, both these variables are hypothesised to negatively affect the decision to sell through the formal market. The same hypothesis applies to both variables in respect of the proportion of cattle to be sold through the formal market.

To quantify the first variable, respondents were asked to indicate whether they had ever experienced problems transporting their cattle to the MeatCo abattoir. A binary score of 1 for Yes and 2 for No applied in the expression of problems experienced transporting cattle to MeatCo. Of the interviewed cattle producers, 52 % indicated that they had never experienced any problems transporting their cattle to the MeatCo abattoir, whereas 48 % indicated that they had experienced such problems.

Respondents were asked to indicate the cost of transporting one head of cattle to market in Namibian dollars (N$). The average cost of such transport is N$145.65 per animal. However, as shown in Figure 5, which reflects different modes of transport used to transport different types of livestock to market, transport costs differ according to the mode of transport used.

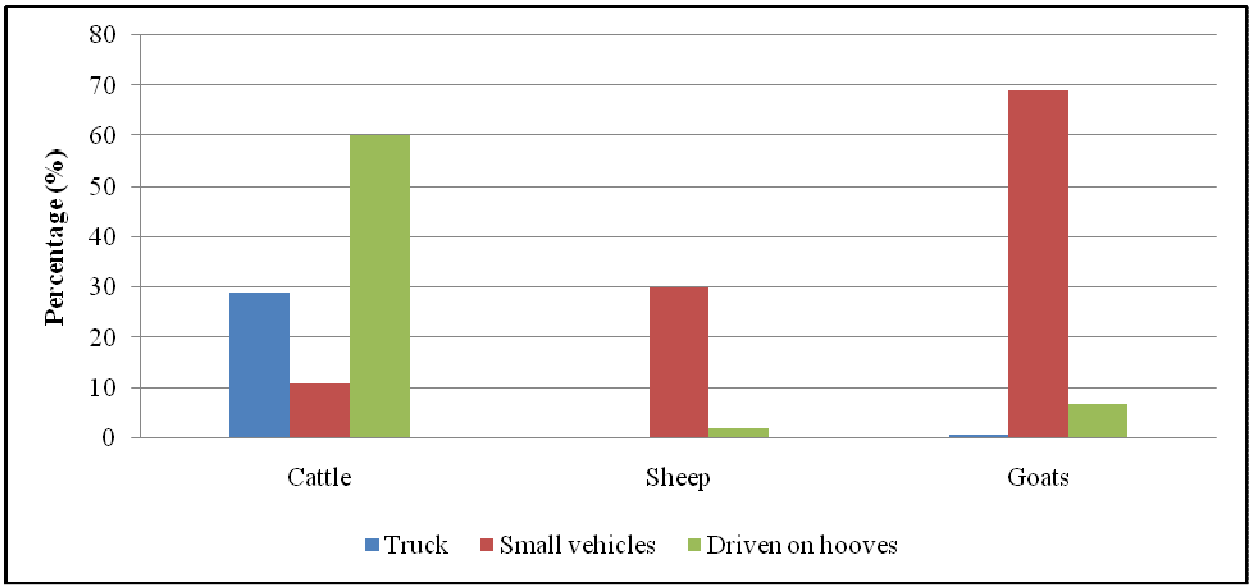

Figure 5: Mode of transport used to transport livestock to market

- **Buyer's bargaining power**

Where the sale is restricted to only one buyer and one seller (producer), a bilateral monopoly could develop where price, rather than reflecting the opportunity costs of production according to the preferences of the buyers, may simply reflect the relative strengths of the two parties (Crase & Dollery, 1999). Bargaining power is an ordinal variable, which refers to whether producers passively accept transaction prices or negotiate with their buyers. In most cases this comes as a result of limited organisational capabilities, various externalities, regulatory failures, and the exercising of market power (Rich *et al.*, 2009). According to Nkhori (2004) the difficulties a farmer faces in finding reliable markets is one source of transaction costs, due to the farmer's low bargaining power. Producers experience a weak bargaining position vis-à-vis buyers because often they do not have timely access to salient and accurate information on prices, locations of effective demand, preferred quality, and alternative marketing channels (Magingxa *et al.*, 2006). Having less negotiating power with MeatCo is hypothesised to negatively influence the decision to sell through the formal market, because it reduces the control over the order in which cattle are sold, which may be a further negotiation cost (Hobbs, 1997). This variable is expected to reduce the proportion of cattle sold through the formal market.

Respondents were asked to indicate whether they had any bargaining power when it came to influencing the selling price when marketing to MeatCo. A score of 1 indicates that the respondent had no bargaining power when it came to influencing the selling price, while a score of 3 indicates that the respondent did have some bargaining power. As shown in Figure 6, MeatCo does not negotiate selling prices as do the informal markets. Consequently, 72 % of respondents indicated that they had no bargaining power whatsoever when it came to influencing the selling price at MeatCo.

- **Payment arrangements by MeatCo**

The delay between the time when cattle are sold and when payment is received is also a negotiation cost (Hobbs, 1997). A payment arrangement is also a form of negotiation cost, which is measured in terms of the number of weeks by which the buyer delays payment to the producer. Producers are likely to encounter payment delays when selling to a meat processor with the power to establish prices and determine the time of payment delivery (Gong *et al.*, 2007). The delay is not expected to be significant in the case of auctions, since producers usually receive payment within one working day of the sale. The delay in payment is more important when selling to formal markets. A good relationship with a buyer means that the producer need not seek alternative buyers when marketing his cattle. However, if producers are not satisfied with the conduct of the buyer, they must either find alternative outlets or take steps to avoid using the procurement officer (Hobbs, 1997). Due to MeatCo's payment arrangements, according to which payment is usually made the day after the slaughtering date, this variable is hypothesised to positively influence the decision to sell through the formal market. This variable is expected to similarly influence the proportion of cattle to be sold through the formal market.

Respondents were asked to indicate whether they had ever experienced any payment delay with MeatCo. A score of 1 indicates that the respondent had never experienced any payment delay, while a score of 3 indicates that the respondent had experienced repeated payment delays. As shown in Figure 6, of the interviewed respondents, 74 % indicated that they had never

experienced any payment delay with MeatCo, while 8 % indicated that they had experienced repeated payment delays.

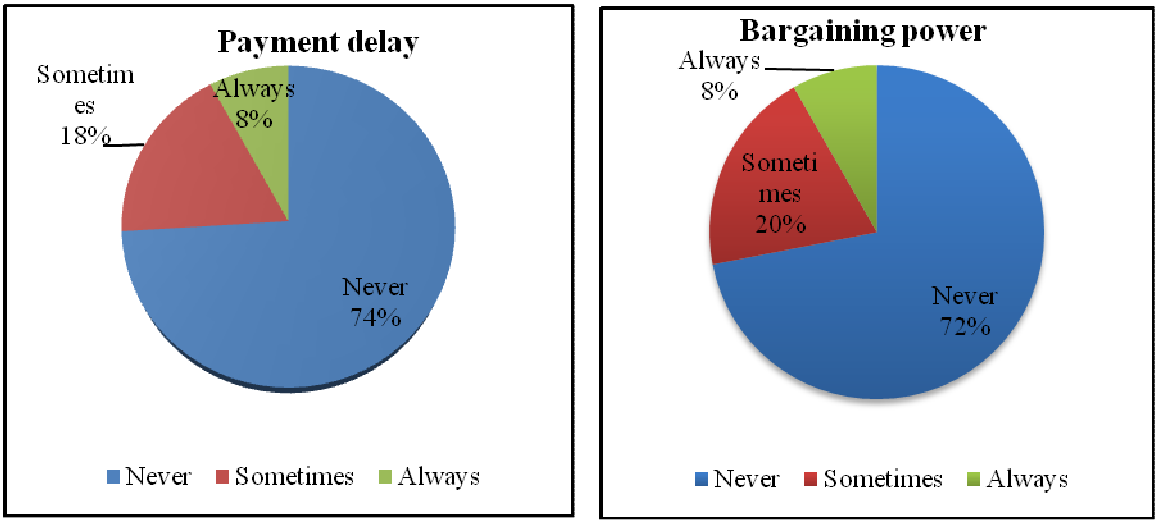

Figure 6: Responses in respect of payment delays and bargaining power to influence price with MeatCo

3.2.4.3 Monitoring costs

Chen *et al.* (2006) indicated that transaction costs can be affected by product uncertainty and process uncertainty. According to those authors, product uncertainty refers to the possible unexpected outcomes of using the product or the inability of the product to meet customer expectations. Process uncertainty refers to the customer not having complete confidence in the transaction process, and a higher level of uncertainty generally implies a higher transaction cost. This category includes price uncertainty (PRCEUNCETY), animal handling prior to market (HANDLING), and grading uncertainty (GRDEUNCETY).

- **Price uncertainty**

When selling live cattle to formal markets, cattle producers may face price uncertainty, which is determined only after the animal has been slaughtered (Fausti & Feuz, 1995; Gong *et al.*, 2007; Grosh, 1994). MeatCo sets the price per grade and the producer has no control over it. Although information on price per grade is published by MeatCo and made available to producers through

cattle agencies, extension officers and publications, the producers remain uncertain about the price they are likely to receive until after the cattle have been slaughtered. Due to the long travelling distances, weight losses occur and thus reduce the carcass weight, which is what determines price. Therefore, price uncertainty increases negotiating and decision-making costs, while demand and supply certainty raises search and information costs (Ayars, 2003). The cost of obtaining price information has the greatest impact in explaining the proportion of cattle sold through the formal market and thus the producer's choice of marketing channel (De Bruyn, *et al.*, 2001). This means that information differences between marketing alternatives generate uncertainty, and uncertainty affects the behaviour of the market participants (Fausti & Feuz, 1995). There is also an element of mistrust on the part of the producers, who fear that their cattle may be mixed with inferior (lower grade/quality/condition) cattle and not priced properly (Feuz, Fausti & Wagner, 1995). Therefore, this variable is hypothesised to negatively affect the decision to sell through the formal market. The impact of this variable is expected to take the same direction with regard to the proportion of cattle sold through the formal market.

To quantify this variable, respondents were asked to indicate whether they had ever experienced any problems associated with weight loss during the transportation of their cattle. A score of 1 indicates that the respondent had never experienced problems with weight loss during transportation, while a score of 3 indicates that the respondent had repeatedly experienced such problems. As shown in Table 5, of the interviewed respondents, 45 % indicated that they had never experienced any problems with weight loss during transportation, while only 15 % indicated that they had repeatedly experienced such problems.

- **Animal handling prior to market**

Hobbs (1997) indicated that producers may incur monitoring costs in ensuring that, from the time the cattle leave the farm to the time they are slaughtered, problems related to shrinkage and carcass damage are minimised. The producers lack a commercial mindset and therefore market their cattle for various other socio-economic reasons. Producers do not always dehorn their cattle, which further increases the risk of damage during transportation or even while the animals are kept in the waiting area prior to slaughter. Hence, hide/carcass damage is perceived

to have no impact on the decisions made in respect of cattle marketing. Consequently, the influence of this variable on the decision of whether or not to sell through the formal market, as well as the proportion of cattle to be sold through that market, is unresolved at this stage.

This variable was quantified by asking the respondents to indicate whether they had ever experienced any problems with carcass/hide damage due to poor animal handling. A score of 1 indicates that the respondent had never experienced any problems with carcass/hide damage due to poor animal handling, while a score of 3 indicates that the respondent had repeatedly experienced such problems. As shown in Table 5, of the interviewed respondents, 54 % indicated that they had never experienced any problems with carcass/hide damage due to poor animal handling, while 12 % indicated that they had repeatedly experienced such problems. However, this does not rule out the possibility of carcass damage caused by stress during the animals' long journey to market.

- **Grading uncertainty**

The production process of beef cattle is typically characterised in terms of a number of distinct stages starting with genetic selection and breeding, then rearing and weaning, and finally fattening to market weight (finishing) and slaughter (Hueth & Lawrence, 2002). Moreover, this involves decisions on the type of stock, the method and timing of sales, as well as price and payment. Production and marketing policies need to be integrated to maximise the margin between cost and return (Davies, Eddison, Cullinane, Kirk & Hayne, 1998).

Marketing decisions must take into account the need to produce livestock that yield carcasses of the weight and quality preferred by buyers. In addition, Düvel (2001) argued that, from the point of view of an understanding of marketing behaviour, preferences regarding the age at which animals are sold is even more important. He found that there is a clear preference among cattle producers in the area to sell cattle only after reaching six years of age. This reduces tenderness, which is one of the most important attributes affecting consumer preferences for beef products (Riley, Schroeder, Wheeler, Shackelford & Koohmarais, 2009). Producers selling cattle directly to packers may incur product information costs if different buyers require cattle

with different quality specifications (Hobbs, 1997). The payment received by producers is based on final grade results, which creates risks for producers (Gong *et al.,* 2007). Grading uncertainty tends to arise when producers sell only through the formal market, as cattle are priced according to grade category (age, weight, body conformation and fatness). Furthermore, stress during transport tends to cause dark-cutting beef, which lowers quality, because the beef is then perceived to become unattractive, tasteless and unpopular. Therefore, quality uncertainty is hypothesised to negatively influence the decision to sell through the formal market, as well as the proportion of cattle to be sold through that market.

Respondents were asked to indicate whether buyers consider the age of the animal as a grading attribute during purchasing. A score of 1 indicates that the respondent had never had a buyer who had considered the age of the animal as a grading attribute, while a score of 3 indicates that the respondent had repeatedly had buyers who had considered the age of the animal. As shown in Table 5, of the interviewed respondents, 41 % indicated that they had repeatedly had buyers who had considered the age of the animal as a grading attribute, while 21 % indicated that they had never had a buyer who had considered the age of the animal. This variable may be influenced by many factors, as it depends on the type of animal being purchased and the reason for the purchase.

Table 5: Responses in respect of accessibility to information

Information variables	**Percentage (%)**		
	Never	**Sometimes**	**Always**
Price uncertainty	45	40	15
Poor animal handling prior to market	54	34	12
Grade uncertainty	21	38	41

3.2.4.4 Productivity uncertainty

The four most important factors, namely livestock diseases, drought, scarcity of livestock watering points, and lack of money for farming inputs, are all directly concerned with livestock production (Düvel & Stephanus, 1999). Alene *et al.* (2007) stated that production shifters are equally important variables to the extent that increased production promotes output marketing.

These authors argued that understanding the effects of transaction costs on input use, which can increase production itself, should be as important as understanding the effects of transaction costs on market supply. Transaction cost perceptions are based not only on the objective risks that individuals face, such as variable rainfall, but also on their subjective assessment of risk. Thus, their subjective assessments combine their expectations about likely events with their beliefs about their own ability to deal with future events (Doss *et al.,* 2005). Included in this category are improved productivity (IMPRODUCTY) and access to credit (CREDACCES).

- **Improved productivity**

The strong link between rainfall and grass biomass production means that any reduction in the former brings about a reduction in the productivity of natural pastures (Kamuanga *et al.,* 2008). Düvel (2001) identified lack of grazing due to overgrazing, scarcity of stock watering points and drought to be directly concerned with stock production. Increasing farm-level production and productivity will require more improved animals, improved fodder/feed technology, and better access to livestock services (Kumar *et al.,* 2007). However, in the communal areas, herds from different households are allowed to graze together and mate, irrespective of their health status. This is worsened by the lack of proper disease and parasite control in communal grazing areas (Mapiye, Chimonyo, Dzama, Raats & Mapekula, 2009). Although government's focus on productivity improvement and their associated efforts through numerous different projects are recognised for bringing about changes to the arena of livestock production in the area, the objectives are far from being achieved. The communal areas are still dominated by a low bull-to-cow ratio, a low ratio of extension officers to producers, a lack of water, and inadequate grazing areas (Mushendami *et al.,* 2006). Therefore, this variable is expected to negatively influence the decision to sell through the formal market. The same negative influence is hypothesised to apply in the decision on the proportion of cattle to be sold through the formal market.

Respondents were asked to indicate whether they had experienced any change in their livestock business over the past five years. A binary choice of 1 for Yes and 2 for No was given. Of the

interviewed producers, 83 % indicated that the productivity of their animals had increased over the past five years.

- **Access to credit**

Apart from access to information and institutional innovations, accessibility to production inputs is extremely important, as this can promote market participation and supply (Alene *et al.*, 2007). Producers engaged in small-scale agriculture have limited access to factors of production, credit and information, and markets are often constrained by high transaction costs (Matungul *et al.*, 2001). Lack of institutional credit is a severe constraint to the development of livestock production (Kumar *et al.*, 2007). Inappropriate policies and misallocation of investment resources could skew the distribution of the benefits and opportunities away from those smallholders who would potentially gain the most from a livestock revolution (Lapar *et al.*, 2003). The accessibility of credit is therefore expected to have a positive influence on the decision to sell through the formal market, as inputs and credit access may have a major influence on the quantity and quality of cattle produced. Therefore, given the accessibility of credit in the study area, this variable is hypothesised to positively influence the decision to sell through the formal market. This is also expected to have a similar influence on the proportion of cattle sold through the formal market, as producers will be obliged to harvest a large number of cattle at a time in order to repay debt.

Respondents were asked to rank the importance of credit access as a constraint to livestock production. A score of 1 indicates that the respondent considered credit access to be the most important constraint, while a score of 5 indicates that the respondent considered credit access to be the least important constraint. As shown in Figure 7, of the interviewed respondents, 51 % indicated that access to credit is the most important constraint to productivity, while only 11 % identified it as being the least important constraint.

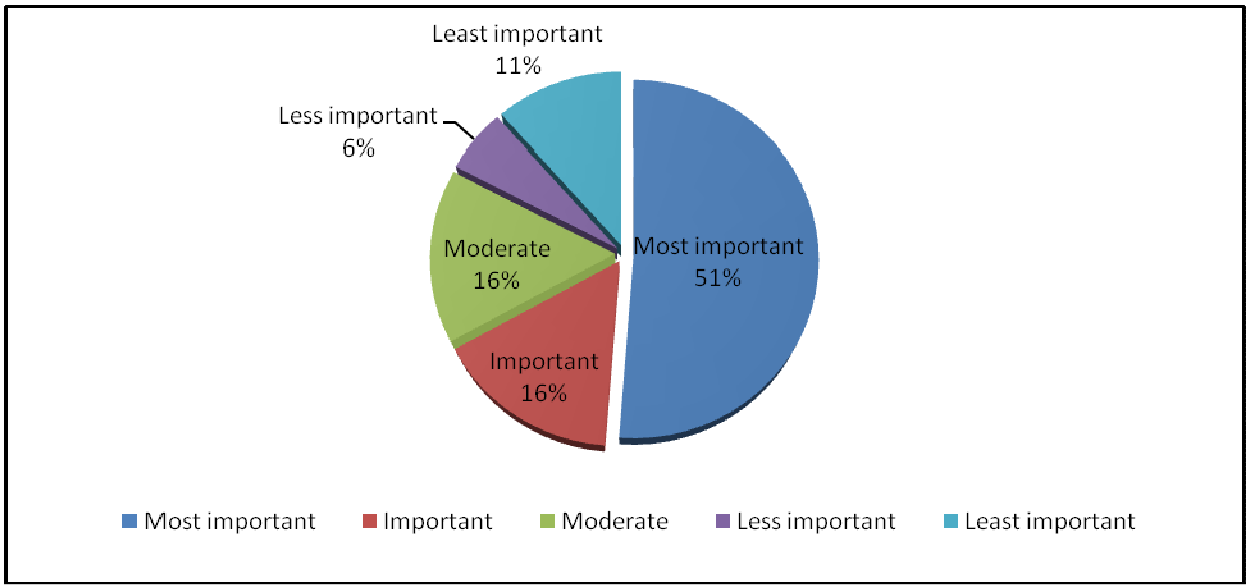

Figure 7: Accessibility of credit

3.3 Methodology

3.3.1 Introduction

The second section of this chapter outlines the econometric models used to determine the personal and farm characteristics influencing the marketing behaviour of farmers. The following procedures are discussed in this section: principal component regression; the procedure to investigate the factors influencing the decision of whether or not to sell cattle through the formal market; the procedure to investigate the factors influencing the decision on the proportion of cattle to be sold through the formal market; the procedure to formally test whether it is sufficient to model the analysis as a one-decision-making model or as a two-decision-making model; and the procedure to investigate the underlying structure of factors influencing transaction costs.

3.3.2 Principal component regression

The survey data confirmed that most of the variables did not vary significantly across respondents, prompting the testing of data for correlation. A correlation matrix confirmed that many explanatory variables were statistically correlated with one another (see Appendix B).

Multi-collinearity may cause lack of significance of individual independent variables, while the overall model may be strongly significant. It may also result in incorrect signs and magnitudes of regression coefficient estimates, and consequently in inaccurate conclusions about the relationship between independent variables (Gujarati, 2003). Due to this redundancy, it was deemed possible to reduce the observed variables into a smaller number of principal components (artificial variables) that would account for most of the variance in the observed variables. The first method attempted was Principal Component Analysis (PCA) – a standard tool in modern data analysis – which is a simple, non-parametric method for extracting relevant information from confusing data sets. However, due to the nature of the data, PCA was abandoned due to the complexity of observing the influence of a single variable within a component. As an alternative, Principle Component Regression (PCR) was selected as a way to deal with the multi-collinearity problem. This method standardises all variables to a mean of zero and a standard deviation of one prior to analysis, thereby minimising the problems associated with scaling. A rule of thumb to determine the number factors at principal components, known as the *Kaiser Criterion*, dictates that only factors with eigenvalues greater than 1.00 are able to explain the observed variance (Ridho, Setyono & Sumi, 2002).

The purpose of PCR is to estimate the values of a response variable at the basis of hypothesised explanatory variables (EV). Due to the nature of the data used in this study, least square (LS) regressions and classical PCA are vulnerable with respect to outlying observations, since even a single massive outlier can heavily influence the parameter estimates of these methods. It is therefore important to robustify PCR, which in fact means to robustify both PCA and linear multiple regression (Filzmoser, 2001).

- **Application to principal component regression**

In PCR, **Y** is regressed on a subset of the sample principal components. The estimated regression coefficients for the explanatory variables in the chosen subset are used to obtain regression coefficients for the original columns of **X** (Hwang & Nettleton, 2002). Following Magingxa *et al.* (2006), PCR is applied within a maximum likelihood estimation framework.

The correlation matrix C, using both standardised and non-standardised variables, was used to calculate the eigenvalues $\lambda_1, \lambda_2, ...\lambda_k$ and corresponding eigenvectors ν_i respectively in Equations 1 and 2:

$$|C-\lambda I| = 0,\ |C-\lambda_j I|V_j = 0 \quad \textbf{(1)}$$

The eigenvectors V_j were then arranged to give matrix V in Equation **2**:

$$\boldsymbol{V} = \begin{bmatrix} \nu_{11} & \nu_{12} & . & . & . & \nu_{1k} \\ \nu_{21} & \nu_{22} & . & . & . & \nu_{2k} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \nu_{k1} & \nu_{k2} & . & . & . & \nu_{kk} \end{bmatrix} \quad \textbf{(2)}$$

The matrix **V** is orthogonal, as its columns satisfy the conditions $\nu_i'\nu_i = 1$ and $\nu_j'\nu_i = 0$ for $i \neq j$

$$Z = X^S V \quad \textbf{(3)}$$

Where X^S is the n×k matrix of standardised variables, and **V** is the eigenvector matrix as defined in Equation **3.** There are **k** explanatory variables, as there are **k** variables. The new sets of variables (explanatory variables), unlike the original variables, are orthogonal, i.e. they are uncorrelated.

After the explanatory variables had been calculated and the explanatory variables with the smallest eigenvalues eliminated, Equation **4** was fitted to determine the explanatory variables having a significant impact on the probability of the producer deciding to sell his cattle through the formal market, as well as the proportion of cattle to be sold through that market:

$$\boldsymbol{P} = \boldsymbol{F}(\alpha_0^s + X^s VV'\varphi^s + \varepsilon) \quad \textbf{(4)}$$

Once the insignificant explanatory variables from Equation **5** had been identified and eliminated, Equation **5** was obtained in terms of the retained hypothesised variables.

$$\boldsymbol{P} = \boldsymbol{F}\left(\alpha_0^s + Z\gamma + \varepsilon^\circ\right) \quad \textbf{(5)}$$

where $Z = X^s V$ and $\gamma = V'\varphi^s$. Z is $n \times \ell$ matrix of retained explanatory variables, $\boldsymbol{V}$ is $k \times \ell$ matrix of the eigenvectors corresponding to the ℓ retained components, and γ is $\ell \times \ell$ vector of coefficients associated with ℓ variables. Standard errors of the estimated coefficients γ are represented by $\ell \times 1$ vector.

$$Var(\hat{\gamma}) = \hat{\delta}^2 (Z'Z)^{-1} = \hat{\delta}^2 \, diag\left(\lambda_1^{-1}, \lambda_2^{-1}, ... \lambda_l^{-1}\right) \quad \textbf{(6)}$$

where $\hat{\delta}^2$ is the variance of residuals from Equation **4**. Therefore, the standard error of γ may be given by:

$$k^s = \left(s.e.\hat{\gamma}_1 s.e.\hat{\gamma}_2 ... s.e.\hat{\gamma}_\ell\right) \quad \textbf{(7)}$$

The standard error is simply the standard deviation of the dependent values about the estimated regression and is often used as a summary measure of the goodness of fit of the estimated regression (Gujarati, 2003). Another conventional way in which to report results is to replace the standard errors with the *t*-values that arise when testing H_0: $\beta_1 = 0$ against H_1: $\beta_1 \neq 0$ and H_0: $\beta_2 = 0$ against H_1: $\beta_2 \neq 0$ (Griffiths, Hill & Judge, 1993). In some analyses, both the standard errors and *t*- values are reported in parentheses below the coefficients. Griffiths *et al.* (1993) recommended that, given the *t*-statistics, it is useful to report the *p*-values, which are the probabilities of exceeding the computed *t*-value.

Results obtained using Equation **5** may be transformed back to the explanatory variable estimators of standardised variables as follows:

$$\begin{bmatrix} \alpha^s_{1,EV} \\ \alpha^s_{2,EV} \\ . \\ . \\ . \\ \alpha^s_{k,EV} \end{bmatrix} = \begin{bmatrix} V_{11} & V_{12} & . & . & . & V_{1l} \\ V_{21} & . & . & . & . & V_{2l} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ V_{k1} & . & . & . & . & V_{kl} \end{bmatrix} \times \begin{bmatrix} \hat{\gamma}_1 \\ \hat{\gamma}_2 \\ . \\ . \\ . \\ \hat{\gamma}_l \end{bmatrix} \quad \textbf{(8)}$$

where $\hat{\gamma}_i$ is the estimator of γ_i in Equation **6** and the constant $\alpha^s_{\circ,EV} = \bar{y}$.

The standardised coefficients evaluate the relative importance of the explanatory variables in determining the marketing decisions of cattle producers. Variance of the explanatory variables estimators in standardised variables is given by:

$$Var(\alpha_{EV}^{s}) = \Psi_{\ell}^{s} \mathrm{K}^{S} \quad \textbf{(9)}$$

where Ψ_{ℓ}^{s} contains the squares of the elements of V_{l}^{s} in Equation **2** and K^{S} contains the squares of the elements of the matrix of standard errors of the coefficient matrix of γ in Equation **5**. The corresponding standard errors for the estimators of explanatory variables of standardised variables are given by:

$$s.e\left(\alpha_{EV}^{s}\right) = \left[\mathrm{var}\left(\alpha_{EV}^{s}\right)\right]^{1/2} \quad \textbf{(10)}$$

The transformed standardised coefficients $\alpha_{j,EV}^{s}$ of standardized variables X_{j}^{x} back to $\alpha_{j,EV}$ non-standardised coefficients $\alpha_{j,EV}$ of X_{j}

$$\alpha_{j,EV} = \frac{\alpha_{j,EV}^{s}}{S_{xj}},\ j = 1,2,...,k \quad \textbf{(11)}$$

and

$$\alpha_{\circ,EV} = \alpha_{\circ,EV}^{s} - \frac{\alpha_{1,EV}^{s}\bar{x}_{1}}{S_{x1}} - \frac{\alpha_{2,EV}^{s}\bar{x}_{2}}{S_{x2}} - ... - \frac{\alpha_{k,EV}^{s}\bar{x}_{k}}{S_{xk}} \quad \textbf{(12)}$$

where S_{xj} is the standard deviation of the j^{th} original variable $\mathrm{X_j}$, and $\alpha_{0,EV}^{s}, \alpha_{1,EV}^{s}, \alpha_{2,EV}^{s}, \alpha_{k,EV}^{s}$ are coefficients of the standardised variables.

The partial effects of the continuous explanatory variables on the marketing decision may be computed by the expression:

$$\frac{\partial p_{i}}{\partial x_{ij}} = \beta_{j}\phi(\mathrm{Z}_{i}) \quad \textbf{(13)}$$

where $Z_i = \beta_\circ + \sum_{i=1}^{k} \beta_i x_{ij}$

The "partial" effects of the discrete variables are calculated by taking the difference of the probabilities estimated when the value of the variable is set to 1 and 0 $(x_i = 0, x_i = 1)$ respectively.

3.3.2 Factors affecting the decision of whether or not to sell through the formal market

The regressand in this objective is a binary variable that takes only two values (1, 0) – say 1 if a cattle producer has at least at one point sold through the formal market and 0 if a producer has never sold through the formal market. Hence a Probit Model was used to determine the factors influencing the decision of whether or not to sell through the formal market (**secondary objective 1**). Given the fact that the regressand is qualitative in nature, Gujarati (2003) explained the difference in objectives between quantitative and qualitative regressands as follows: When a regressand is quantitative, the objective is to estimate its expected or mean value, given the values of the regressors. Where a regressand is qualitative, the objective is to find the probability of something happening. Hence, qualitative response regression models are often known as probability models. Gujarati (2003) and Malhotra (1983) specified three alternative approaches to estimating a probability model for a binary response variable, namely the Linear Probability Model (LPM), the Logit Model, and the Probit Model.

- **Linear Probability Model**

The Linear Probability Model is given by:

$$Y_i = \beta_1 + \beta_2 X_i + \mu_i \qquad \textbf{(14)}$$

where Y_i is 1 if the *i*th decision-maker selects the first alternative (selling through the formal market) and 0 if the *i*th decision-maker selects the second alternative (not selling through the formal market). x_i is the *i*th row of the $n \times p$ matrix of regressors, $i = 1, 2, \ldots, n$ (*n* refers to the sample size and *p* to the number of coefficients); β is the $p \times 1$ vector of parameter

coefficients; and μ_i is the ith independently and identically distributed random variable with zero expectation.

The probabilities of these events are βx_i and (1-βx_i). Thus we have:

u_i	$f(u_i)$
$1-\beta x_i$	βx_i
$-\beta x_i$	$1-\beta x_i$

(15)

Hence

$$\begin{aligned} \text{Var}(u_i) &= \beta x_i (1-\beta x_i)^2 + (1-\beta x_i)(-\beta x_i)^2 \\ &= \beta x_i (1-\beta x_i) \\ &= E(Y_i)[1-E(Y_i)] \end{aligned} \qquad \textbf{(16)}$$

Due to this heteroskedasticity problem, the ordinary least squares (OLS) estimates of β from Equation **14** will not be efficient.

The LPM is the simplest of the three models in that it can be estimated by the familiar OLS setup. Although LPM is simple to apply, this model is fraught with several problems, such as non-normality and heteroskedasticity of the error term, which allows the predicted values of the dependent variable to fall outside the unit interval and the predicted errors to be extremely large (Greene, 2008; Maddala, 2001; Mahmood & Cheema, 2004). Gujarati (2003) explained that the assumption of normality for the error term is not tenable, because, like Y_i, the error term also takes only two values; that is, it also follows a Bernoulli distribution. These difficulties can be overcome by using monotonic transformation (Probit and Logit specifications), which ensures that the values of prediction are within the unit interval (Gujarati, 2003; Mahmood & Cheema, 2004).

- **Logit Model**

The Logit Model is given by:

$$P_i = \frac{1}{1+\ell^{-Z_i}} = \frac{\ell^{z}}{1+\ell^{z}} \qquad \textbf{(17)}$$

where $Z_i = \beta_1 + \beta_2 X_i$

Equation **17** represents what is known as the (cumulative) logistic distribution function. It is easy to verify that as Z_i ranges from $-\infty$ to $+\infty$, P_i ranges between 0 and 1 and P_i is nonlinearly related to Z_i thus satisfying the two requirements not met by the LPM (Gujarati, 2003; Malhotra, 1983). The Logit Model is very similar to the Probit Model, with the only difference lying in the specification of the distribution of the error term (Davidson & MacKinnon, 2004; Maddala, 2001). Maddala (2001) specified that if the cumulative distribution of the error term is logistic, we have what is known as the **Logit** Model, whereas if the error term follows a normal distribution, we have the **Probit** (*Normit*) Model. Since the cumulative normal and logistic distributions are very close to one another, except at the tails, we are not likely to get very different results using the Logit Model and the Probit Model (Maddala, 2001). Malhotra (1983) cautioned that the relative computational advantage of these procedures will vary somewhat depending on the nature and size of the problem. Nevertheless, Ramanathan (1995) made it clear that the Logit Model has the property that the predicted value of *P* (the observed fraction of the number of times a particular decision is favoured) is always between 0 and 1, whereas if the dependent variable is not the observed fraction, but rather binary (taking the values 0 and 1 only), then a Probit Model is appropriate. Therefore, for purposes of this study, a Probit Model was selected to be used instead of a Logit Model.

- **Probit Model**

If a cattle producer makes the participation and volume decisions simultaneously, he effectively pre-commits to a volume before acquiring the information available only upon arriving at the market (Bellemare & Barrett, 2005). This *ex ante* decision-making effectively gives the traders with whom the household interacts market power by rendering the cattle producer demand

(supply) inelastic with respect to new market (e.g. price) information discovered, leaving poor, pre-committed cattle producers vulnerable to exploitation by astute traders (Bellemare & Barrett, 2005).

Cragg (1971) cited in Peracchi (1987) pointed out that the censored (and truncated) regression model may not be a valid representation of market behaviour, because it does not distinguish between the decision to purchase goods and the decision on how much to purchase. Therefore, the discrete decision of whether or not to sell through the formal market is usually estimated with a Probit Model, because a decision of this kind is similar to the decision of whether or not to adopt a marketing contract (Katchova & Miranda, 2004), modelling multiple adoption decisions in a joint framework (Dorfman, 1996). The Probit Model is a popular model in applied micro-econometric work. Estimates for the Probit Model are developed by the method of maximum likelihood and it capitalises on the assumed normality of the error term (Aldrich & Cnudde, 1975; Bertschek & Lechner, 1998). Following on Maddala (2001), the under-mentioned Probit Model was estimated.

It is assumed that we have a Regression Model:

$$\mathrm{Y}_i^* = \beta_\circ + \sum_{j=1}^{k} \beta_j x_{ij} + \mu_i \qquad \textbf{(18)}$$

where Y_i^* is not observed. This is commonly known as a latent variable. What can be observed is a dummy variable y_i defined by:

$$y_i = \begin{cases} 1 & if \quad Y_i \rangle 0 \\ 0 & otherwise \end{cases} \qquad \textbf{(19)}$$

If Y_i^* in Equation **19** is multiplied by any positive constant, this does not change y_i. Hence, if we observe y_i, we can estimate the β's in Equation **18** only up to a positive multiple. It is customary to assume var(u_i) = 1. From the relationship between Equations **18** and **19** we get:

$$\boldsymbol{P_i} = \text{Prop}\ (y_i - 1) = \text{Prop}\ [u_i > -\ (\beta_\circ + \sum_{j=1}^{k} \beta_j x_{ij})\ ] \qquad \textbf{(20)}$$

$$= 1\text{-}F\left[-\left(\beta_{\circ} + \sum_{j=1}^{k} \beta_j x_{ij}\right)\right]$$

where F is the cumulative distribution function of u if the distribution of u is symmetric, since 1-F(-Z) = F(Z). The observed y_i are just realisations of a binomial process, with probabilities given by:

$$\boldsymbol{P_i = F}\left(\beta_{\circ} + \sum_{j=1}^{k} \beta_j x_{ij}\right) \qquad \textbf{(21)}$$

Varying from trial to trial (depending on x_{ij}), we can write the likelihood function as:

$$L = \prod_{y_i=1} P_i \prod_{y_i=0} (1 - P_i) \qquad \textbf{(22)}$$

We can write Equation **21** differently, as given by Katchova and Miranda (2004):

$$P(c_i = 1) = \Phi(\gamma' \mathbf{z}_i) \qquad \textbf{(23)}$$

where c_i is the formal marketing decision, Φ is the standard normal cumulative density function, $\mathbf{z}_i$ is an $R \times 1$ vector of personal and farm characteristics for farmer i, and γ' is a vector of coefficients. It is assumed that the density of c_i, conditional on being a non-limit (positive) observation, is that of $N(X_t\beta_2, \sigma^2)$.

3.3.3 Factors affecting the decision on the proportion of cattle to be sold through the formal market in cases where the producer has decided to make use of the formal market to sell his/her cattle

This specification relies on the potentially strong assumption that the cattle producer's discrete choice to participate in the formal market is made simultaneously with the continuous choice as to the number of animals to sell, conditional on having chosen to go through the formal market. Bellemare and Barrett (2005) indicated that the distinction between whether a cattle producer makes his decisions on market participation and purchase or sales volume sequentially or simultaneously has significant implications for several relationships of interest in market participation studies.

The percentage of cattle sold to the formal market was used as the dependent variable in this analysis. The Truncated Model on this analysis captures the characteristics influencing the producer's decision on the proportion of cattle to be sold through the formal market (**secondary objective 2**). This decision was analysed conditional to the respondent having made use of the formal market during the 12 months prior to the data collection date. It was hypothesised that the same variables influencing the decision of whether or not to make use of the formal market would also have a similar influence on the proportion of cattle sold through the formal market.

- **Tobit and Truncated models for the proportion of cattle sold through the formal market on condition that the producer had made use of the formal market to sell his/her cattle**

The discrete decision of whether or not to sell through the formal market, and the continuous decision on the proportion of cattle to be sold through that market, was estimated using the Tobit Model. Following on the work of Katchova and Miranda (2004), the Tobit Model assumes that a latent variable α_i^* is generated by:

$$\alpha_i^* = \beta_\alpha' X_i + \varepsilon_{\alpha i} \qquad \textbf{(24)}$$

where X_i is an $S \times 1$ vector of personal and farm characteristics for farm i, β_α is a vector of coefficients, and $\varepsilon_{\alpha i}$ are independently and normally distributed with mean zero and variance σ^2. If α_i^* is negative, the variable that is actually observed, namely the proportion of cattle sold through the formal market, α_i, is zero. When α_i^* is positive, $\alpha_i = \alpha_i^*$. In the Tobit Model, the probability that the proportion of cattle sold through formal market would be zero was calculated by Equation **25**:

$$P(\alpha_i = 0) = \Phi\left(-\frac{\beta_\alpha' X_i}{\sigma}\right) \qquad \textbf{(25)}$$

where the density for the positive value of α_i is

$$f(\alpha_i \mid \alpha_i > 0) = \frac{f(\alpha_i)}{P(\alpha_i > 0)} = \frac{\frac{1}{\alpha}\phi\left(\frac{\alpha_i - \beta'_\alpha X_i}{\sigma}\right)}{\Phi\left(\frac{\beta'_\alpha X_i}{\sigma}\right)} \quad \textbf{(26)}$$

and where $\phi(\bullet)$ is the standard normal probability density function. Equation **25** represents the adoption decision, and is a valid Probit Model if considered separately from Equation **26.** Equation **26** represents a Truncated regression for the positive values of the continuous decision on the proportion of cattle to be sold through the formal market $(\alpha_i > 0)$, as indicated by Peracchi (1987). The Tobit Model arises when the decision represented by the Probit Model in Equation **26**, and the decision on the proportion of cattle to be sold through the formal market, represented by the Truncated Regression Model in Equation **26**, have the same variables X_i and the same parameter vector β_α. In the Tobit Model, a variable that increases the probability of the producer deciding to sell through the formal market will also increase the mean number of cattle marketed through the formal market (Katchova & Miranda, 2004).

Using Equation **26,** a Truncated Regression Model was used to determine the proportion of cattle sold through the formal market **on condition that the producer had made use of the formal market to sell his/her cattle**. The data used for this analysis was obtained from the matrix V in Equation **2**, and the same procedures were followed as specified from Equations **5** to **12.** Only those cattle producers who claimed to have made use of the formal market were included in this analysis. The use of a two-step model allows different variables to influence the decision of whether or not to use the formal market, as well as the proportion of cattle sold through that market. A variable can also influence these decisions in the same or the opposite direction (Katchova & Miranda, 2004).

3.3.4 Is marketing behaviour a single decision or are there other factors influencing adoption and quantity decisions?

Within a one-decision-making framework, the log-likelihood for the Tobit Model consists of the probabilities of some farmers who had not sold any cattle through the formal market and a classical regression for the positive values of α_i

$$\ln L = \sum_{\alpha_i=0} \ln \Phi\left(-\frac{\beta'_\alpha \mathrm{X}_i}{\sigma}\right) + \sum_{\alpha_i>0} \ln\left[\frac{1}{\sigma}\phi\left(\frac{\alpha_i - \beta'_\alpha \mathrm{X}_i}{\sigma}\right)\right] \quad \textbf{(27)}$$

Katchova and Miranda (2004) revealed that Cragg relaxed the assumption that the same variables and the same parameter vector affect both the decision of whether or not to sell through the formal market and the decision on the proportion of cattle to be sold through that market. Following on the work of Katchova and Miranda (2004), a hurdle model was used in which a farmer makes a two-step decision:

$$P(c_i = 1) = \Phi(\gamma' \mathbf{z}_i) \quad \textbf{(28)}$$

If the "impediment" is crossed – that is, if the farmer has decided to sell through the formal market (c_i=1), a Truncated Regression (Equation **26)** describes his choice of how many cattle to sell through the formal market ($\alpha_i > 0$). The log-likelihood in Cragg's Model is a sum of the log-likelihood of the Probit Model (the first two terms) and the log-likelihood of the Truncated Regression Model (the second two terms),

$$\ln L = \sum_{c_i=0} \ln \Phi\left(-\gamma' \mathrm{Z}_i\right) + \sum_{\alpha_i>0} \left\{ \ln \Phi\left(\gamma' \mathrm{Z}_i\right) + \ln\left[\frac{1}{\sigma}\phi\left(\frac{\alpha_i - \beta'_\alpha \mathrm{X}_i}{\sigma}\right)\right] - \ln \Phi\left(\frac{\beta'_\alpha \mathrm{X}_i}{\sigma}\right) \right\} \quad \textbf{(29)}$$

Testing the more restrictive Tobit Model against the more general Cragg's Model, first and second conditions are stated as:

H_0: Tobit, with a log-likelihood function given in Equation **27**

H_1: Cragg's model (Probit and Truncated Regression estimated separately), with a log-likelihood function given in Equation **29**

Cragg's Model reduces to a Tobit Model if $\mathbf{Z}_i = \mathbf{X}_i$ and $\gamma = \beta_\alpha / \sigma$. Given the first condition, the second condition is a testable restriction. Therefore, the Tobit Model can be tested against Cragg's Model (**secondary objective 3)** by estimating a Probit, a Truncated Regression, and a Tobit Model with the same variable (X_i) and computing the following likelihood ratio statistic:

$$\lambda = 2(\ln L_{\text{Probit}} + \ln L_{\text{Truncated regression}} - \ln L_{\text{Tobit}}) \qquad \textbf{(30)}$$

where λ is a chi-square distribution with R degrees of freedom (R is the number of independent variables including a constant). The Tobit Model will be rejected in favour of Cragg's Model if λ exceeds the appropriate chi-square critical value.

3.3.5 Underlying structure of factors causing transaction costs

The **fourth secondary objective** of this study was to investigate the underlying structure causing transaction costs in the marketing behaviour of selling cattle through the formal market. The respondents interviewed were asked a number of questions with regard to transaction costs in order to determine the underlying structure of factors causing transaction costs in the use of the formal market. A factor analysis was performed to find and interpret the underlying structure. NCSS 1998 statistical software was used to identify common factors in the producers' personal perceptions of those things hindering them in the use of the formal market to sell their cattle.

Many statistical methods are only used to study the relation between independent and dependent variables. Factor analysis is different, as it is used to study the patterns of relationships among many dependent variables, with the goal of discovering something about the nature of the independent variables that affects them, even though those independent variables were not measured directly (DeCoster, 1998). This author identified two basic types of factor analysis, namely exploratory and confirmatory. Exploratory Factor Analysis (EFA) attempts to discover the nature of the collection influencing a set of responses, while Confirmatory Factor Analysis (CFA) tests whether a specified collection set is influencing responses in a predicted way.

Factor analyses are performed by examining the pattern of correlation (or covariance) between the observed measures. Measures that are highly correlated (either positively or negatively) are likely influenced by the same factors, while those that are relatively uncorrelated are likely influenced by different factors (DeCoster, 1998). According to Darlington (2004), the fewer factors influencing a measure, the simpler the theory; however, the more factors influencing a measure, the better the theory fits the data.

- **Measuring sampling adequacy**

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is an index used to examine the appropriateness of factors analysis. High values (between 0.5 and 1.0) indicate that factor analysis is appropriate, a value below 0.5 implies that factor analysis may not be appropriate. The KMO Measure of Sampling Adequacy (MSA) can be presented as:

$$\text{MSA (J)} = \frac{\sum_{k \neq j} r_{jk}^2}{\sum_{k \neq j} r_{jk}^2 + \sum_{k \neq j} q_{jk}^2} \qquad \textbf{(31)}$$

where MSA(J) is the measure of sampling adequacy for the *j*th variable, r_{jk} represents an element of the correlation matrix R, and q_{jk} represents an element of the anti-image correlation matrix Q, which is in turn defined by the equation $Q = SR^{-1}S$, where $S = (\text{diag } R^{-1})^{-1/2}$.

- **Number of factors to be included in factor analysis**

There are various methods which, by examining the data, can be used determine the optimal number of factors to be included. Parallel Analysis (PA) is one of the most highly recommended methods to deal with the problem of the number of factors to be retained, but is not available in commonly used statistical packages (Ledesma & Valero-Mora, 2007). The *Kaiser Criterion* determines that the number of factors used should be equal to the number of eigenvalues of the correlation matrix that are greater than one. Despite the simplicity of the *Kaiser Criterion*, many authors agree that it is problematic and inefficient when it comes to determining the number of factors (Ledesma & Valero-Mora, 2007); however; it remains the most popular method. The

Scree Test determines that the eigenvalues of the correlation matrix should be plotted in descending order and that the number of factors used should be equal to the number of eigenvalues that occur prior to the last major drop in eigenvalue magnitude (DeCoster, 1998). However, Ledesma and Valero-Mora (2007) noted that the Scree Test has a tendency to overestimate, and they concluded that given the existence of better methods, its use is not recommended.

- **Extracting the initial set of factors**

To extract the initial set of factors, correlations or covariances must be fed into a computer program. This step is too complex to reasonably be done by hand. There are a number of different extraction methods, including maximum likelihood, principal component, and principal axis extraction. Generally, the best method is maximum likelihood extraction, unless there is a serious lack of multivariate normality in the measures (DeCoster, 1998).

- **Rotating factors to a final solution**

To rotate factors to a final solution in any given set of correlations and number of factors, there are actually any infinite number of ways in which factors can be defined while still accounting for the same amount of covariance in the measures. By rotating factors, an attempt is made to find a factor solution that is equal to that obtained in the initial extraction, but which has the simplest interpretation.

There are many different types of rotation, but they all try to make each factor highly responsive to a small subset of the items. A rotation that requires the factors to remain uncorrelated is an *orthogonal* rotation, while others are *oblique* rotations (Darlington, 2004). The best orthogonal rotation is widely believed to be Varimax (DeCoster, 1998). This method rotates the axes to minimise the number of variables that have high loading on a factor. Only variables with a loading factor of 0.5 or greater are considered in interpreting each factor.

- **Communalities**

The *communality* of each observed variable is its estimated squared correlation with its own common portion – that is, the proportion of variance in that variable that is explained by the common factors. When performing factor analyses with several different values of *m*, as suggested above, it is found that the communalities general increase with *m* (Darlington, 2004). Low communalities are not interpreted as evidence that the data fails to fit the hypothesis, but merely as evidence that the variables analysed have little in common with one another.

- **Reliability analysis scale alpha**

This method randomly splits the data set into two. A score for each participant is then calculated based on each half of the scale. The correlation between the two halves is the statistic computed in the split-half method, with large correlations being a sign of reliability (Friel, 2006). *Cronbach's alpha* α_1 is the most common measure of scale reliability (Friel, 2006). A value of 0.7 – 0.8 is an acceptable value for *Cronbach's alpha*, while a value substantially lower indicates an unreliable scale.

Following Friel's lecture outlines; Cronbach's alpha is calculated by:

$$\alpha = \frac{(k)\left(\overline{\text{cov}} / \overline{\text{var}}\right)}{1+(k-1)\left(\overline{\text{cov}} / \overline{\text{var}}\right)} \qquad \textbf{(32)}$$

where :

k = The number of items in the scale

$\overline{\text{cov}}$ = The average covariance between pairs of items

$\overline{\text{var}}$ = The average variance of the items

If the scale items have been standardised:

$$\alpha = [(k)(\bar{r})]/[1+(k-1)(\bar{r})] \quad \textbf{(33)}$$

- **Interpretation of factor structure**

Each of the measures will be linearly related to each factor. The strength of this relationship is contained in the respective *factor loading*, produced by rotation. This loading can be interpreted as a standardised regression coefficient, regressing the factor on the measures.

This concludes the data and methodology chapter. Amongst the issues discussed in this chapter were questionnaire design and data collection procedures. In addition, this chapter included a description of hypothesised explanatory variables and the procedures and methods used to achieve the objectives of the study. The next chapter will discuss the results of the data gathered, using the methodologies described above.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

Chapter 4 is devoted to the research results and the discussion of the research findings. It is presented in four sections, namely findings on the factors influencing the producer's choice of whether or not to sell through the formal market; findings on the factors influencing the proportion of cattle marketed through the formal market in cases where the producer has decided to use such a market; results of the formal testing of whether it is sufficient to consider the analysis as a one-decision-making model or a two-decision-making model; and discussion of the investigation of the underlying structure of factors causing transaction costs.

4.2 Factors influencing the producer's choice of whether or not to sell through the formal market

A binary Probit Regression Model was used to determine the factors influencing the decision of whether or not to sell through the formal market (**secondary objective 1**). Due to the low number of cattle producers indicating that they had never sold their cattle through the formal market, a decision was subsequently made to assign a value of zero to those producers selling less than 20 % of their cattle through the formal market, and a value of one to those producers selling more than 20 % of their cattle through the formal market. Table 6 shows the results of the standardised coefficient of the Probit Model (Eviews 6) used to quantify the variables hypothesised to influence the decision of whether or not to sell through the formal market. It should be noted that the interpretation of the Probit coefficients differs from that of typical linear regressions (Bahta & Bauer, 2007). Greater manipulation is thus required in order to calculate the impact of the independent variables on the probability of the producer deciding to sell through the formal market (Bahta & Bauer, 2007). For purposes of this study, coefficients

were only interpreted according to the direction of their influence on the marketing behaviour of the cattle producers. The partial effects of individual variables were thus not calculated.

Table 6 can be interpreted as follows: (i) Firstly, we consider the probability value, which indicates the significance of the factor's influence on the marketing behaviour of cattle producers; (ii) Secondly, we consider the coefficient magnitude, which indicates the impact of the variable on the marketing behaviour of cattle producers, from the largest magnitude to the smallest; and (iii) Finally, we consider the coefficient and T-value sign, indicating the direction of the variable's influence on the marketing behaviour of cattle producers. Hence, the variables are interpreted in the following order: Firstly, **problems transporting cattle to MeatCo**, followed by **improved productivity**, then **accessibility of market-related information**, and **accessibility to information on new technology**. The remaining variables are interpreted in the same way. This means that if a variable is not significant up to 15 %, then it has no influence on the marketing behaviour of cattle producers in the NCR.

The model correctly predicted 84 % of the observations, which implies that the model is a good fit. The McFadden R-Squared value of 0.2790 indicates that the explanatory variables included in this study explains only about 28 % of the variation in the probability of the producer deciding to market at least 20 % of his cattle through the formal market. The small McFadden R-Squared value indicates that there are some other factors not considered in this model, which have a major influence on the decision of whether or not to sell through the formal market. The model Chi-Square statistic was also used as a measure of goodness of fit. The model chi-square statistic is the difference in the values of the two log-likelihood functions (i.e. the null model-**2** log-likelihood and the full model-**2** log-likelihood), which is 32.017. If the ***p*-value** for the overall model fit statistic is less than the conventional 0.05, then there is evidence that at least one of the independent variables contributes to the prediction of the outcome (Bahta & Bauer, 2007). The latter is true for the fitted model. The overall chi-square statistic is significant (***p*<0.05**), indicating that at least one of the parameters in the equation is non-zero.

Table 6: Regression results of Probit Model of factors influencing the probability of the producer deciding to use the formal market

Variable	Coefficient	Standard error	T-value	Probability
Constant	1.3488	0.2326	5.7982***	0.0000
Age	0.0147	0.0144	1.0226	0.3099
Experience	-0.0042	0.0166	-0.2519	0.8016
Lack of market experts	0.0974	0.1229	0.7929	0.4297
Market-related info	-0.3120	0.1339	-2.3298**	0.0218
Government-related info	-0.0302	0.0909	-0.3322	0.7404
Info on new technology	0.1873	0.1188	1.5766S	0.1181
Market uncertainty	-0.0099	0.1652	-0.0599	0.9524
Transport problems to MeatCo	-0.7808	0.4393	-1.7774*	0.0785
Transport costs	0.0017	0.0010	1.6609*	0.0999
Bargaining power of buyer	-0.0490	0.6599	-0.0742	0.9409
Payment arrangements	-0.0230	0.2735	-0.0839	0.9333
Price uncertainty	0.7545	0.5192	1.4533S	0.1493
Animal handling	-0.2697	0.3096	-0.8709	0.3859
Grading uncertainty	-0.2670	0.2218	-1.2038	0.2315
Improved productivity	-0.72353	0.429611	-1.6842*	0.0953
Credit access	0.0456	0.1243	0.3670	0.7144
Model summary				
No. of observations				121
% correct predictions				84%
McFadden R^{2a}				0.2790
Model chi-square[b]				32.017
Model significance				0.031
N sellers				99
N non-sellers				22

***, **, and * = 1 %, 5 %, and 10 % significance level respectively

S = Significant at 15 % level

[a] = McFadden R^2 is given by one minus the ratio of the unrestricted to restricted log-likelihood function value

[b] = The chi-square test evaluates the null hypothesis that all coefficients (not including the constant) are jointly zero

As can be seen from Table 6, only six variables are significant at 5 %, 10 % and 15 % level of significance. Two variables are significant at 15 %, but are included in the model because the intention is to identify those factors that have a significant influence on the decision of whether or not to sell to the formal market. Interestingly, two of the significant variables (transport costs and price uncertainty) have signs opposite to those expected.

It was not expected that **transport costs (p<0.10)** would have a positive sign on the decision to sell to the formal market, because, as discussed earlier, it was hypothesised that this variable would negatively influence the decision to sell to the formal market. Although the sign does not make economic sense, it may indicate that cattle producers may decide to sell to the formal market irrespective of whether or not the transport costs are high. Such a decision may become necessary in cases where the producers are obliged to sell their cattle to the formal market because they need the money. Other possible reasons that may have influenced the direction of **transport costs** could be aligned to the mode of transport used by most producers in the NCR, as different costs are associated with different modes of transport. This study has revealed that 60 % of the interviewed producers were driving their cattle on hoof to market (see Figure 5). A possible reason for this could be affordability, as it is cheaper for producers to drive their cattle on hoof.

Although **price uncertainty (p < 0.15)** was hypothesised to negatively affect the decision to sell to the formal market, the results indicate a positive influence, making it difficult to justify the influence of **price uncertainty** on the marketing behaviour of cattle producers in the NCR. Nonetheless, this may be an indication that cattle producers are not sensitive to the weight differences of their cattle, because marketing patterns are driven more by income needs than by price movements. This may be attributed to the limited access to resources, as producers typically do not own scales with which to weigh their animals before market. The differences in weight (animal's weight at the production area compared to its weight after delivery to the slaughtering plant) will therefore not influence the marketing decision, because the initial weight is unknown. According to the literature review, producers do not wish to see their cattle moving around the area after having been sold, and they may therefore opt for the formal market, where the animals are slaughtered a few days after delivery. Irrespective of price uncertainty, cattle producers are likely to sell their cattle to the formal market as long as this market honours their wish to not see their cattle moving around the area after having been sold. Moreover, it may be justified to state that due to uncertainty, producers may hope to receive high prices because they perceive their cattle to be in good condition – thus, the expectation of fetching high prices may mobilise the producers to sell their cattle to the formal market.

According to the magnitude of the standard coefficients relating to problems transporting cattle to MeatCo, improved productivity, accessibility to market-related information and accessibility to information on new technology, **problems transporting cattle to MeatCo (*p*<0.10**) is the variable with the most significant impact on the decision of whether or not to sell through the formal market. Prominent livestock production areas (cattle posts) are located far from the Oshakati abattoir, creating a situation where producers have to drive their cattle on hoof, trekking long distances over several days. This study found that some producers in Omusati and North-West of Oshikoto have to transport their animals over distances of more than 330 km. As a result, livestock often loses weight while being transported.

The situation is worsened by the poor road network from the livestock production area, as certain places cannot be accessed by trucks. Trucks often become stranded along the way, particularly during the rainy seasons. Most cattle posts are situated deep in the forests, with dense vegetation along single, narrow roads, fit for small vehicles only. In most cases, trucks become tangled in the hanging branches of trees along the road, causing massive damage to vehicles. Consequently, transportation costs are blatantly transferred onto the cattle producers.

Improved productivity (*p*< 0.10) is the second variable to have a significantly negative influence on the decision to sell through the formal market. It is very important to point out that **improved productivity** does not necessarily mean an increase in the number of animals. Rather, it refers to a situation where an increase in the number of animals can be attributed to improved quality and more desirable breeds of cattle being used for farming. This argument is based on the fact that producers may perceive large numbers of animals to be evidence of improved productivity. However, no matter how many animals the producer owns, if they are of poor quality they will not generate a good income, because productivity will be low.

Thus, lack of improved productivity among animals in the NCR is believed to discourage producers from selling through the formal market. A possible reason could be that producers have high expectations of receiving good returns when selling their cattle to the formal market, without considering the productivity value of their cattle. Consequently, after the cattle have

been slaughtered and graded, producers who receive a lower price than expected often feel deceived and become discouraged from supplying cattle to MeatCo.

In cases where improved productivity truly occurs, producers tend to retain their cattle, especially when they are healthy and with an attractive appearance. The attitude of retaining healthy and attractive animals is stimulated by the mindset of first marketing off the unhealthy and unattractive animals. Thus, improved productivity may make it more difficult to select cattle for marketing, leading to a situation where fewer or even no cattle are marketed. Improving feed rations and feed efficiency would lower costs, but would necessitate capacity-building in ancillary value chain functions, such as cattle nutrition practices and long-run investment in better feed resources. Consider, for example, a policy that seeks to induce a farmer to adopt a specific feeding regime pool so that all livestock production may be pooled and marketed together in order to improve market bargaining power for all producers.

Accessibility to market-related information ($p<0.05$) is another factor that significantly influences the decision of whether or not to sell cattle to the formal market. Lack of production- and marketing-related information has been revealed to be a major constraint that requires immediate attention in terms of the marketing behaviour of cattle producers in the NCR, because it results in producers being unable to make mainstream market-related decisions. Moreover, lack of information results in producers being unable to receive information for the purpose of adopting new and relevant technologies at the right time. There might be a number of financial schemes that are designed to benefit producers in a certain way; however, due to lack of information, producers know very little in terms of whether or not they are eligible for these funds and how they can access them. Sometimes the information only reaches them after the application deadlines have passed. Insufficient market information is common due to large numbers of small producers, inefficient communication systems, and a low level of literacy and information administration.

Market related-information may include any information type that will be relevant to the marketing of cattle in the area. This may include price, demand and supply (consumption and meat-trading patterns), slaughter date, transportation permits, as well as outbreaks of animal

diseases. Cattle producers do not have access to information on things like herd off-take and the carrying capacity of the available grazing areas. Even if such information is made available, there are still fears of incurring transaction costs in assimilating the supplied information in terms of understanding and interpreting the information to find the real meaning thereof. Thus, the provision of market information will strengthen producers' negotiating powers during transactions with buyers and will consequently prevent possible exploitation by better informed buyers. Furthermore, provision of market information would result in the opportunistic use of markets, allowing cattle producers to increase their wealth by buying when prices are low and selling when prices are high. This would also smooth consumption through conversion between livestock and cash, which is useful when it comes to solving their immediate needs.

Unlike the three factors discussed above, **accessibility to information on new technology ($p<0.15$)** has a positive influence on the decision to sell through the formal market. Information Technology (IT) can have a direct impact on transaction costs by reducing the cost and increasing the accuracy of product quality measurement. This may be evident in cattle productivity in terms of meat yield per investment unit (cow), as this varies substantially according to breed improvement, feeding regime and health status. Through the adoption of new livestock production technologies, producers are in a position to use medication to combat diseases and employ improved management practices, which leads to a reduced mortality rate and increased weight gain. Since cattle producers are confident of the quality of their cattle, they are motivated to sell them through the formal market, as they are confident that they will get a good return.

4.3 Factors influencing the proportion of cattle sold through the formal market in cases where the producer has decided to make use of that market

To achieve the second **secondary objective** of identifying factors influencing the proportion of cattle sold through the formal market in cases where the producer has decided to make use of that market, the Truncated Model was used. The results of the Truncated specification are presented in Table 7. Similar to the Probit Regression, the marginal effect of the independent

variables was not calculated. The coefficients were interpreted only on the basis of the direction of their influence on the dependent variable.

Table 7 can be interpreted in the same way as Table 6: Firstly, we consider the probability value, which indicates the significance of the factor's influence on the proportion of cattle sold through the formal market **on condition that the producer has decided to make use of that market**; Secondly, we consider the magnitude of the coefficient, which indicates the impact of the variable on the proportion of cattle marketed through the formal market **on condition that the producer has decided to make use of that market**; and finally we consider the coefficient and T-value sign, indicating the direction of the variable's influence on the proportion of cattle sold through the formal market **on condition that the producer has decided to make use of that market**.

Table 7: Regression results of Truncated Model on the proportion of cattle sold through the formal market on condition that the producer has decided to use that market

	Truncated estimators			
Variables	**Coefficient**	**Standard error**	**T-value**	**Probability**
Constant	0.3752	0.0170	22.0470***	0.0000
Age	0.0041	0.0014	2.9559***	0.0039
Experience	-0.0022	0.0014	-1.5597S	0.1219
Lack of market experts	-0.0199	0.0122	-1.6419S	0.1037
Market-related info	-0.0063	0.0144	-0.43517	0.6644
Government-related info	-0.0078	0.0097	-0.80718	0.4216
Info on new technology	-0.0259	0.0114	-2.2889**	0.0242
Market uncertainty	-0.0128	0.0154	-0.8271	0.4101
Transport problems to MeatCo	-0.0257	0.0391	-0.6566	0.5129
Transport costs	0.0001	0.0001	0.9866	0.3262
Buyer's bargaining power	-0.0336	0.5973	-0.5628	0.5749
Payment arrangements	0.0456	0.0261	1.7434*	0.0843
Price uncertainty	0.0053	0.0327	0.1632	0.8707
Animal handling	0.0451	0.0285	1.5823S	0.1167
Grading uncertainty	0.0049	0.0239	0.2022	0.8402
Improved productivity	-0.0507	0.0424	-1.1955	0.2347
Credit access	0.0047	0.0132	0.3584	0.7208
Model summary				
No. of observations				121
Sigma[a]				12.421*** (0.0126)
Log-likelihood				51.5469

***, **, and * = 1 %, 5 % and 10 % significance level respectively, and numbers in parentheses are standard errors

[s] = 15 % significance level
[a] = Represents the percentage variation in the dependent variable explained by the independent variables in the model

Based on the results shown in Table 7, six factors (**age**, **accessibility to new information technology**, **payment arrangements by MeatCo**, **experience**, **lack of market experts** and **animal handling**) have a significant influence on the proportion of cattle sold through the formal market.

There was no expectation that **marketing experience (p<0.15)** would have the opposite sign to that anticipated. Satisfaction with the experience of selling to the formal market determines the individual's interest in that particular marketing channel. The lower the level of satisfaction, the fewer cattle the producer will be willing to sell through that market channel. The way in which cattle producers view their farming businesses depends on their personal aspirations, objectives and goals. Thus, the producer's decision in respect of marketing is influenced by the relative importance they attach to their selling and producing roles.

The longer a cattle producer is engaged in agricultural activities, the more marketing experience he gains. This gives the producer adequate time to compare different marketing channels and establish a good bond with the channel that offers him the best price.

Given the standardised coefficients of the significant factors, **payment arrangements by MeatCo (p<0.10)** has a significant influence in encouraging cattle producers to sell a large proportion of their cattle through the formal market. MeatCo policy is to settle payment the day after the slaughtering date. Due to this rapid payment process, producers are encouraged to increase the proportion of cattle sold, as they are confident of receiving a lump sum of income shortly after their cattle have been slaughtered.

With regard to the influence of **animal handling (p<0.15)** on the proportion of cattle sold through the formal market, it appears that poor handling of their animals does not deter producers from selling their cattle to the formal market. Instead, it seems to encourage them to sell more animals to that market. This may be attributed to a number of reasons. Firstly, cattle

hides are of no value to the producers, as MeatCo does not grade hides and offal or compensate producers for them. Secondly, producers tend to dispose of their unattractive cattle first, and any animal showing bruises or symptoms of disease is likely to be sold before any others.

The next factor influencing the proportion of cattle sold through the formal market is **accessibility of information on new technology ($p<0.05$)**. The influence of this variable is negative, which implies that although new technology can help the producer to increase the number of animals as a herd, it does not necessarily help to increase the number of cattle with the same qualities. Thus, producers only choose the best quality cattle to sell through the formal market and discard the rest for home consumption or for selling to the informal markets, which have no specified quality requirements or grading procedures. Another possible reason could be that producers do not have access to the necessary technology to meet the quality demands of the market, or they may not have enough information on the type of qualities demanded by the market. For information on new technology to have any effect, it is a prerequisite that certain infrastructure must be put in place, which means that certain investment decisions must be made. Given the land tenure system in the NCR, some of the prearrangements made in terms of paving the way to the implementation of new technology will not be met, as producers are reluctant to invest in such land (state owned).

Another factor influencing the decision on the proportion of cattle to be sold through the formal market is **lack of market experts ($p<0.15$)**. As expected, the sign of this variable is negative. Market experts (advisors) are important in any market, as these are the people who study the market trends and patterns. They forecast the market in terms of demand and possible opportunities that are likely to arise in the market or related areas. Therefore, **lack of market experts** may have a lethal effect on the functionality of the entire marketing system if the stakeholders in the system are uninformed. Producers will typically be the most uninformed stakeholders, given their rate of digesting circulated market information (market signals). Producers lacking market information have a reduced ability to respond to the market requirements and catch up with improved technology, causing them to make ill-informed decisions, especially regarding the proportion of cattle to be sold through the formal market.

The inaccessibility of market experts indicates that cattle producers have no access to the most relevant information and they are likely to base their decisions on the outdated information they have available, or on the little marketing experience they have. Cattle producers who are not well advised, or who fail to consult market experts, continue to supply aged cattle on which they receive small returns according to the low grades of those animals. Such producers then tend to believe that the formal market is cheating them and they consequently reduce the proportion of cattle sold through the formal market. Lack of information thus prevents them from selling larger proportions of their cattle to the formal market.

The **age (p<0.01)** of the producer is the final factor that significantly influences the proportion of cattle sold through the formal market. As discussed earlier, there is a relationship between the age of the cattle producer and the size of the herd. Older cattle producers are likely to sell a large quantity of cattle at one time. In most cases, their herds are of a good breed (hybrid) and this encourages them to sell through the formal market, as they are confident that their cattle meet the quality attributes considered by buyers.

The results presented by the **Probit** and **Truncated** models indicate that different factors influence the market behaviour of cattle producers in different ways and at different levels. This strongly defends the second research hypothesis, namely "modelling market behaviour within the two-decision-making framework". The next section presents the formal results of testing whether it is sufficient to model the analysis as a one-decision-making model or as a two-decision-making model.

4.4 Formal testing of whether it is sufficient to model the analysis as a one-decision-making model or as a two-decision-making model

The Tobit Model imposes the restriction that the coefficients that determine the probability of being censored are the same as those that determine the conditional means of the uncensored observation. To test this restriction, a Likelihood Ratio (LR) test, comparing the Tobit to the unrestricted log-likelihood, that is the sum of a Probit and a Truncated Regression (Equation **30**), was carried out. The dependent variable of the Tobit is the proportion of cattle sold to the

formal market. Those producers who had never sold any cattle through the formal market were assigned a value of 0. The other producers were allocated a value equal to the proportion of cattle sold through the formal market.

The estimation results of the Probit, Truncated and Tobit specifications are presented in Table 8. Table 8 is not interpreted here, but rather the results of the three specified models are compared with one another to determine the feasibility of testing whether it is sufficient to model the analysis as a one-decision-making model or as a two-decision-making model.

From Table 8, the results of the different regression analyses can easily be compared. It is noted that some variables that are identified as significant factors [**accessibility of market-related information**, **animal handling**, and **improved productivity**] influencing the proportion of cattle in the Tobit Model are not significant in the Truncated Model. Similarly, **accessibility to information on new technology** and **payment arrangements by MeatCo** are significant in the Truncated Model specification, but insignificant in the Tobit Model. Besides being insignificant in the Tobit, **accessibility to information on new technology** is also observed to have an inconsistence sign.

The inconsistency in the significance of factors across alternative specifications prompted the researcher to consider testing the more restrictive Tobit Model against the more general Cragg's Model. The three models were estimated with the same variables, and the log-likelihood of the Tobit Model was compared to the sum of those in the Probit and the Truncated Regression models.

Table 8: Regression results for alternative model specifications when modelling cattle marketing behaviour

	Single Decision	Choice Decision	Quantity Decision
	Tobit	**Probit**	**Truncated**
Dependent variable	Proportion of cattle sold to formal market	Dummy = 1 if formal market used	Proportion of cattle sold to formal market
Variables	**Coefficient**	**Coefficient**	**Coefficient**
Constant	0.3894*** (0.0223)	1.3488*** (0.2326)	0.3755*** (0.0170)
Age	0.0056*** (0.0018)	0.0147 (0.0144)	0.0041*** (0.0014)
Marketing experience	0.0011 (0.0018)	-0.0042 (0.0166)	-0.0022S (0.0014)
Lack of market experts	0.0034 (0.0153)	0.0974 (0.1229)	-0.0199S (0.0122)
Market-related info	-0.0428** (0.0180)	-0.3119** (0.1339)	-0.0063 (0.0144)
Government-related info	0.0114 (0.0125)	-0.0302 (0.9091)	-0.0078 (0.0097)
New tech. information	0.0005 (0.0143)	0.1873S (0.1188)	-0.0259** (0.0114)
Market uncertainty	-0.0239 (0.0200)	-0.0099 (0.1652)	-0.0128 (0.0154)
Transport problems to MeatCo	-0.0084 (0.0497)	-0.7808* (0.4393)	-0.0257 (0.0391)
Transport costs	0.0001 (0.0001)	0.0017* (0.0010)	0.0001 (0.0001)
Buyer's bargaining power	0.0153 (0.0753)	-0.0489 (0.6599)	-0.0336 (0.5973)
Payment arrangements	0.0078 (0.0345)	-0.0229 (0.2735)	0.0456* (0.0261)
Price uncertainty	-0.0006 (0.0418)	0.7545S (0.5192)	0.0053 (0.0327)
Animal handling	0.0878** (0.0373)	-0.2697 (0.3096)	0.0451S (0.0285)
Grading uncertainty	0.0382 (0.0303)	-0.2670 (0.2218)	0.0049 (0.0239)
Improved productivity	-0.2108*** (0.0548)	-0.26701* (0.2218)	-0.0507 (0.0424)

Credit access	0.0062 (0.0169)	0.0456 (0.1243)	0.0047 (0.0132)
Model summary			
No. of observations	121	121	121
Sigma[a]	13.728*** (0.0175)		12.421*** (0.0126)
Log-likelihood	-19.913	-41.356	51.546
McFadden R^{2b}		0.2790	
Model chi-square[c]		32.017	
Model significance level		0.031	
LR test for Tobit vs. Truncated regression			60.2075[d] (0.0000)[e]

***, **, and * = 1 %, 5 % and 10 % significance level respectively and numbers in parentheses are standard errors

s = 15 % significance level

a R represents the percentage variation in the dependent variable explained by the independent variables in the model

b = McFadden R^2 is given by one minus the ratio of the unrestricted to restricted log-likelihood function value

c= The chi-square test evaluates the null hypothesis that all coefficients (not including the constant) are jointly zero

d = The likelihood ratio test is given by $\lambda = 2(\ln L_{Probit} + \ln L_{Truncated\ regression} - \ln L_{Tobit})$

e = Numbers in parentheses are associated with chi-square probabilities

The highly significant (***p*<0.000012**) log-likelihood test ratio of 60.21 strongly rejects the Tobit Model specification in favour of the more general Cragg's Model specification. This implies that the same personal and farm characteristics do not influence both the decision of whether or not to sell to the formal market and the decision on the proportion of cattle to be sold through the formal market in the same way through the restricted coefficients in the Tobit Model. For instance, in the Tobit Model, any variable that increases the probability of a non-zero value must also increase the mean of the positive values (Lin & Schmidt, 1983). Thus, modelling the proportion of cattle sold to the formal market within a one-decision-making framework will fail to identify the correct factor affecting the decision of whether or not to sell through the formal market.

Cragg's Model avoids both the above problems associated with the Tobit Model. A reasonably strong case can be made for it as a general alternative to the Tobit Model, for the analysis of data sets in which zero is a common (and meaningful) value of the dependent variable, and the non-zero observations are all positive. The distribution of such a dependent variable is characterised by the probability that it equals zero and by the (conditional) distribution of the positive observations, both of which Cragg's Model parameterises in a general way.

4.5 Investigation into the underlying structure of factors causing transaction costs

A factor analysis was conducted to reduce the dimensionality of producers' perceptions of the factors hindering frequent use of the formal market and the supply of large proportions of cattle to that market. As stated in Chapter 3, the first step when performing a factor analysis is to determine whether it is actually necessary. This is done by testing the adequacy with which the data can be sampled. In this study, the suitability of individual variables for use in the factor analysis was evaluated using the *Kaiser-Meyer-Olkin* (KMO) measure of sampling adequacy. The measure of sampling adequacy was determined by means of PASW Statistics 17. The KMO values of the final variables included in the factor analysis are presented in Table 9. From Table 9 it is clear that all of these variables scored a KMO value well over 0.5, with the lowest being 0.745. This indicates that the remaining individual variables "belong to the family" of the large group of variables, and a factor analysis could be performed on them.

Table 9: Results of the Kaiser-Meyer-Olkin measure of sampling adequacy

Variables	KMO value
Weight loss during quarantine period	**0.745**
Weight loss during transportation	**0.768**
Carcass/hide damage	**0.784**
Consideration of time of delivery	**0.934**
Consideration of place of delivery	**0.925**
Frequency of cattle sales	**0.784**
Number of cattle to market	**0.784**

- **Variables used in the factor analysis**

Weight loss during quarantine period is a variable indicating that loss of weight has a direct impact on the pricing of the carcass at the abattoir. This variable was included in the data collection, because the temporarily abolition of the cattle quarantining law was implemented within the 12 months prior to the date of data collection, and some of the interviewed respondents had experience of this. Moreover, there is a possibility that the system may be re-

implemented in light of the reopening of the South African market, which in the past has required cattle from the NCA to be quarantined for 21days before slaughter.

Weight loss during transportation indicates weight loss that occurs between the production area and the slaughter house. Weight loss occurs because most producers drive their cattle to market on hoof in order to avoid the high cost of using trucks. It may take several days to trek cattle (on hoof) from the production areas (cattle post) to Oshakati, and in the process cattle may become stressed, thus affecting the grading of the carcass. This has an impact on the pricing of the carcass, thus reducing the expected return.

Carcass/hide damage leads to a reduction in the selling price of cattle. Damage to the carcass or hide may happen as a result of poor handling of the animal in the production area or during transportation to the abattoir. Carcass/hide damage has a similar impact to weight loss on the selling price.

Consideration of time of delivery indicates that producers are obliged to deliver their cattle to the abattoirs only during working hours. Due to the long distances travelled and poor timing, this is an inconvenience to producers who are unable to meet the deadlines.

Consideration of place of delivery indicates that producers have to deliver their cattle to a single point. MeatCo's Oshakati abattoir is the only slaughterhouse formally recognised by the NCA as being permitted to serve more than four regions. A producer who is not familiar with the town of Oshakati may spend several hours searching for the abattoir.

Frequency of cattle sales indicates the number of times that producers are able to bring their cattle for sale. Faced with a low supply of cattle, MeatCo has devised a strategy to cut production costs by rationing slaughtering dates. Producers with large numbers of cattle ready for market find this to be problematic, since the next slaughtering date may be one or two weeks away. Producers who require an income urgently in order to solve an immediate problem may find themselves having to wait for the next slaughtering date. However, poor planning on the part of producers has also been also identified as a factor in this problem.

Number of cattle to market indicates that the number of cattle ready for market may be considered a transaction cost, especially for producers who arrange trucks to transport their

cattle to the abattoir. There is a higher cost involved in repeatedly marketing a small number of cattle than in marketing a large number of cattle at once.

- **Determining the number of factors**

The Principle Component Analysis was performed using an NCSS statistical package. The eigenvalue criteria were used to determine the number of factors to be specified in the factor analysis. Using the eigenvalue criteria, an eigenvalue of **1** was used as the cut-off value. Three principle components had eigenvalues greater than **1** and explained 100 % of the variance in all the respondents' personal reasons for not using the formal market to sell their cattle. This led to three factors being specified in the factor analysis.

Knowing the number of factors to be specified in the factor analysis will determine whether it is worth performing the factor analysis. The factor analysis is discussed below.

- **Factor analysis**

Varimax rotation was used to determine factor loading, because it is the best and most widely used *orthogonal rotation* that requires the factors to remain uncorrelated (Darlington, 2004; DeCoster, 1998). The factor loadings after Varimax rotation are presented in Table 10. This means that if a factor has loaded a value of more than ± 0.5 on more than one variable, then those variables will be grouped in one family group. Weight loss during quarantine period loaded -0.77 on Factor 1; weight loss during transportation loaded -0.78 on Factor 1; and carcass/hide damage loaded -0.79 on Factor 1, indicating that all three variables belong to the Factor 1 family (**discounting factors**). The rest were also grouped in the same way.

Factor loading represents the degree of correlation between individual variables and a given factor. Values range from **-1** to **+1** with a large absolute value indicating a stronger contribution of a variable to that factor. Within a factor, a positive loading indicates a direct association with the factor, while a negative loading indicates an inverse association (Ridho *et al.,* 2002).

Table 10: Factor loadings and communalities after Varimax rotation

	Factor 1	Factor 2	Factor 3
Variables	**Discounting Factors**	**Delivery Aspects**	**Market Features**
Weight loss during quarantine period	**-0.7706**	-0.1759	-0.0606
Weight loss during transportation	**-0.7847**	-0.0135	0.0486
Carcass/hide damage	**-0.7980**	-0.1103	0.1035
Consideration of time of delivery	-0.0740	**-0.9414**	-0.0028
Consideration of place of delivery	-0.1811	**-0.8906**	0.0676
Frequency of cattle sales	0.0295	0.1380	**-0.7519**
Number of cattle to market	0.0332	-0.0749	**-0.7175**

The variables **weight loss during quarantine period**, **weight loss during transportation**, and **carcass/hide damage** scored the highest factor loadings in Factor 1 with an eigenvalue of 1.89, explaining 39.86 % of the observed variance, as shown in Figure 8. This indicates that these three variables are grouped in Factor 1. Factor 1 can be explained as features that cause reduction in the selling price of cattle. Factor 1 is defined "**discounting factors**", which indicates the dissatisfaction of producers in selling their cattle through the formal market. Producers who have experienced the impact of **discounting factors** in the selling of their cattle become discouraged from using the formal market. A producer who has found that weight loss in his cattle during the quarantine period may have a negative influence on the selling price will fear that additional weight loss during transportation and carcass/hide damage to the cattle going to market will further reduce the returns from selling those cattle through the formal market. The formal market determines price depending on carcass weight, and an animal may be discounted if it has bruises; therefore, this transaction cost may be an impediment to the marketing behaviour of cattle producers.

Time of delivery and **place of delivery** scored the highest factor loadings in Factor 2 and are hence grouped into Factor 2, which has an eigenvalue of 1.75 and explains 36.91 % of the observed variance. Cattle producers who consider time of delivery to be an obstacle to the selling of cattle to the formal market are likely to believe that place of delivery is an additional

hindrance to the accessibility of that market. As the formal market only operates during official working hours, the long distances travelled by producers trekking cattle and delays along the way make it likely that producers will fail to reach MeatCo during working hours. Given only one delivery place, the producer has no alternative place to deliver his cattle and may thus be forced to overnight near Oshakati and tend to the cattle until they can be delivered on the next working day. Unfamiliarity with the surroundings may make producers uncomfortable and discourage them from selling their cattle through the formal market. Factor 2 is therefore defined as "**delivery aspects**".

Frequency of cattle sales and **number of cattle to market** scored the highest factor loadings in Factor 3. The frequency of sale at MeatCo may be inconvenient to a producer who has only a small number of cattle ready for market at that time, which makes arranging for truck transport unfeasible. Transaction costs, including the availability of loading facilities and the number of cattle to be marketed, will have an impact on the per-unit cost of moving the cattle from the production area to the slaughterhouse. MeatCo's slaughtering dates are scheduled at intervals of two to three months, meaning that a producer who missed the last slaughtering date has to wait two to three months before the next slaughtering date. Thus a producer who requires a constant income through the continuous marketing of a given number of cattle per month will be disappointed in the formal market. Factor 3 has an eigenvalue of 1.10 and explains 23.27 % of the observed variance, as presented in Figure 8. Factor 3 is defined as "**market features**".

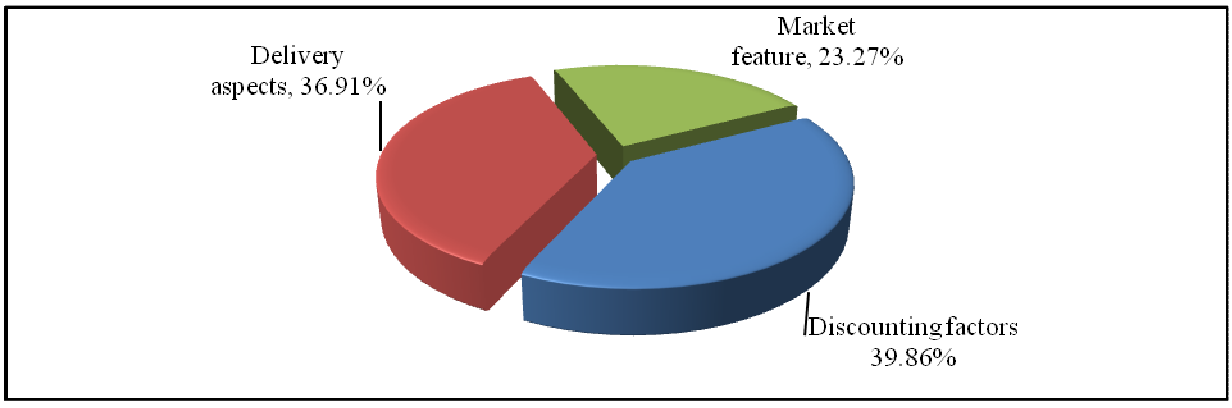

Figure 8: Percentage of observed variance based on eigenvalue

Following a factor analysis, the next step is to determine whether the variables included in the factor analysis explain a significant amount of the variation in the respective variables. Communalities are used to determine the variation in the respective variables.

- **Communalities**

Communalities are used as a measure of goodness of fit. From Table 11, it can be seen that all the variables are more than 0.5, which indicates that the factors explain more than 50 % of the variation in the variables.

Table 11: Communalities after Varimax rotation

	Factor 1	Factor 2	Factor 3	
Variables	**Discounting Factors**	**Delivery Aspects**	**Market Features**	**Commonality**
Weight loss during quarantine period	0.5938	0.0309	0.0037	**0.6284**
Weight loss during transportation	0.6158	0.0002	0.0024	**0.6184**
Carcass/hide damage	0.6368	0.0122	0.0107	**0.6597**
Consideration of time of delivery	0.0055	0.8862	0.0000	**0.8917**
Consideration of place of delivery	0.0328	0.7932	0.0046	**0.8306**
Frequency of cattle sales	0.0009	0.0190	0.5653	**0.5852**
Number of cattle to market	0.0011	0.0056	0.5149	**0.5216**

All these variables also contribute to well-defined factors, hence the values are not only high, they are also acceptable. Once there is certainty that all the variables that are included in the factor analysis contribute to well-defined factors, the factors explain the variation in the variables. Cronbach's alpha was used to test the level of internal consistency within each of the factors, as discussed below.

- **Reliability analysis scale alpha**

Cronbach's alpha was used to calculate the overall reliability of internal consistency. Using PASW Statistics 17 to compute the **average covariance between pairs of items** and the **average variance of the items,** Cronbach's alpha values were manually calculated using equation **32**. All three factors had a Cronbach's alpha value greater than 0.7. Factor **1** had a Cronbach's alpha value of **0.83**, Factor **2** a value of **0.93**, and Factor **3** a value of **0.71**. This is an indication that the internal consistency in all three factors is reliable and hence each item measures the same concept as the overall factor.

- **Interpreting factor structure**

The variables discussed in the factor analysis section investigated cattle producers' arguments and sensitivity in respect of the decision not to sell their cattle through the formal market. Contemplating these results signifies that producers believe that marketing cattle through the formal market involves many inconveniences, thus leading to high transaction costs. They consider carcass/hide damage and weight loss during transportation and quarantine periods as the main source of low returns on their cattle when sold through the formal market. Due to low returns perceived to be caused by weight loss and lack of compensation for hides and offal, producers abstain from using the formal market because they assume that the formal market is cheating them. Delivery aspects annoy producers who initially intended to market through the formal market. Lack of co-ordination and poor communication may cause producers to divert their marketing channel. For instance, let us assume that a producer has trekked his cattle over a long distance to deliver them to MeatCo on a Friday. If he encounters delays along the way and is therefore not able to reach his destination before closing time, he will only be attended to after the weekend. As a result, the producer will be forced to sell his cattle to the only available market – the informal market. The diversion of marketing channel applies the same scenario as market features.

These negative perceptions about the formal market contribute to the producers' decision not to use the formal market to sell their animals. Therefore it is important for all stakeholders in the

meat industry to work together in the effort to change the negative perceptions of producers towards the use of the formal market. Producers need to make well-informed marketing decisions that encourage a stable income generation. Thus, producers must be given incentives to make use of the formal market. A new mechanism is required to illustrate that if the producer is willing to properly organise his affairs and make careful preparations, he will find it more beneficial to sell his cattle to the formal market than to the informal market. Brilliant strategies must be formulated to educate producers in such a way that they will change their perceptions and be motivated to make use of the formal market. Producers must be informed about the economic importance of selling through the formal market, as this is a means of directly entering the economic mainstream. With the right knowledge, producers will be able to make more informed decisions about the tradeoffs between income and variability in income associated with production and marketing options.

This concludes the presentation and discussion of the results of the different models used to achieve the objectives of the study. In this chapter, the Probit Regression Model was used to determine the factors influencing the cattle producer's decision of whether or not to sell through the formal market. The Truncated Model was used to identify factors influencing the proportion of cattle sold through the formal market. The formal testing of whether it is sufficient to model the analysis as a one-decision-making model or as a two-decision-making model was done using Cragg's Model. An investigation into the underlying structure of factors causing transaction costs was conducted by performing factor analysis.

The conclusions drawn from this study and the recommendations for further research are presented in the next chapter.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides the conclusions and recommendations of this study, which saw 121 cattle producers surveyed to determine the effect of transaction costs on the choice of marketing channel in the North-Central Regions (NCR) of Namibia. This chapter contains the conclusions drawn on the different factors influencing the cattle producer's decision of whether or not to sell through the formal market, as well as the proportion of cattle sold to that market. Recommendations are made in view of improving the current situation, and possible topics for further research into the marketing of cattle in the NCR are presented.

5.2 Conclusions on the findings

The empirical results shed light on the factors influencing the cattle producer's decision of whether or not to sell his/her cattle through the formal market, which was the first secondary objective of the study. The Probit Model used to analyse this objective identified **problems transporting cattle to MeatCo** and **market-related information** as having a significantly negative impact on the decision to sell through the formal market. This indicates that transport problems and lack of access to information are the main sources of transaction costs hindering full participation of producers in the formal market. The results confirm the first hypothesis of the study, i.e. "**The producer's decision to sell his cattle through formal channels is significantly affected by high transaction costs**". Transport problems and lack of access to information are believed to originate from the production and infrastructural setup in the area. Many producers surveyed in the study area are constrained in their ability to make proper use of the marketing system. Lack of grazing land due to demarcation for crop production around the nearby towns forces cattle producers to separate cattle production from crop production areas. Cattle production areas (cattle posts) are consequently moved deeper into the forest in the

search for good grazing pastures and underground water sources. Cattle posts are difficult to access by truck due to the poor road network and lack of telecommunication infrastructure.

This study concludes that the provision of Information Technology (IT) would have a positive influence on the producer's decision to sell his cattle through the formal market. This indicates that the effective introduction of livestock technologies must be clearly understood by the producers if they are to improve feeding and management practices in order to uplift livestock production and take marketing to another level. The development of feasible technical options that address producers' priorities and a participatory extension system responsive to producers' needs is critical to enhance the knowledge of producers and win their trust so that they are at least willing to try the new technologies introduced. Producers should be provided with information about all feasible options and must be allowed to make an informed decision in adopting the innovations that best suit their farming systems. Such participatory extension systems must involve producer training, diagnosis of animal problems, planning of optional measures, and follow-up monitoring and support in partnership with producers.

The stakeholders in the meat industry, with the assistance of the government, are therefore called upon to intervene and assess the seriousness of the transportation problems that exist. A specialised agency to disseminate information and thereby keep producers updated could be introduced within the Directorate of Extension and Engineering Services (DEES) to ease the flow of information. Producers from the same production area should create marketing committees to co-ordinate and assist one another in various aspects concerning the production and marketing of cattle in general.

The second secondary objective was to identify factors influencing the proportion of cattle sold through the formal market **on condition that the producer has decided to make use of that market**. Lack of market experts and IT were identified as significant factors that negatively influence the proportion of cattle sold through the formal market. This indicates that if some "important elements" of a marketing system are lacking, it could lead to a lack of quality cattle supplied to the market. Lack of market experts means that producers are not equipped with updated information that will allow them to make the correct marketing decisions.

Payment arrangements, animal handling and age of the respondent were found to positively influence the decision on the proportion of cattle to be sold through the formal market. This indicates that cattle producers are satisfied with MeatCo's payment arrangements, thus influencing them to supply a larger percentage of cattle to the formal market. The respondent's age was found to positively influencing the proportion of cattle sold through the formal market, because there is a correlation between age and the number of cattle per herd, suggesting that the formal market seeks to provide digested information to older cattle producers who are believed to have larger herds of cattle and thus be able to supply a larger proportion of cattle at a time.

The different factors identified by the Truncated and Probit analyses indicate that different factors must be considered when opting to influence marketing behaviour, i.e. when producers are advised to sell their cattle through the formal market, and when they are advised on the proportion of cattle to be sold through that market.

The results from Cragg's Model justify the decision to model the analysis as a two-decision-making framework, as different factors were found to influence the decision of whether or not to sell through the formal market, as well as the decision on the proportion of cattle to be sold through that market. By assuming a one-decision-making framework, one runs a risk of failing to identify factors that influence the discrete and continuous making of decisions. Cragg's Model therefore provides clear recommendations on dealing with the two separate decision-making measures. The estimation of factors influencing the decision of whether or not to sell through the formal market, and a separate estimation of the factors influencing the decision on the proportion of cattle to be sold through that market, are useful for policymaking, as the government or other agency knows which factors to focus on when trying to influence producers to choose the formal market as their market of choice. Likewise, factors that should be considered when motivating producers to increase the proportion of cattle sold through the formal market are also identified.

Factor analysis specified three factors (**discounting factor**, **delivery aspects**, and **market features**) that are perceived to make up the underlying structure causing transaction costs. This indicates that if these factors are left unattended, producers will hardly ever change their

negative perception of the use of the formal market. Persistence of producers' negative perception of the formal market determines the future survival of MeatCo's Oshakati abattoir. Therefore, producers with transport problems should be assisted in that regard, while those with saltwater problems should be assisted with the drilling of boreholes, and those with road problems should be assisted with the opening up of such road through de-bushing.

To conserve the rangeland currently under pressure due to the increasing number of cattle in the communal areas, awareness of the importance of carrying capacity and the effects of overgrazing must be emphasised. Thus a campaign to mobilise producers to market their cattle must be considered. Awareness of the degradation of the natural pasture and the extinction of highly palatable and nutritive grass species, which results in the invasion of unpalatable shrub species in the limited available rangeland, should be carefully planned. The replacement of palatable grass species with unpalatable species has a direct effect on the reduction of the biomass of the natural pasture.

Finally, it is emphasised that the development of cattle production on communal land must focus on equipping producers to efficiently utilise their natural resources so as to produce livestock that can meet buyers' standards and thus achieve the objectives and goals of all stakeholders in the meat industry. In order to facilitate livestock marketing, cattle producers should be provided with information to enable them to make informed decisions on the marketing of their cattle.

5.3 Recommendations

Considering the results of this study and the conclusions drawn above, the following recommendations are made:

It is assumed that improving certain factors will remove or reduce the identified transaction costs and hence stimulate the choice of the formal market in the NCR.

- **Transportation of cattle to the abattoir**

Improving the transportation infrastructure to and from the production areas may go a long way towards boosting livestock marketing to the benefit of producers and towards poverty reduction. Transportation costs can be reduced if producers from one production area are well organised and make use of the same transport to market. By transporting in bulk they stand a better chance of getting good basic consent of economies of scale compared to transporting as individuals and in small quantities.

- **Strengthening producers' bargaining power**

Efforts are needed to increase cattle producers' bargaining power and specialisation in cattle farming. As producers become more specialised in beef cattle production, their bargaining power will increase when dealing with buyers (Gong *et al.*, 2007). Therefore, producers are encouraged to work collectively in the procurement of production inputs, managing all shared grazing land and infrastructure, obtaining all required production- and marketing-related information, and collectively marketing their livestock.

- **Accessibility of IT and market-related information**

The movement from traditional farming methods towards sustainable production techniques can generally be accomplished by the adoption of a combination of new technologies, which result in benefits such as less deterioration of rangeland pasture, less soil erosion, and lower water requirements (Dorfman, 1996). Hence, it is important to take a gradual approach to disseminating new technologies with substantial capacity-building support at field level to ensure their successful adoption, as well as marketing development and information support, development of private service providers in essential areas of livestock production, and marketing for sustainable and effective livestock development.

The diffusion of new and adapted technologies capable of generating technical and financial incentives is essential. The development of training programmes for producers to assist them in

improving their farm management skills, farming efficiency and the correct use and management of livestock veterinary technologies is hereby recommended. Information dissemination through producers' information days, printed media, radio programmes and road shows should be used to empower producers with knowledge, skills and appropriate techniques on cattle production and marketing behaviour. Educating cattle producers on the grading system will reduce transaction costs for some producers who feel cheated because they do not know how the grading system works.

- **Improving the quality and quantity of livestock**

Animal improvement programmes that supply good-quality breeding material should be easily accessible throughout the regions in question. Firstly, livestock research stations must be established in these regions. Secondly, cattle producers must be invited to participate in the animal improvement programmes on a voluntary basis to gain knowledge and experience. The programmes should be encouraging and well-synchronised to ensure equal opportunities for extensive benefits to all competent and interested cattle producers. Equally important are the accessibility of general economic and specific market information, promotion of marketing associations, participatory breeding, and regulation of contract production schemes between producers and buyers (processors).

- **Modification of cattle purchasing strategies**

There is an urgent need for the abattoirs to devise alternative strategies to ensure an adequate market supply of quality live cattle to meet their processing needs in order to improve their efficiency and competitiveness. Purchasing strategies may be used to gradually induce change in producer selling behaviour in terms of cattle sold and time and place of sale to suit the needs of the abattoirs.

A step towards improving the market supply of quality cattle is to understand the livestock producers' ownership patterns and marketing behaviour and the factors affecting this. Such information provides useful insights towards the designing and implementation of strategies to

alleviate the shortage of quality cattle in the market. In order to overcome these supply-related problems, the abattoirs should consider using contracts as an instrument for sustained delivery of adequate numbers of quality animals throughout the year. It is therefore recommended that abattoirs contract existing prominent cattle producers and cattle producers' co-operatives in the regions in question to deliver certain numbers of animals of a specific quality at specific intervals at pre-agreed attractive prices. By doing so, overall transaction costs may be reduced, because the cost of monitoring groups handling larger numbers of animals should be much lower than the cost of the time and effort required to locate, select and complete the transaction of only one or two animals from numerous different sellers at several markets.

- **Further research**

Further research should be done to determine the marginal probability of factors influencing the marketing behaviour of cattle producers in the NCR. This will ensure that factors with a significant influence are identified and attended to first. Moreover, this study recommends that a larger sample size be used in order to improve the reliability of the results and the ability to generalise the results. Similar studies should be conducted in other regions in order to compare the marketing behaviour of cattle producers in different regions.

An assessment of the technical factors affecting cattle productivity and production, the effectiveness of input supply, and credit and marketing support services is required to gain a comprehensive understanding of the cattle supply and marketing system. Therefore, a study should be conducted to investigate the cattle supply chain in order to provide information on the current operation of the chain and identify potential constraints to be alleviated and opportunities to be utilised.

Should Namibia resume its beef exports to the South African market, with requirements regarding the quarantining of cattle from the north of Namibia in place, the study suggests that an alternative system be used to permanently replace the quarantine system. Due to the rapid spread of foot-and-mouth disease (FMD) and serious economic consequences that can arise from an outbreak, fast and reliable diagnosis of FMD is essential for effective disease control

(Alamdari, Ghorashi, Ahmadi & Salehi-Tabar, 2006). Therefore, one should consider the use of rapid diagnostic tests for FMD. The use of infrared technology (IRT) is believed to detect elevated temperatures up to two days before cattle develop clinical signs (Alamdari *et al.*, 2006). This technique is cheaper, more effective and faster than the existing quarantine system. It could allow veterinarians to identify potentially infected cattle in large groups, without examining animals individually. The advantage of this system is that it enables veterinarians to concentrate their resources by quickly isolating animals that require further testing with a disease-specific method. This study recommends that a study be done to assess the economic viability of the use of infrared technology cameras in the Namibian context.

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Appendix A

Transaction costs and cattle farmers' choice of marketing channel in North-Central Namibia

The information revealed in this questionnaire will be treated with the highest order of confidentiality.

Thank you sincerely for your honest responses

Instruction: Fill in or tick (√) where applicable

Region:……...

Constituency:……..

Date: / / /2009

Time Started: / / /H/ / /

Time ended: / / /H/ / /

Section 1: Personal (biographical) details

(1.1) Respondent's name			
(1.2) Respondent's relationship to household head			**Code: 1= Household Head, 2 = Spouse, 3= Child, 4= Other Relative**
(1.3) Number of people in the household			**People**
(**1.4**) Gender of the respondent			**Code: 1 = Male, 2 = Female**
(1.5) Marital status		**Code: 1= Married, 2= Single, 3=Divorced/separated, 4= Living together, 5= Widow/widower, 6= Other**	
(1.6) Age of respondent			**Years**
(1.7) What is the occupation of the head of the household			
(**1.8**) What is the highest level of education the head of household has completed?			
(a) Primary school only			**Code: 1= Yes, 2 = No**
(b) Secondary school			**Code: 1= Yes, 2 = No**
(c) University degree			**Code: 1= Yes, 2 = No**
(d) Postgraduate training			**Code: 1= Yes, 2 = No**
(1.9) Number of years in this Village			**Years**

Section 2: Household assets and activities

(2.1) Please detail the percentage of income received from following activities:			
	% today	**% 1 years ago**	**% 5 years ago**
Livestock production			
Crop production			
Livestock trading			
Crop trading			
Off-farm employment			
Own business (non-farm)			
Remittances			
Other			

(2.2) For how many years have you been engaged in agricultural activities?		**Years**
(2.3) Do you have any training in farming activities?		**Code: 1= Yes, 2 = No**
If yes, (please specify)		
(2.4) Why are you in this business?		

(2.5) How many employees do you employ?				
	Number of employees		Monthly wage rate	Payments in kind
Full-time employees	Male			
	Female			
Part-time employees	Male			
	Female			
Family Labour	Male			
	Female			

(2.6) Please provide information on access to land and land use:			
Plot ID	**Size of each plot (ha)**	**Land ownership (code)**	**Current land use (for land used by household) (code)**
1			
2			
3			
4			
5			

Codes:

Land ownership: 1= Family owned, 2= Rent in (no payment), 3= Rent out (payment), 4= Rent in (payment), 5= Freehold title, 6= Communal land, 6= other

Land use: 1= idle/fallow, 2= Crop cultivation, 3= Livestock grazing/fodder/fodder trees, 3=Fruit trees/gardening, 4= other

(2.7) Do you own…		
Cattle		**Code: 1= Yes, 2 = No**
Sheep		**Code: 1= Yes, 2 = No**
Goats		**Code: 1= Yes, 2 = No**

(2.8) What breeds do you use?			
	Now	**5 years ago**	**reason for change (code)**
Cattle			
Sheep			
Goats			

Code: 1=Disease resistant, 2=Drought resistant, 3=Fertility, 4=Higher growth, 5=demanded by buyer, 6=Better mothering ability, 7=other

(2.9) Why do you keep livestock?						
				Own consumption		
	Draft power	Status	Selling of surplus	Normal	Religious reasons	Cultural/ traditional
Cattle						
Sheep						

Goats						

Code: 1 = Yes, 2= No

(2.10) Are you satisfied with buying arrangements for your livestock?		
Cattle		**1=Yes, 2=No**
Sheep		**1=Yes, 2=No**
Goats		**1=Yes, 2=No**

(2.11) Are you satisfied with selling arrangements for your livestock?		
Cattle		**1=Yes, 2=No**
Sheep		**1=Yes, 2=No**
Goats		**1=Yes, 2=No**

(2.12) Are you a member of an agricultural, farmer or other association or group?		
		1=Yes, 2=No
If Yes, Please specify the association:		

(2.13) What is your current breeding (growth/expansion) strategy?					
Increasing breeding herd		**Code: 1=Yes, 2=No**	Increasing surplus (offtake)		**Code: 1=Yes, 2=No**
Decreasing breeding herd		**Code: 1=Yes, 2=No**	Decreasing surplus (offtake)		**Code: 1=Yes, 2=No**
Keeping breeding herd stable		**Code: 1=Yes, 2=No**	Keeping surplus (offtake) stable		**Code: 1=Yes, 2=No**

(2.14) How do you identify your animals?				
	Cattle	**Sheep**	**Goats**	
Know them by name, looks or patterns				**Code: 1=Yes, 2=No**
Brand mark or tattoo				**Code: 1=Yes, 2=No**
Individual animal identification system				**Code: 1=Yes, 2=No**
Formal animal identification (traceability system)				**Code: 1=Yes, 2=No**

Section 3: Detail of livestock operations

(3.1) Please specify current inventories, purchases, sales, and inflows/outflows in the past 12 months									
	Stock this year	**This time last year (more/less)**	**Animals purchased in the last 12 months**	**Purchase price/animal**	**Animals sold in the past 12 months**	**Sales price/animal**	**Consumed at home in the last 12 months**	**Animals died in the past 12 months**	**Reason for losses (code)**
Cattle									
Adult female									
Young female									
Young males									
Breeding bulls									
Calves born in the last 12 months									
Castrated males									
TOTAL									
Sheep									
Adult female									
Young female									
Young males									
Breeding rams									
Lambs born in the last 12 months									
Castrated males									
TOTAL									
Goats									
Adult female									
Young female									
Young males									
Breeding rams									
Kids born in the last 12 months									
Castrated males									
TOTAL									
Code: 1=Disease, 2=Drought, 3=Theft, 4=Predators, 5=Don’t know, 9=Other									

Section 4: Livestock purchase and sales

(4.1) Please provide information on the livestock purchases and sales you made in the last 12 months

	Month of last purchase (1=Jan, 2=Feb … 12=Dec.)	Month of last sale (1=Jan, 2=Feb … 12=Dec.)	Most important month(1=Jan, 2=Feb … 12=Dec.13 All)		Approximate average weight of animal (kg)		Purchased from (code)	Sold to (code)	Where (code)		Form of payment (code)		Reason for (code)	
			Purchase	Sales	Purchase	Sales	Purchase	Sales	Purchase	Sales	Purchase	Sales	Purchase	Sales
Cattle														
Adult female														
Young female														
Bulls														
Castrated/other males														
Calves														
TOTAL														
Sheep														
Adult female														
Young female														
Breeding rams														
Castrated/other males														
Lambs														
TOTAL														
Goats														
Adult female														
Young female														
Breeding rams														
Castrated/other males														
Kids														
TOTAL														

Code: **Purchased from whom**: 1 = Smalholder farm, 2= Commercial farm, 3= Government farm, 4= Auction yard, 5= Village market, 6= Town/city market, 7 = others

Where sold: 1 = Smallholder farm, 2 = Village market, 3 = Local collection point, 4 =Informal slaughter facility, 5 =Oshakati abattoirs, 6 = Broker/trader, 7= Butchery, 8= Retailer, 9= Final consumer (live animals), 10= Final consumer (slaughtered animals), 11= others

Sold to whom: 1 = Other small-holders, 2 = MeatCo (Abattoirs), 3 = Informal slaughter market, 4 = Butchers, 5 = Others

Where purchased: 1=Farm gate, 2=Village market, 3=Parallel local sales pen,4=Local collection point, 5=Local business centre, 6= Local dip tank, 7= Regional auction yard, 8= Regional town, 9= Other

Form of payments: 1 = Contract, 2 = Spot cash payment, 3 = Loan, 4 = Exchange, 5 = Others

Reason for purchase: 1= Replace animal that died, 2= Increase herd size, 3=Breed improvement, 4= Resale before fattening, 5= Resale after fattening, 6= other

Reason for sale = 1 = Household expenses, 2 = Business, 3 = Culling, 4 = Social obligation,5=others

(4.2) Where do you obtain price information from?		
	Purchases	Sales
Cattle		
Sheep		
Goats		

Code: 1=Cell phone, 2=buyer/trader, 3=e-mail, 4=Announced by government, 5=Newspaper, 6=Radio, 7=TV, 8=Extension officer 9=Third party, 10=word of mouth

(4.3) On average, what percentage of your purchases/sales is made through the following channels?						
	Purchases			**Sales**		
	Cattle	Sheep	Goats	Cattle	Sheep	Goats
Smallholder farms						
Commercial farms						
Government farm						
Auction yard (uses auction sale)						
Village market (less than 20 animals/day)						
Town/city market						
Broker						
Informal slaughter facility						
Abattoir						
Butchery						
Retailer						
Final consumer/live animal						
Final consumer (slaughtered animal/meat)						
Other						

(4.4) How has your use of the channels in **Q4.3** changed in the last 5 years?						
	Purchases			**Sales**		
	Cattle	Sheep	Goats	Cattle	Sheep	Goats
Smallholder farms						
Commercial farms						
Government farm						
Auction yard (uses auction sale)						
Village market (less than 20 animals/day)						
Town/city market						
Broker						
Informal slaughter facility						
Abattoir						
Butchery						
Retailer						
Final consumer/live animal						
Final consumer (slaughtered animal/meat)						
Other						

(4.5) Who pays for transport costs at purchase/sales								
	Cattle		**Young cattle**		**Goats**		**Sheep**	
	Purchase	Sales	Purchase	Sales	Purchase	Sales	Purchase	Sales
To market								
From market								

Code: 1=Farmer, 2=Buyer, 3=Broker, 4=Other

(4.6) How much does transport cost?				
	Cows	**Young cattle**	**Goats**	**Sheep**
Cost to market (per animal)				
Distance to market (km)				
Other transport costs				

(4.7) What mode of transport is used to take animals to market?		
Cattle		**Code: 1=Truck, 2=smaller vehicle/car, 3=driven on hooves, 4=other**
Sheep		**Code: 1=Truck, 2=smaller vehicle/car, 3=driven on hooves, 4=other**
Goats		**Code: 1=Truck, 2=smaller vehicle/car, 3=driven on hooves, 4=other**

(4.8) Do you use a broker or middleman for purchases/sales	**Purchase**	**Sales**	
			1= Yes, 2 = No
If Yes, how much do you pay him/her per animal			
Cattle			**N$**
Sheep			**N$**
Goats			**N$**
(4.9) Do you use contracts to purchase/sell livestock?			
Cattle			**1= Yes, 2 = No**
Sheep			**1= Yes, 2 = No**
Goats			**1= Yes, 2 = No**
If No to all go to question **4.12**			

(4.10) If contracts are used, do they specify:				
	Purchase		**Sales**	
age		**1=Yes, 2=No**		**1=Yes, 2=No**
sex		**1=Yes, 2=No**		**1=Yes, 2=No**
breed		**1=Yes, 2=No**		**1=Yes, 2=No**
weight (measured)		**1=Yes, 2=No**		**1=Yes, 2=No**
weight (apparent)		**1=Yes, 2=No**		**1=Yes, 2=No**
condition of animal		**1=Yes, 2=No**		**1=Yes, 2=No**
free of disease		**1=Yes, 2=No**		**1=Yes, 2=No**
specified use of feed or medicine		**1=Yes, 2=No**		**1=Yes, 2=No**
pelt condition		**1=Yes, 2=No**		**1=Yes, 2=No**
pelt colour		**1=Yes, 2=No**		**1=Yes, 2=No**
time of delivery		**1=Yes, 2=No**		**1=Yes, 2=No**
place of delivery		**1=Yes, 2=No**		**1=Yes, 2=No**
advance payment		**1=Yes, 2=No**		**1=Yes, 2=No**

(4.11) If contracts are used, what proportion of purchases/sales is made with them?		
	Purchase	**Sales**
Cattle		
Sheep		
Goats		

Code: 1=0-25% 2=25%-50%, 3=50-75%, 4=75%-99%, 5=All purchases

(4. 12) Rate the quality attributes buyers look for:		
Age		**1=never, 2=sometimes, 3=always**
Sex		**1=never, 2=sometimes, 3=always**
Breed		**1=never, 2=sometimes, 3=always**
Weight (measured)		**1=never, 2=sometimes, 3=always**
Weight (apparent)		**1=never, 2=sometimes, 3=always**
Condition of animal		**1=never, 2=sometimes, 3=always**
Free of disease		**1=never, 2=sometimes, 3=always**
Specified use of feed or medicine		**1=never, 2=sometimes, 3=always**
Pelt condition		**1=never, 2=sometimes, 3=always**
Pelt colour		**1=never, 2=sometimes, 3=always**
Time of delivery		**1=never, 2=sometimes, 3=always**
Place of delivery		**1=never, 2=sometimes, 3=always**
Advance payment		**1=never, 2=sometimes, 3=always**

(4.13) For animals slaughtered at home, what is done with byproducts?	
	Channel
Offals	
Hides	
Others	

Code=1 Kept; 2=Sold to trader, 3=Sold to processor, 4=throw away

Section 5: Costs of production

(5.1) Please detail the different costs of production incurred by livestock operations:					
Production input costs	**Physical units**	**Where purchased (code)**	**Who paid for this (code)**	**Total cost**	**Time linked to total cost (code)**
Feeding expenses					
Animal health					
Labour costs					
Electricity					
Land costs (rental)					
Housing costs (rental)					
Spares					
Water cost					
Fuel cost					
Other					

Code: **Where purchased** 1=local general store, 2=farmers cooperative, 3=local veterinary, 9=other
Who paid for this1=yourself (cash), 2=yourself (credit), 3=Government, 9=other
Time linked to total cost 1=Day, 2=week, 3=month, 4=year

Section 6: Infrastructure

(6.1) Rate quality/availability of the following :		
Fences		**Code: 1=poor, 9=very good**
Animal handling facilities		**Code: 1=poor, 9=very good**
Water sources		**Code: 1=poor, 9=very good**
Buildings/sheds		**Code: 1=poor, 9=very good**
Vehicles		**Code: 1=poor, 9=very good**
Machinery and other equipment		**Code: 1=poor, 9=very good**
Animal feeding facilities and equipment		**Code: 1=poor, 9=very good**

Section 7: Miscellaneous information

(7.1) Sources and reliability of information:		
Type	**Main sources (code)**	**Reliability of source (code)**
Production practices		
Input use		
Animal health issues		
Markets (physical)		
Price		
Product standards		
Traceability		
Risk management		

Code: Main source:1=Extension officer, 2=Veterinary officer, 3= Newspaper, 4=word of mouth, 5=Third party, 6= None,7=other
Reliability source: rank 1=not reliable. 9=very reliable

7.2) How has your livestock business changed over the last 5 years	**1 = Yes, 2=No**
More animals in herd/flock	
Higher productivity of animals	
Greater use of technology (breeding, AI, etc)	
Diversification of herd (raising of other types of animals	
Diversification of business activities (raising feed, slaughter for business purposes)	
Specialization of livestock activities (e.g., breeding for larger farmers)	
Other	

Constraints

(7.3) Rank the following constraints in order of importance:		
Variability in prices		**Code: 1=most important, 5=least important**
Low productivity levels		**Code: 1=most important, 5=least important**
Access to markets		**Code: 1=most important, 5=least important**
Access to credit		**Code: 1=most important, 5=least important**
Access to inputs		**Code: 1=most important, 5=least important**
Access to information		**Code: 1=most important, 5=least important**

Risks

(7.4) Rank the following risk factors in order of importance:		
Climate		**Code: 1=most important, 5=least important**
Disease		**Code: 1=most important, 5=least important**
Availability of inputs		**Code: 1=most important, 5=least important**
Non-payment		**Code: 1=most important, 5=least important**
Theft/corruption		**Code: 1=most important, 5=least important**
Predation		**Code: 1=most important, 5=least important**

Preferred market

(**7.5**) What is your preferred marketing channel regarding the marketing of cattle?		
(a) MeatCo		**Code: 1= Yes, 2 = No**
(b) Informal market		**Code: 1= Yes, 2 = No**
(c) Sell to other farmers		**Code: 1= Yes, 2 = No**
(d) Self slaughtering and sell meat		**Code: 1= Yes, 2 = No**
(e) Others (please specify)		
(7.6) Why do you prefer that marketing channel chosen in the previous question **(Q 7.5)**?		
(a) Better price		**Code: 1= Yes, 2 = No**
(b) Easy to access		**Code: 1= Yes, 2 = No**
(c) Can sell many cattle at once		**Code: 1= Yes, 2 = No**
(d) Others (please specify)		

Information Cost

(7.7) How do you rate the marketing of cattle in this area regarding:		
(a) Frequency of sale		**Code:**1= **Very poor**,5= **Very good**
(b) Quantity of cattle marketed		**Code:**1= **Very poor**,5= **Very good**
(c) Quality of cattle marketed		**Code:**1= **Very poor**,5= **Very good**
(d) Availability of marketing infrastructure		**Code:**1= **Very poor**,5= **Very good**
(e) Marketing experts (advisor) / Extension officers		**Code:**1= **Very poor**,5= **Very good**

(7.8) By rating describe how easy / difficult it is to obtain the following information.		
(a) Price information		**Code: 1 = Very easy – 5 = Very difficult**
(b) Market related information (Auction date)		**Code: 1 = Very easy – 5 = Very difficult**
(c) Government related information		**Code: 1 = Very easy – 5 = Very difficult**
(d) New technology		**Code: 1 = Very easy – 5 = Very difficult**

Negotiation Cost

(7.9) Is there a payment delay with the following marketing channels?		
(a) MeatCo		**Code: 1=never, 2=sometimes, 3=always**
(b) Informal market		**Code: 1=never, 2=sometimes, 3=always**
(c) Sell to other farmers		**Code: 1=never, 2=sometimes, 3=always**
(e) Others (Please specify)		

(7.10) Do you have bargaining power to influence the selling price when selling to:?		
(a) MeatCo		**Code: 1=never, 2=sometimes, 3=always**
(b) Informal market		**Code: 1=never, 2=sometimes, 3=always**
(c) Sell to other farmers		**Code: 1=never, 2=sometimes, 3=always**
(e) Others (Please specify)		

(7.13) Do you use a broker or middleman and contract to market your cattle?		
(a) Broker or middle-man		**Code: 1= Yes, 2 = No**
(b) Contract		**Code: 1= Yes, 2 = No**

(7.14) Is it a problem to transport cattle to?		
(a) MeatCo abattoir		**Code: 1= Yes, 2 = No**
(b) Informal market / Open market		**Code: 1= Yes, 2 = No**

(7.15) How far are the following points from your cattle post?		
(a) Nearest quarantine camp		**km**
(b) Oshakati abattoirs		**km**
(c) Nearest open market		**km**
(d) Local sale pen		**km**

(7.16) Percentage of household income from cattle marketing?	
	Code: 1 = < 30%, **2** = 30-59%, **3** = 60-79%, **4** = > 80%

(7.17) How do you rate the grazing condition of this area?	
	Code:1= **Very poor**,5= **Very good**

Monitoring Cost

(7.18) Have you experienced problems associated with:		
(a) Weight loss during quarantine period		**Code: 1=never, 2=sometimes, 3=always**
(b) Weight loss during transportation		**Code: 1=never, 2=sometimes, 3=always**
(c) Carcass/hide damage due to poor animals handling		**Code: 1=never, 2=sometimes, 3=always**
(d) Incorrect/bad grading of cattle by MeatCo		**Code: 1=never, 2=sometimes, 3=always**

(7.19) With own opinion what can be done to ensure a better market price for cattle in this area?
(7.20) What do you want the government to do, to ensure that producers are satisfied with the prices they receive for their cattle?
(7.21) You are welcome to raise any comment regarding the marketing of cattle in NCR

Thank you!!

Appendix B

Correlation Coefficient t-values. Bold values indicate statistical significance at the specified level.
Significance 95% t-critical 1.98

	AGE	EXPERIENCE	TRANSCOST	GRDEUNCETY	RQABTD	RQABPD	IMPRODUCTY	MRKUNCETY	CREDACCES	MRKEXP	MRKINF	GOVINF	NEWTECH	PAYMENT	BUYERPOWER	PTRNSPMEATC	PWLQP	PRICEUNCETY	HANDLING
AGE	1	**7.51**	1.01	1.53	0.64	0.97	1.36	0.70	0.03	0.13	1.65	1.91	0.49	1.17	0.66	0.01	0.26	0.01	0.79
EXPERIENCE		1	0.06	0.61	1.06	0.72	0.18	0.28	1.07	0.54	0.04	1.64	1.02	1.86	0.64	0.10	0.07	0.49	0.08
TRANSCOST			1	0.60	1.49	**2.14**	0.26	0.91	**2.81**	0.65	1.18	0.28	1.22	**3.64**	**3.94**	0.17	1.06	1.24	0.41
GRDEUNCETY				1	1.16	1.20	0.84	0.73	0.53	1.22	1.08	**2.96**	0.47	0.57	0.89	0.13	0.90	0.49	0.96
RQABTD					1	**18.03**	0.67	0.85	0.98	1.02	0.11	1.59	0.60	**2.42**	0.48	1.46	**2.13**	0.24	1.53
RQABPD						1	1.52	1.22	0.14	0.17	0.63	1.13	1.13	**2.34**	0.12	**1.32**	**2.83**	1.76	1.77
IMPRODUCTY							1	**3.59**	1.04	0.26	0.77	0.96	**3.15**	**2.48**	1.19	**2.69**	1.32	**2.24**	**2.73**
MRKUNCETY								1	**2.26**	1.56	1.09	0.37	0.61	**0.81**	0.03	**3.41**	0.10	0.63	0.02
CREDACCES									1	**2.00**	0.14	1.59	0.11	**2.44**	0.51	0.21	0.59	0.03	0.35
MRKEXP										1	**2.93**	**3.27**	**3.23**	0.36	1.16	0.37	0.69	0.78	0.99
MRKINF											1	**4.73**	1.46	0.85	**2.41**	0.37	**2.01**	1.26	0.68
GOVINF												1	**5.51**	**3.16**	**2.04**	0.53	0.07	1.34	0.93
NEWTECH													1	1.08	**3.37**	1.48	1.09	0.14	0.31
PAYMENT														1	0.99	1.35	0.88	1.70	1.09
BUYERPOWER															1	1.00	0.30	0.19	0.16
PTRNSPMEATC																1	1.45	1.02	0.42
PWLQP																	1	**8.11**	**8.29**
PRICEUNCETY																		1	**9.09**
HANDLING																			1

Transaction costs and cattle farmers' choice of marketing channel in North-Central Namibia

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Submitted in partial fulfillment of the
Requirements for the degree of

Master of Science in Agriculture

(Agricultural Economics)

In the

Department of Agricultural Economics
Faculty of Natural and Agricultural Sciences
University of the Free State
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December 2009