DETERMINANTS OF CATTLE OWNERSHIP AND HERD SIZE IN VHEMBE DISTRICT OF SOUTH AFRICA: A TOBIT APPROACH

By

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DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo, for the degree of Master of Agricultural Management has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

_____ 04 March 2015

Surname, Initial(s) **Date**

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ABSTRACT

Livestock production particularly cattle production is a major component of Southern African rural agriculture with a population of some 14.1 million cattle. Cattle occupy a unique role in human livelihoods and they are raised for meat, milk, and as draft animals for pulling carts and plows. Cattle farmers in communal areas are rational in the ways in which they use and manage their herds, and economic benefits are contributory drivers of their behaviour. The title of the study was the determinants of cattle ownership and herd size in Vhembe District of Limpopo Province, South Africa. The study had two objectives; firstly, to determine the socio-economic factors affecting the household decision to keep cattle and secondly, to analyse the determinants of herd size in livestock keeping households. The study was conducted in Mutale Local Municipality located in Vhembe District of Limpopo Province in South Africa. The study employed a sample of 185 small scale farmers from five villages covering about 5% of each village's population. The statistical programme used to analyse the data was STATA 2010. For empirical analysis, the study used three analytical techniques namely: the logistic regression model, the OLS model and the Heckman selection model. Empirical results revealed that nine variables were significant in determining the probability of a household to own cattle namely; gender of household head, marital status of household head, age of the household head, household total size, benefits from livestock, previous cattle ownership in the family, homestead category, other income source and also the land area . Most of the variables that explained the decision of a household to keep cattle were also associated with explaining the decision of a household to keep a given number of cattle. Based on the findings of this study, several policy recommendations were proposed, namely; encouragement of youth participation in agriculture, promotion of gender equality and improvement of women's consideration in decision-making processes in agricultural production, provision and conservation of agricultural grazing land and livestock infrastructural development. Additional policy recommendations were; intensification of the cattle input support schemes (feed, water and disease control), incentives for cattle farmers to consider farming as a business than just a cultural norm, provision of job opportunities in homelands and provision of livestock production institutions.

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LIST OF ABBREVIATIONS

Abbreviation	
CSC	Cold Storage Commission
FAO	Food and Agriculture Organisation
IFAD	International Fund for Agricultural Development
HIV	Human Immunodeficiency Virus
TFS	Teso Farming System
ILRI	International Livestock Research Institute
OLS	Ordinary Least Square
GOF	Goodness Of Fit
SDF	Spatial Development Framework
PGDS	Provincial Growth and Development Strategy
USAID	United States Agency for International Development
FANRPAN	Food Agriculture and Natural Resources Policy Analysis Network

CHAPTER 1

INTRODUCTION

1.1 Introduction and background

Livestock in South Africa, as in other developing countries, could be one of the most important sources of livelihoods for the poor. Livestock is estimated to contribute to livelihoods of at least 70% of the world's poor (Ngqangweni, 2000). For households affected by poverty, livestock products remain one of the few rapidly growing markets within the agricultural sector that bring support to income earning opportunities. It has also been shown elsewhere that the poor earn a higher income from livestock than the wealthy (Delgado *et al.,* 1999). Cattle occupy a unique role in human livelihoods and they are raised for meat, milk, and as draught animals for pulling carts and ploughs. Other cattle products include leather and dung for manure or fuel.

Cattle production is the most important livestock subsector in South Africa. It contributes about 25-30% to the total agricultural output per annum. Cattle meet the multiple objectives that are desired by resource-poor farmers. These include provision of draught power, manure, cash sales, among other socio-economic functions (Shackleton *et al.,* 1999; Dovie *et al.,* 2006). Erratic rainfall and high incidence of droughts in most communal areas of South Africa influence the majority of the resource-poor farmers to depend on livestock for their livelihoods. Livestock farming has great potential to alleviate household food insecurity and poverty in communal areas of South Africa.

Livestock production is a major component of South Africa rural agriculture with a population of some 14.1 million cattle (Ainslie *et al*., 2002). Limpopo province is primarily a beef producing area with extensive ranching conditions. The hot and sometimes arid bushveld conditions that prevail in most of the western and northern areas make Limpopo province more suitable for livestock production than extensive crop production (Ainslie *et al*., 2002; Reijnjtes *et al*., 1992).

In South Africa as a whole, the output of livestock commodities (milk, eggs, meat, skins etc.) account for 25% of the national agricultural domestic products. A study conducted in 2002 (GOSA-Stats, 2002) found that 17,6% of farming operations in the Limpopo Province kept beef cattle, 0,7% kept dairy cattle, 2,9% kept donkeys, 22,7% kept goats, 6,1% kept pigs and 33,8% kept poultry.

For many small-scale farmers, livestock also represent a form of capital that is easily converted into cash (Rocha *et al.,* 1991). The presence of cattle in the village or community also benefit the non cattle owners in various forms such as; transactions between households in the form of bride-wealth payments, loaning of animals, cooperative ploughing arrangements, manure, meat and milk sharing; thereby extending the benefits of cattle to many more households. Thus overall, cattle continue to have an important role in the community (Campbell *et al.,* 1998; Crookes, 2003).

Household or individual decisions to keep cattle and their herd size may be influenced by many factors that vary across time and space. Such factors include culture, the bio-physical environment, farmer management practices and household socio-economic characteristics. Understanding of these factors is essential in rural development planning and implementation of strategies to improve agriculture. The priorities for owning cattle and their herd sizes may also change over time according to changes in livelihood strategies, household income, stage of the household development cycle, or in relationship to drought cycles (Barrett, 1992). For instance; following a drought period the main objective may be herd building and owners may invest in purchasing animals. Any kind of off-take will be negligible and the amount of draught hours worked per animal will be high. However, as the herd grows, slaughtering and cash sales are likely to increase in frequency and importance and the number of draught hours per animal will decrease (Campbell *et al.,* 1998).

Cattle farmers in communal areas are rational in the ways in which they use and manage their herds and economic benefits are contributory drivers of behaviour (Barrett, 1992; Ainslie, *et al.,* 2002). The primary objectives of herd

owners are thus to maximise the yield of consumable products for the household, as well as increase the size of the household's investment portfolio or number of animals for savings, security and emergency cash purposes (Tapson, 1991).

Small scale cattle farmers in developing countries have low participation in the formal markets (FAO, 2009). The reasons for no or low participation are many and include, small herd sizes, low fertility coupled with high mortality, therefore herd growth is small and slow. A large proportion of the animals sold are also of such age and body condition that many of them are unlikely to meet the needs of formal markets and meat export abattoirs (FAO, 2009). Moreover, livestock remains an investment option for saving and store of wealth and price responsiveness is not very high which also limit market supply and off-take. Under such conditions, small-scale farmers and pastoral livestock production systems are unlikely to provide regular and adequate supply of quality live animals to the formal market.

In order to provide a strong livestock economy in rural areas that would provide trickle down benefits to the rural farmers, there are factors that should be explored which have an influence on the total herd size that a farmer keeps as well as factors that influence the decision to keep cattle by household. There is a need to document such information so as to improve productivity by cattle farmers whilst improving the number of cattle that a farmer keeps.

1.2 Problem statement

South Africa has approximately 14.1 million cattle with over two-thirds found in communal areas. The Limpopo Department of Agriculture has identified livestock as an important driver of rural development, and has focussed on development of livestock marketing and production infrastructure (Stroebel *et al.,* 2008). Despite such development, off-take rates based on formal sales in rural South Africa remain low at less than 8% per annum (Ainslie *et al.,* 2002; Stroebel *et al.*, 2008).

Although the role of cattle in rural livelihoods is widely accepted, not all households in rural areas own cattle and household herd sizes vary widely (Shackleton *et al.,* 2005). There is also conflicting literature about why farmers own cattle and why herd sizes are too small or too large in rural areas (Shackleton *et al.,* 2005). In order to understand the factors influencing household decisions to keep and sell cattle, it is imperative to analyse the livelihood options and characteristics of the farmers in relation to livestock keeping. Within the South African context, cattle keeping may be said to be linked to the livestock support program and the socio-economic environment of the cattle keepers, yet it has never been clearly investigated and recommended.

The factors that influence a farmer's choice to own cattle or the size of the herd are still poorly understood (Delgado *et al.,* 1999; Ainslie, 2005). As a result policies may be targeted at irrelevant groups of people, or solving perceived rather than real problems, resulting in a waste of potential and expensive resources. In South African rural areas, it is not well documented which category of rural people are likely to be owners of cattle. The categories of rural people vary with regard to the age, education, asset possession and employment opportunities. Such information which could help policy makers is not readily available. Furthermore, the dynamic nature of the rural economy necessitates that up to date information is available. There is a need to fill this information gap to facilitate more targeted policy responses and improve the understanding of the role of cattle in rural livelihoods.

1.3 Aim of the study

The aim of the study was to find the determinants of cattle ownership and herd size in Vhembe District of Limpopo Province.

1.4 Objectives of the study

The objectives of the study were;

i. To describe the characteristics of farmers in the Limpopo province.
ii. To describe livestock keeping systems in the Limpopo Province.

iii. To determine the socio-economic factors affecting households' decision to keep cattle.
iv. To analyse the determinants of herd size in cattle keeping households.
v. To suggest livelihoods improvement policies based on cattle production.

1.5 Hypotheses of the study

The study was guided by the following hypotheses;

i. There are no significant socio-economic factors influencing household decisions to keep cattle in Limpopo Province.
ii. There are no significant socio-economic determinants of cattle herd size in cattle owning households in Limpopo Province.

1.6 Motivation for the study

Livestock directly aids livelihoods of the world's most vulnerable and marginalized citizens. Livestock can contribute towards addressing problems of limited income earning opportunities, shrinking job markets and extreme poverty prevalent in rural South Africa. Keeping cattle for economic reasons could lead to the increased herd size, improved returns or incomes from small scale cattle farming and rural household food security.

It is imperative to obtain information on the factors that influence a farmer's choice to own cattle and the herd size for better understanding of the circumstance and plausible formulation of appropriate and effective supporting agricultural policies. Well-formulated policies can remove doubts on actual problems and improve livestock productivity, promote positive attitudes among cattle owners and non owners within a particular community and also lower the herd mortality rates of the more commercially orientated livestock farmers in former homelands and rural areas (Dercon, 1998).

The findings of the study will assist in identifying constraints to rural poverty alleviation and finding sustainable sources of livelihoods in rural areas of South Africa for implementing deliberate investments to support these. The potential for agricultural growth and its possible contribution towards poverty alleviation has not been adequately studied. However, initial indications are

that smallholders in Africa have a comparative advantage in certain commodities such as livestock and irrigated citrus, which if properly supported by targeted public investments, could result in multiplied income and employment benefits for the rural poor (Ngqangweni, 2000).

1.7 Organisational structure of the study

The study is organised into six chapters. Chapter one introduces the study and presents the background information on cattle production in South Africa. It also outlines the problem statement, hypotheses, justification of the study and lastly the objectives that guided the study. The rest of the thesis is organised as follows. Chapter two reviews the literature. Chapter three describes research methodology with focus on: the study site, data collection method and the data analysis techniques. Chapter four presents results of the descriptive analysis of variables, whilst chapter five presents the empirical results of the regression analyses and the related discussion. Finally chapter six presents the summary, conclusion and policy recommendations of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter defines the key concepts used in the study and reviews existing literature on the subject from South Africa and from other countries.

Shanley *et al.,* (2002) define livelihoods as the means by which households obtain and maintain access to essential resources to ensure their immediate and long-term survival. Livelihoods may simply mean how people live, and comprises the capabilities, assets, activities and strategies required and pursued by households and individuals for a means of living. Livelihood strategies are the behavioural strategies and choices adopted by people to make a living, they include; how people access food, how they earn income, the way they allocate labour, land and resources, patterns of expenditure, the way in which they manage and preserve assets, and how they respond to shocks and the coping strategies they adopt (Chambers,1995). Livelihood assets define the context which influences and to a large degree defines the options and constraints available to households and individuals in their livelihood strategies. Livelihood assets are either controlled directly by households/individuals, or include publicly owned assets and also intangible assets related to social and cultural relations. Livelihood assets are defined within six distinct asset categories: Physical, Financial, Human, Social, Natural and Capital (Shanley *et al.,* 2002; Chambers, 1995).

Communal land is a mostly rural territory occupied by a community, rather than an individual or company. Such areas were formerly called Tribal Trust Lands with farms that are traditionally unfenced. Subsistence farming and small scale commercial farming are the principal economic activities in communal lands, and there is usually limited additional employment. Some communal lands are characterised by high population densities and as a consequence overgrazing by cattle and goats occur resulting in soil erosion (Barrett, 1992; Mavedzenge *et al.,* 2006). Communal lands are led by the

resident traditional African Chiefs. Many communal lands are at a lower elevation than the richer commercial farms, and consequently experience higher average temperatures and lower rainfall levels (Mavedzenge *et al.,* 2006).

Poor livestock farmers are those unable to access critical resources to meet their basic subsistence needs. They often include rural women, youth, landless poor, destitute herders and HIV-affected communities, whose animals at most, provide subsistence or the minimum augmentation of daily nutrition requirements (Heffernan *et al.,* 2001).

The poor livestock producers tend to own little or no land and are often of low social status, they are unlikely to benefit from interventions that require land or financial resources.

Livestock income is the value of sales and barter of livestock, plus the value of sales, barter and self-consumption of livestock products (such as milk, meat, eggs, honey, and so forth) minus the expenditures related to livestock production which, depending on the country, may include feed, labour and veterinary services (Adams, 2002). With respect to the majority of studies in the literature, the livestock income variable is calculated only for livestock-keeping households, which ensures that results are influenced by the pattern of livestock ownership among the population.

Poor marketing infrastructure in rural areas limit profit margins for farmers and hence disposable income. The need to compete with more developed markets often increases processing costs. In addition, poor households often lack the labour needed for sustainable livestock production (Heffernan *et al.,* 2001). Nevertheless, it is recognised that in the application of livestock as a means of poverty alleviation, for every benefit, there is a direct cost for the poor households involved. Livestock owners face increased household expenditures for animal healthcare and often fodder and water (Shackleton *et al.,* 2005).

Cattle off-take is the number of animals marketed and/or slaughtered per given time as a percentage of total herd size and it is used as the most

common measure of herd productivity (Bebe *et al*., 2003). However it does not consider whether the class of cattle sold and/or slaughtered is saleable or consumable. In generalising the concept, the study by Bouwman *et al.*, (2005) defined off-take rate as the fraction of the animal population that is taken out in a given year for slaughter regardless of farming system such as; specialised commercial farming system, smallholder mixed farming systems and also in pastoral systems.

2.2 The importance of livestock farming in poverty alleviation

Growth of agriculture is critical to sustain poverty reduction as about 75%of the world's 1.2 billion extremely poor (< US$ 1 a day) were estimated to live in rural areas and derive a non-negligible part of their income from agriculture and/or agriculture related activities (Datt and Ravallion, 1998; World Bank, 2008). The pace of poverty reduction does not only depend on the overall rate of agricultural growth, but also on the ability of poor households to participate in that growth, that is on the quality or inclusiveness of the growth process (Christiansen *et al.,* 2006; Datt and Ravallion, 1998). Given that about three quarters of the extreme poor are estimated to keep livestock as part of their livelihood portfolios (FAO, 2009), safeguarding and increasing the returns from their livestock assets is expected to help them in their endeavour to escape poverty (ILRI, 2007). Analyses of the livestock-poverty linkages are however limited, constraining the formulation of policies and investment plans intended to have a positive impact on the livelihoods of the livestock-dependent households.

According to Montshwe, (2005), livestock farming holds a position of great significance in the developing areas of South Africa and has been considered as a major agricultural activity in the past ten years. The potential significance of livestock in the development of rural livelihoods is undisputedly substantiated by the enormous contribution of the livestock sector at a macroeconomic level. The livestock sub-sectors' contribution to the total agricultural gross domestic product (GDP) is the largest of all the agricultural sub-sectors in South African agriculture.

Livestock farming and more specifically cattle farming in South Africa has multiple dimensions and objectives. The cattle sub-sector is the most important red meat sub-sector in South Africa. Moreover Coertze (1986) mentioned that cattle farming in rural areas was enshrined within the traditional practices and that a large proportion (approximately 35%) of the national livestock herd was owned by the non-commercial sector.

2.3 The social and financial value of livestock

Smith (1992), Dovie *et al.,* (2006), and Shackleton *et al.,* (2005) are some of the few researchers who attempted to consider the financial value of livestock to the broader community and not just to the cattle owners only. The social value of cattle in rural African communities has long been recognised. The financial value has not and it has been documented that even non-owning households receive a net financial benefit from the presence of livestock in their immediate surroundings.

Between 40 and 60% of non cattle owning households consumed a range of cattle products cheaply and/or freely in southern African countries and these included: meat, milk, manure and ploughing (Heffernan *et al.,* 2001). A number of negative reasons were identified against the presence of livestock, the most common one being that they damage crops and gardens and therefore everyone had to fence their fields even if they did not have livestock. If crops were damaged by livestock, the aggrieved household could claim compensation from the owner, but this was sometimes difficult to implement.

Smith (1992) indicated that even after accounting for the cost of fencing a property, non cattle owning households still accrue a positive financial benefit due to the presence of livestock in the community. This value is probably not immediately evident to non owning households, but most do recognise the positive values gained from ownership, hence 65.4% stated that they aspired to own livestock, particularly cattle. As recorded, the rate of increase in number of cattle owners (4.2% p.a.) in the Mhala region of South Africa is greater than the population growth rate in the same area.

2.4 The role of livestock in communal systems and rural livelihoods

A study by Shackleton *et al.,* (2001) in South Africa found that livestock contributed to household livelihoods through a variety of direct and indirect pathways. Firstly, livestock provided cash income or income through the sale of animals and/or the sale and consumption of milk, meat, eggs and other animal products. Secondly, livestock was a form of savings (capital growth through herd growth) and insurance, as the sale of animals provided immediate cash to deal with significant or unexpected expenditures (for example, school or medical fees). Thirdly, livestock provided manure, draught power and transport services, which can be used on the household farm or exchanged on the market (for example, rental of bull for ploughing). Fourthly, being a source of wealth, livestock not only contributed to social status but could possibly facilitate access to financial services in both formal and informal markets.

Furthermore, livestock helped generate social capital by traditionally providing employment, wealth, prestige, identity, respect and connectedness within and outside the community. Exchange of animals among households or groups created exclusive ties, which are relevant for risk minimization, conflict resolution and business relationships. Irrespective of the way in which income from livestock is estimated, there is some evidence that poor and landless households derive a higher share of their income from livestock than the relatively better off.

Adams (2002) found that in Pakistan livestock contributed about 20% to total income for households in the first lower three income categories, 10% to 15% for households in the fourth and top income categories, these findings concur with a study by Delgado *et al.,* (1999) which was conducted in seven countries in Africa, Asia and Latin America, which found that the contribution of livestock to income is larger for the poorest households than for those with higher incomes, larger farm size and more balanced dietary adequacy. These also referred to the Philippine household survey which indicated that the poorest of the sampled population relied on livestock for 23% of their income, while the richest only relied on livestock for 10% of their income.

Shackleton *et al.,* (2005) revealed that the range of goods and services obtained from livestock by rural communities were similar, but the relative importance of individual goods may vary from place to place.

Whilst the most important reasons for keeping cattle vary from region to region they can be related to a number of factors, including agro-ecological conditions, herd size, alternative sources of income, or a combination of these. For example, in semi-arid and arid areas, off-take for sales tends to assume greater importance than goods for consumption (especially draught and manure) because arable agriculture is less viable and herd owners cannot rely on crop production for income and food security (Ainslie *et al.*, 2002).

Ainslie *et al.*, (2002) substantiated other studies such as (Dercon, 1998; Delgado *et al.,* 1999), in establishing that in rural areas of southern Africa livestock are kept for a range of purposes, and not simply for cultural reasons, social status and bride-wealth payments, as is a common perception. In the Sand River catchment, Shackleton *et al.,* (2005) found that the most important reason for keeping cattle was to sell for cash. The second was savings, which was conceptually linked to the first. The third most important reason, according to respondents, was draught power. Each of these contributed 9.4%, 43.2% and 1.1%, respectively, to the total direct-use value.

2.5 Factors influencing variation in herd size

Seasonal variations are a key factor in communal areas where extensive management of cattle is directly linked to the environmental conditions (Jooste and Van Rooyen, 1996). For instance, variation in precipitation will cause fluctuations in forage quality and quantity, forage conservation and utilization and consequently changes in cattle condition indices and populations (Spio, 1997). The variations result in fluctuations in marketable cattle numbers, beef yield, quality and market values. Information on the effect of seasonal changes on herd dynamics and management in communal areas is scarce, making it difficult to assess the efficiency of utilization of communal rangelands.

Socio-economic circumstances of farmers form part of the differences in cattle numbers or simply livestock in general. The ability of the poor to acquire livestock is constrained by the capital and maintenance costs of the different species, which are typically highest for large ruminants (IFAD, 2001; Kitalyi *et al.,* 2005). Poor households rarely specialise in one particular crop or livestock species, preferring to diversify to take advantage of the different, often complementary roles each species can play, as well as to spread risks, including that of animal diseases.

Kaimba *et al.,* (2011) investigated the household characteristics on migration decisions and herd size amongst pastoralists in Kenya. The results revealed that male-headed households were more likely to keep larger herds of livestock, whereas household heads with higher level of education were more likely to keep smaller herd sizes. Also, households with bigger family sizes and those that have inherited livestock were more likely to own larger herds of livestock. The generation of income outside livestock rearing by the pastoralists lead to the keeping of smaller herds of animals. The intensity and frequency of cattle rustling inversely affects the herd size of pastoralists. Droughts and diseases often lead to loss of livestock, thus reducing herd size, and therefore influence the decision to migrate so as to avoid loss of animals.

The effects of farmer characteristics on livestock herd sizes were also investigated by Ngqangweni and Delgado (2002) revealing that there were socio-economic factors that affect the cattle herd size, these were; farm assets, access to finance or credit institution, household head characteristics e.g. (age, gender, marital status and educational level).

2.6 Factors affecting individual decision to keep cattle and other animals

Many studies (e.g. Fidzani, 1993; Dercon, 1998; Birner, 1999) have provided evidence that individual household members' risk preferences and their perceptions of the benefits, costs, and riskiness play a significant role in the choice of different livelihood alternatives available to them. Therefore, the individual decision to keep cattle and other animals such as sheep and goats is strongly affected by the risk preferences and perceived benefits associated

with each species. Sometimes, types of animals that were associated with better profits were also perceived to be riskier (Beckford, 2002). In such cases, differences in risk aversion between individual decision makers may explain their choices of animals to own (Cousins, 1996).

According to Dercon (1998), there are several long-term and short-term reasons to keep cattle. Short-term reasons include direct economic returns on products such as milk, meat, hides, manure and traction. Long-term reasons are investment, bank and/or life insurance. There are many ways of keeping animals for production; the one that a farmer chooses depends very much on the circumstances in a given area: climate, type of vegetation, market for selling the product, availability of labour and local traditions.

A study by Shackleton *et al.,* (2005) in Bushbuckridge, South Africa revealed that there were a range of reasons for not owning cattle, the two most common being that rural people did not have sufficient capital to purchase an animal (60%), and the other being that rural people did not have anyone to herd the animals during the day (24%). Consequently, they did not wish to get into disputes with their neighbours if their animals damaged someone's crops. Other households (8%) mentioned theft of animals as a deterrent from their desire to own cattle. Even though most households did not own livestock, a lot of them aspired to do so. Two-thirds (65.4%) of the households sampled stated that they would like to own livestock.

El Aich and Waterhouse (1999) noted that unlike sheep and goats, keeping cattle required high capital. Empirical studies (Ainslie *et al.*, 2002; Dercon, 1998; Birner, 1999) have revealed that cultural factors, including religion and ethnicity affect the ownership of certain types of farm animals by the household and/or by certain household members. Rural people, particularly smallholder farmers also consider the risks associated with farming activity. Risks in cattle keeping arise from uncertainty about outbreak of diseases, death or theft of the animals. The attitude of livestock keepers towards risk may affect their perception on the benefits associated with keeping particular cattle breed. For example, the likelihood of a female household member to own small ruminants was expected to be negatively associated with age.

Munn and Zonneveld (1990) investigated the main reasons for keeping cattle in Kanyati Communal Land in Zimbabwe. Among cattle owners, provision of draught power was the most important reason for owning cattle. The second-ranked reason was keeping cattle as a way of saving money. Provision of milk and transport were ranked the third in importance, including the provision of manure whilst keeping cattle for sale to the Cold Storage Commission (CSC) ranked low on the list of priorities, as did social and cultural reasons for cattle ownership. People who did not own cattle and who wanted to acquire them universally gave ploughing as their first reason for wanting cattle, with provision of milk and meat for home consumption coming next in importance. Bride-wealth payment did not appear to be an important consideration although in some societies cattle ownership served religious and cultural functions rather than economic ones.

2.7 Market barriers and access by the small scale livestock farmers

FAO (2009) revealed that the key to access formal markets in livestock production is the control of diseases such as foot and mouth disease, avian flu and brucellosis. Since such diseases cannot be controlled by individual small-scale farmers; a broader approach must be employed. Smallholder farmers face major challenges in national markets in developing countries. Transition countries may export low-priced products to developing countries that compete with local products.

The trend towards supermarkets and concentration of distribution channels generally favours large-scale producers over small producers. More often the only option for the small scale farmers is to combine with other producers. However, there are not enough large enterprises to meet demand in areas with heavy concentrations of population. This, in turn, indicates that an opportunity for small-scale producers still exists. A more important point that constitutes a major problem is the lack of infrastructure available to small-scale farmers who are often located in remote areas. Transport routes are a decisive factor in marketing options, particularly in the case of perishable products and livestock.

A study by Pica-Ciamarra *et al.,* (2011) emphasized that in order to overcome the challenges of poor market access by the small-scale farmers several strategies should be implemented or followed such as; increased investment in animal health services and making those services accessible to the smallholders at the right time and at affordable prices. Given low income of small-scale farmers, they will invest in animal health only if they see the benefits from such investment as a way to increase productivity and income, increased investment and improvement in the content and quality of livestock extension services.

Efforts should be made to make more appropriate and affordable feed technologies available to smallholder farmers. Extension messages should be designed to advise producers to better utilise available scarce feed resources so that improvement in productivity (increase fertility, reduce mortality, improve feed conversion ratio) and quality of marketed animals (sell at optimal age, weight and body condition) can be achieved (Pica-Ciamarra *et al.,* 2011).

2.8 The distribution of cattle and the characteristics of cattle owners in rural areas

Several studies have revealed that livestock ownership was highly skewed in most areas (Vink, 1986; Fischer, 1987; Hatch, 1996), with those households that have higher off-farm income usually owning larger herds, accounting for a disproportionate percentage of the total number of cattle. For instance, local businessmen, government bureaucrats or members of the traditional authority structures often have larger cattle herds than the average local household. Furthermore, the majority of households own either no livestock or just a few animals (Ainslie, 2005).

Steinfeld (1988) revealed that the total households size of farmers owning cattle were often larger than households who do not own cattle and have more labour available for cattle herding. In some cases, farmers may own cattle because they were wealthy (e.g. through off-farm income) as opposed to them becoming wealthy by owning cattle. When linked to crop production, cattle ownership and crop production had a positive relationship with cattle owners who have more cattle owning larger fields due to their ability to plough

more units. Thus the increase in area ploughed was primarily due to availability of animal draught to replace hand tillage.

Ellis and Freeman (2004) compared the mean livestock herd growth along income categories in Kenya, Malawi, Tanzania, Uganda and Botswana. Eventually, the observations revealed a similar positive correlation between mean income and cattle herd sizes. Livestock ownership across operational holding classes also showed a positive correlation between farm size and ownership of cattle, small stock and poultry.

Some studies (McKinley, 1995; Mellor, 2003; Zezza *et al.,* 2011) reported that, in developing countries livestock are fairly and equitably distributed more often than land, essentially because even landless households can keep some livestock. It is thus difficult to generalise whether poorer or richer households are more likely to keep livestock. Whether livestock-keeping is more important for the better-off or the poor is therefore an empirical question that needs to be assessed country by country.

2.9 Analytical methods used to analyze the process of decision making on participation/ownership and the value/size thereafter participation.

Thys *et al.,* (2005), investigated the socio-economic determinants of urban household livestock keeping in semi-arid Western Africa. The study applied multi-nomial regression model using STATA, The Pearson correlations were used to estimate correlations between variables and CART (Classification and Regression Trees) was used to determine the major determinants of urban livestock and crop production.

The Tobit model was used to examine the decisions on livestock keeping in the semi-arid areas of Limpopo Province conducted by Ngqangweni and Delgado (2002). The study by Joseph *et al.,* (2007) applied the similar approach in evaluation of the determinants of dairy market participation by agricultural households in Cote d'Ivoire. The study applied the Heckman selection model to correct for endogenous cattle ownership. A key result was that ignoring the population of non-owners biases estimates of market participation parameters. These findings are important in light of the

widespread application of livestock market participation analyses that assume cattle ownership is exogenous.

Socio-economic determinants of keeping goats and sheep by rural people in southern Benin were deemed crucial when formulating technologies and policies that support village-based small ruminant production (Dossa *et al.,* 2008), all these were examined using the Logit model.

Makhura (2001) followed the same approach to investigate smallholder farmers' participation in maize markets in the Northern Province in South Africa. Ramoroka (2011) also used the Tobit model in determining the participation and utilisation of formal vegetable markets by smallholder farmers in Limpopo province. Musemwa *et al.,* (2007) investigated the probability of small-scale cattle farmers participating in the Nguni project not selling their cattle with the logistic regression model.

2.10 Summary

Cattle production is one of the major livelihood improvement opportunities to the rural poor, offering opportunities for better and improved livelihood options such as employment creation, food production and many more that are core to human survival. Rural livestock keeping and poverty alleviation are closely linked thus, with the appropriate support; livestock can be a key mechanism in the fight for poverty alleviation.

It is important to understand the characteristics of rural farmers and the factors that influence them in decision making, concerning cattle ownership and their herd sizes for a plausible formulation of policies that can help improve their productivity and also their livelihoods.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

This chapter describes the research methods used in collecting and analysing data. The chapter also outlines the study site, climatic condition, population composition and agricultural activities conducted in the area.

3.2 Description of the study site

The study was conducted in Mutale Local Municipality of Vhembe District in Limpopo Province (South Africa). Limpopo is the northernmost province of South Africa and shares international borders with districts and provinces of three countries: Botswana's Central and Kgatleng districts to the west and north-west respectively, Zimbabwe's Matabeleland South and Masvingo provinces to the north and northeast respectively, and Mozambique's Gaza Province to the east. The province is the link between South Africa and countries further in sub-Saharan Africa.

Limpopo Province comprises of six district municipalities wherein Vhembe is one of the Provincial District Municipalities. Vhembe District Municipality is predominantly rural, with 95% of its population living in Tribal settlements and or farms and only 5% living in urban areas. The urban population in Vhembe is less than half of that of the Limpopo provincial average of 11% living in urban areas. On average, across all age groups, 53% of the labour force in the Vhembe District is unemployed (SDF, 2007).

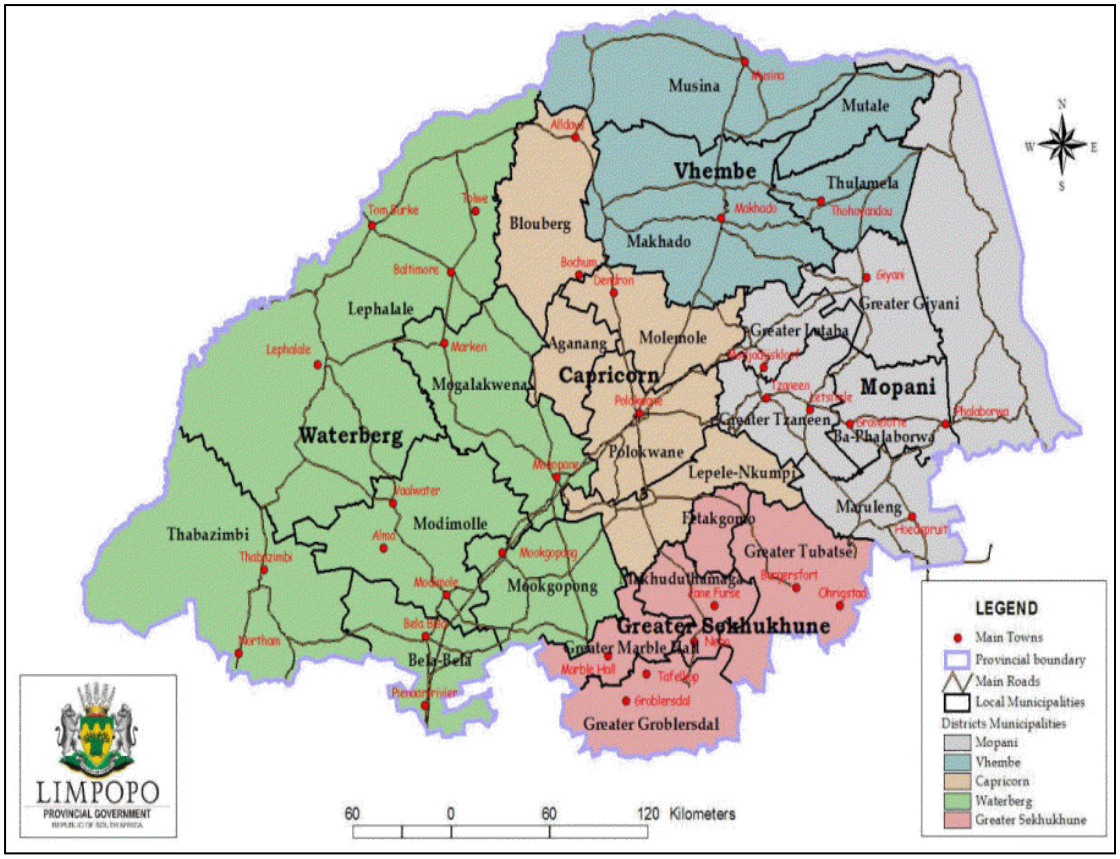

Figure 3.1 Limpopo provincial map (source: NDA)

Mutale Local Municipality is one of four local municipalities in Vhembe District and it is situated in the far north-eastern corner of Vhembe District approximately 35 kilometers from Thohoyandou town. Mutale Municipality has got 13 wards, and it shares borders with Musina Local Municipality to the north and Makhado Local Municipality to the south. It serves a population of 95 712 spread over 150 villages which are completely rural.

The total land cover of the Municipality is 2,375,782.12 hectares with the great Limpopo River forming the north-eastern boundary. Mutale Municipality is accessed through R525 route linking the Kruger National Park to other local municipalities within Vhembe District. It can also be accessed through R524 route linking Makhado and Thohoyandou. The racial makeup of Mutale area consist of; Black African (99.3%), Coloured (0.1%), Indian/Asian (0.1%) and White (0.5%). Language make up consists of; Venda (96.0%) and other (4%). Mutale Local Municipality's population is spread over former homeland areas, commercial farms, towns and semi-urban centres (SDF, 2007; CENSUS,

2011). Approximately (73%) of the population does not have access to clean potable water; many people have to travel long distances to collect water from public taps. The rural areas mostly make use of fountains and boreholes as their water source.

3.2.1 Infrastructure

Overall, the roads within the jurisdiction area of Mutale Local Municipality are in a poor condition and in dire need of upgrading. Apart from the main provincial and regional roads, most of the rural access routes are gravelled and in a poor state. Within the urban areas, the main roads are old and deteriorating rapidly, whilst most of the distributor roads are gravelled. There are 16 clinics, 83 Primary Schools and 27 Secondary schools in the Mutale area, which are predominantly government funded and operated (SDF, 2007).

3.2.2 Climate

The climate is typically subtropical with mild moist winters and wet warm summers characterized by Lowveld arid and semi-arid conditions (FAO, 2004). Rainfall levels in the Vhembe area are approximately 500mm per annum occurring between October and March (PGDS, 2004). Schulze (1997) reported that the rainfall pattern is largely influenced by the Orographic rain effect of the Drakensberg Mountains joining the Soutpansberg perpendicularly hence decreases from east to the west of the district

The annual temperature ranges from a minimum of 10ºC during winter to a maximum of up to 40ºC in summer. The area experiences frequent droughts most particularly in the most parts of Mutale Local Municipality which is predominantly semi-arid. Mutale area has a dry climate with the majority of the land receiving annual rains of between 300mm and 400mm. The water resources for Mutale municipality are; Nandoni and Vondo reticulation water systems within the Luvhuvhu/Letaba water catchment area which spans across Vhembe and Mopani District Municipalities (SDF, 2007).

3.2.3 Agricultural production

Besides agriculture, the economy of the municipality is also based on mining, and tourism industries. The municipality is rich with natural resources, including minerals such as gold, diamonds, nickel, coal and magnesium.

The principal crops are corn (maize), peanuts (groundnuts), beans, peas, sorghum, and vegetables, and the planting season starts around October. It was reported that Mutale Municipality has a total area of 138 160ha of which 101 645ha was declared arable land (PGDS, 2004). The number of cattle farmers is 3 381. Currently there are 38 338 cattle and 1 294 farmers in the municipality. There are 3 irrigation schemes in Mutale i.e. Rambuda, Folovhodwe and Tshipise, and there are also 8 grazing camps, with the total area of 38 102ha (SDF, 2007).

Vhembe District contributes only 12% of the Province's gross domestic product. The district's gross domestic product is contributed mostly from the Makhado Municipality (41%) and Thulamela Municipality (39%), with Musina Municipality and Mutale Municipality splitting the remainder (20%) (PGDS, 2004).

3.2.4 Mutale Municipality population statistics

The Venda people descended from the creators of the ancient civilisations of Mapungubwe and Thulamela. Amongst the last groups to arrive in South Africa, Venda culture is renowned for its intense spirituality and reverence of artists. The Venda people were one of the last black tribes to migrate south of the Limpopo River. During the 20th century their cattle holdings increased from a few to an appreciable number; they also keep goats, sheep, pigs, and fowl. The total population of Mutale Local Municipality is estimated at 131 215 (PGDS, 2004; Community Survey, 2007). It is estimated that 24239 households live in the municipality area and the average household size is 5 persons.

3.3 Data collection and sampling method

The study used primary data collected through household surveys in 2012. The data were collected using a questionnaire with both closed and open

ended questions. The data collected dated back to three years prior to the survey. There were five enumerators who administered the questionnaires in the process of data collection. The sample consisted of the households who owned cattle and also the households who did not own cattle. The sampling method used was proportional stratified random sampling. The population was divided into different subgroups or strata.

The data was collected from five villages of Mutale Local Municipality in the Vhembe District namely: Tshixwadza, Mapuloni, Gogogo, Matshavhawe and Mabulo. The sample size of 185 households represented 5% of the total population. The general sampling frame was acquired from the traditional leaders and the specific database for cattle owners was acquired from the extension officers of the Department of Agriculture in Mutale Municipality.
The sampling procedure used in the study comprised of the following four phases:

1. Defining the population of concern: The study area population had characteristics that are common in rural areas of South Africa. It consisted of mostly the small scale subsistence farmers and few semi-commercial farmers. Various agricultural practices were being carried out in these groups of rural people. These included crop farmers, crop-livestock farmers, and livestock farmers.
2. Specifying a sampling frame: basically a sampling frame is a complete list of all the members of the population that we wish to study. Such lists were obtained from the traditional leaders and extension officers, the additional index and other information were compiled during the data collection when the enumerators were in direct contact with the interviewees.
3. Specifying a sampling method: the sampling method used was the stratified random sampling. The main sample (185) was split up into sub-samples (stratum). The stratums were arranged according to the villages (five village equals five sub-stratums). In addition, proportional stratified sampling procedure was used to ensure consistency in sampled populations of different sizes. These allowed the different

village population sizes to become proportionally represented in the sample size. All the sub-strata used the same standardized questionnaire on interviewees with the desired characteristics such as: cattle owners and non cattle owners. The sum of the interviewees from all the sub-strata of different villages equals the total sample size.

Table 3.1 The village names, approximate population sizes and percentage sampled.

No#	**Village names**	**Approximate Population size**	**Proportional division of population**
1	Tshixwadza	575	29
2	Mapuloni	1383	69
3	Gogogo	1268	63
4	Matshavhawe	238	12
5	Mabulo	245	12
	Total	**3709**	**185**
	Total %	**100%**	**5%**

- Distinguishing the cattle owners from the non cattle owners: The local traditional leaders and also the extension officers had the information on cattle owners in the villages. This information was in forms such as dip records; once the cattle owners were identified it became easy to distinguish them from the non cattle owners.

4. Determining the sample size: The sample size was determined using the standard formula which is: $n = \frac{N}{1 + Ne^2}$

   Where **n**=sample size, **N**=total study area population, $\mathbf{e^2}$=error term ranging from (0.01-0.1)

Details of data collection process

Questionnaires were administered through face to face interviews by an associate of the researcher (enumerator) and also the actual researcher. These took place at the respondents' homes, and also in the farms, in case of some farmers. This kind of data collection has more flexibility than a telephonically done survey because, for instance, the enumerator could skip observable or irrelevant questions, and both the enumerator and respondent could ask for clarification. This also tends to have a higher response rate than with mail surveys because people are less likely to say no to a person as they would to a telephone call. However it should be noted that meeting and interviewing all participants in-person was both expensive and time consuming. Enumerator training is a crucial element of collecting high quality data. Training of enumerators ensured the following:

i. Enumerators fully understood the objectives of the research.
ii. Enumerators were intimately familiar with the data collection instruments.
iii. Enumerators were effective interviewers and could administer the interviews easily, accurately and consistently.

3.4 Methods used in data analysis

STATA (2010) was used to analyze data. STATA is a basic statistical and econometric computer package. Descriptive statistics including means, frequencies, and standard deviations were also computed.

3.4.1 Descriptive analysis

Before all the empirical models were applied, descriptive statistical analysis was performed. Descriptive statistics is important especially in social science research as it describes the basic features of the data in a study in a manageable form. Descriptive statistical analysis reduces lots of data into a simpler sensible form providing unsophisticated summaries about the sample and the measures forming the basis of virtually every quantitative analysis of data (Jackson, 2009).

The most common way to describe variables was with a frequency distribution. Data are best described when grouped into categories first as it

would usually not be sensible to determine the frequencies for each value. Frequency distributions can be depicted in two ways i.e. as a table or as a graph. Distributions were also displayed using percentages.

3.4.2 Model specification

The data set is such that some farmers own cattle and some do not. Some explanatory variables affect both the decision of cattle ownership and the herd size kept, once the farmer has decided to own cattle; therefore this study involves two stages. First stage, the farmer must decide to own cattle or not and the second stage is conditional to a farmer‘s decision having decided to own cattle/ participate in cattle ownership.

The farmer’s decision concerning cattle ownership is affected by different socio-economic factors. Thus; the binary choice model taking the limits 1 and 0 was obligatory. According to Hosmer and Lemeshow (2000), a typical method used to solve such dichotomous variables is the logistic regression. Ordinary least square (OLS) was used in stage two to explain factors that determine the herd size in cattle owning households/farmers. Heckman selection model (type II Tobit model) was applied on the same variables to identify factors that influence farmers’ decision to own cattle (selection) and factors determining the herd size in livestock owning households (outcome).

3.5 Heckman selection model/ type II Tobit model

This model is known as the Heckman selection model, or the type II Tobit model. The Tobit II model was designed to deal with estimation bias associated with consoring (Heckman, 1979). The sample selection bias arises when interest centres on the relationship between *x* and *y*, but data is available only for cases in which another variable, $z*$, exceeds a certain value (Heckman, 1979).

Using standard notation and denoting the determinant factors by the vector W, the selection stage can be written as:

$$zi^* = \gamma' w_i + \eta i$$

$$yi^* = \beta' X_i + \varepsilon_i$$

Where w_i is a vector of characteristics and η_i is unobserved.
But only observe *y* such that

$$zi = 1 \text{ if } z_i^* > 0 \qquad z_i = 0 \text{ if } z_i^* \leq 0$$

The first equation (the decision equation z_i^*) explains whether an observation is in the sample or not. The second equation (the regression equation yi*) determines the value of y_i. The sample selection model is often estimated in a two-step way. The two-step procedure is due to Heckman (1979) and is based on the following regression:

$$yi = X'_{1i}\beta + \sigma_{12}\lambda_i + \eta_i$$

Where $\lambda = \sigma_{12}\{\phi(X'_{1i}\beta_1)/\Phi(X'_{1i}\beta_1)\}$

The error term in this model $\eta i = \varepsilon_{1i} - E\{\varepsilon_{1i} \mid x_{1i}, y_i = 1\}$

ε_{1i} is independent of x_i, η_i is uncorrelated with x_i and λ_i by construction. This means that we could estimate β_1 and σ_{12} by running a least squares regression of y_i upon the original regressor x_i and the additional variable λi. The model can be written as:

$$\begin{aligned} E\{y_{2i} \mid y_{1_i} = 1\} &= X'_{2i}\beta_2 + E\{\varepsilon_{2i} \mid y_{1i} = 1\} \\ &= X'_{2i}\beta_2 + E\{\varepsilon_{2i} \mid \varepsilon_{1i} > -X'_{1_i}\beta_1\} \\ &= X'_{2i}\beta_2 + \sigma_{12}/\sigma_1^2 E\{\varepsilon_{2i} \mid \varepsilon 1i > -X'_1\beta_1\} \\ &= X'_{2i}\beta_2 + \sigma_{12}\{\phi(X'_{1i}\beta_1)/\Phi(X'_{1i}\beta_1)\} \end{aligned}$$

Using $E\{\varepsilon_2 \mid \varepsilon_1\} = (\sigma_{12}/\sigma_1^2).\ \varepsilon_1$ and setting $\sigma_1^2 = 1$

$\phi(X'_{1_i}\beta 1)/\Phi(X'_{1_i}\beta_1)$ is known as an inverse Mill's ratio or Heckman's lambda.

3.5.1 Estimation with Heckman's two-Step Procedure

Heckman proposed a two-step procedure which only involves the estimation of a standard probit and a linear regression model. The two step procedure draws on the conditional mean:

$$E(yi \mid Xi, Zi) = Xi'\beta + \rho\sigma\{(Zi'\gamma)/\Phi(Zi'\gamma)\} = X'_i\beta + \rho\sigma_\varepsilon\lambda(Zi'\gamma)$$

of the fully observed y's. Step 1 is the consistent estimation of γ by ML using the full set of observations in the standard probit/logit model.

$$Z_i^* = \gamma' w_i + \eta_i$$

$$Z_i = 1 \text{ if } Z_i^* > 0, \quad Z_i = 0 \text{ if } Z_i^* \leq 0$$

We can use this to consistently estimate the inverse Mills ratio $\hat{\lambda}i = \{ (Zi'\gamma) / \phi Zi'\gamma) \}$ for all observations.

Step 2 is the estimation of the regression equation with the inverse Mills ratio as an additional variable $yi^* = X'_i \beta + \beta_\lambda' \lambda + \eta_i$

for the subsample of full observations. The OLS regression yields $\hat{}\beta$, $\hat{}\beta\lambda$, $\hat{}\sigma\varepsilon$ and thus the correlation $\hat{}\rho = \hat{}\beta\lambda/\hat{}\sigma_\varepsilon$. Heckman's two step estimator is consistent but not efficient. Furthermore, the covariance matrix of the second-step estimator provided by standard OLS is incorrect as one regressor (the Mills ratio) is measured with error and the error term ηi is heteroskedastic. Therefore the standard errors need to be corrected (Greene, 2003). The parameters β and βλ are theoretically identified by the non-linearity of the inverse Mills ratio λ (.).

3.5.2 Stage 1: The factors influencing the farmer's decision to own cattle or not to own cattle.

The logistic regression analysis model describes the choice between two discrete alternatives. Cattle ownership is a qualitative dependant variable and takes the values 0 and 1. And it is explained as: 1 if a farmer owns cattle, 0 if a farmer does not own cattle. Logistic regression estimates the likelihood of cattle ownership by the farmer. The relationship between the probability of Y = 1 and the explanatory variables are determined through the Logit function and that is the natural logarithm of odds of Y = 1.The logistic regression model is based on the probability that Y equals to one (Y = Y1). The value of Y is assumed to depend on the value of X1.....Xk. This model was used primarily for the assessment of factors affecting the probability of a household to own cattle or not to own cattle. This model made use of the variables such as (age of household head, marital status, educational level and many more).

This model allowed the inclusion of the whole sample into the analysis, thus all the cattle owners and the non cattle owners were included in this model. More importantly this model can perform analysis on two types of independent variables such as: Numeric and the dummy variables just like in linear regression. Logit model is highly effective at estimating the probability that an event will occur.

The model was also recommended due to its nature of opening the possibility for multivariate analysis for data that are incompatible with a linear regression. In addition , logistic regression offered a new way of interpreting relationships by examining the relationship between a set of conditions and the probability of an event occurring. It is more robust: the independent variables don't have to be normally distributed, or have equal variance in each group. The weakness of this model is associated with its costliness as it requires much more data to achieve stable, meaningful results as compared to other models such as discriminant analysis.

- **General model formula used in the first stage**

a) $\ln[y/(1-y)] = \beta_0 + \beta_1 x_1 + \ldots\ldots\ldots \beta_k x_k + \mu_i$

Where: y /1-y is the odds ratio.

y_i = Probability that a farmer owns cattle

$1-y_i$= Probability that a farmer does not own cattle

$\beta_0 \ldots\ldots \beta_k$= Estimated parameters

$\chi_1 .. \chi_k$ = Independent variables

μ_i =The disturbance term

Using the variables outlined in Table 3.2, the specific model is written as;

CATTLE OWNERSHIP = β_0 + β_1HEADAGE+ β_2HEADOCCUP + β_3 HEADMERIT + β_4 HEADSCHOO + β_5 HEADBASE + β_6 GRANTRECE/ OINC + β_7 HSTEADCAR + β_8 LANDAREA + β_9 CATOREASON/COMSALE + β_{10}CATOBENEF + β_{11} AVCATTLEPRICE + β_{12} HHSIZETOT + β_{13} HISTO + β_{14} FEEDCATT +.... μ_i

3.5.3 Stage 2: Factors influencing the farmer's decision to keep a given cattle herd size.

Ordinary least squares was used to determine the factors that influence the cattle herd size, thus this model focuses on the cattle owners only and herein it was applied after the participation stage fulfilled by Logit model.

Ordinary least squares (OLS) or linear least squares is a method for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared vertical distances between the observed responses in the dataset, and the responses predicted by the linear approximation. The resulting estimator can be expressed by a simple formula. In a linear regression model the response variable is a linear function of the regressors (Amemiya, 1985).

The herd size is a continuous variable and this was limited to the cattle owners only, hence only cattle owners were included in this step. Thus OLS suits the examination of the relationship between the dependant variable (herd size) and the independent variables such as factors affecting the total herd sizes of the cattle in the cattle keeping farmers. More importantly, it allows researchers to understand both the direction of a relationship (whether one variable is associated with an increase or a decrease in another variable) and strength (e.g. how much of a difference in the dependent variable is associated with a measured difference in the independent variable). This model easily leads to a closed-form expression for the estimated value of the unknown parameter β.

The pitfall is that the OLS has some assumptions that should be met by the data and these assumptions required are stringent (e.g. the independent variables are not too strongly collinear and the residuals are normally distributed). If any of these assumptions are not met, the OLS estimation procedure breaks down and the estimator no longer enjoys all of the properties of estimations. Should this model be applied to the whole sample including the non cattle owners amongst the cattle owners, the sample selection bias would result.

- **General model formula used in the second step**

b) $y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots \beta_k x_k + \varepsilon_i$

Where: y_i= is the dependant variable (herd size),

$X_{1....}X_n$ = are explanatory variables

$B_0 ... \beta_n$ = are parameters

ε_i = is the disturbance term

Using the variables in Table 3.2 the specific model is written as;

HERD SIZE = β_0 + β_1HEADAGE+ β_2HEADOCCUP + β_3 HEADMERIT + β_4 HEADSCHOO + β_5 HEADBASE + β_6 GRANTRECE/ OINC + β_7 HSTEADCAR + β_8 LANDAREA + β_9 CATOREASON/COMSALE + β_{10}CATOBENEF + β_{11} AVCATTLEPRICE + β_{12}HHSIZETOT + β_{13} HISTO + β_{14} FEEDCATT +.... ε_i

3.5.4 Theoretical framework for analyzing with the Heckman selection model or the type II Tobit model

The most important reason for selecting this model is that selection bias problems are endemic to applied econometric problems, which make Heckman's original technique and subsequent refinements indispensable to applied econometrics (Heckman, 1976). This model is a widely used approach to estimate models of ordered type which almost employs the probit link function (Makhura, 2001).

When $\rho = 0$ OLS regression provides unbiased estimates, yet when $\rho = 1$ the OLS estimates are biased, thus OLS cannot be used alone as an estimator, but rather Heckman selection model is the best model to be used in such case. The Heckman selection model allows us to use information from non-participants to improve the estimates of the parameters in the regression model.

Regarding the set-up of this study with cattle owners and non cattle owners, an analysis that only focuses on the cattle ownership would simply ignore the effects of non cattle owners in the results. So, to best describe the effects of

the community/population as a whole, the influential factors from the cattle owners and non cattle owners should both be presented as a fair technique in the designing and implementing of the policies; thus the best model to investigate such factors was Heckman selection model/type II Tobit model. In addition to correcting for a potentially important source of bias, this approach also allows the researcher to extend inference to a broader population of rural households.

Table 3.2 Definition of variables to be used in the first step (logistic regression) and the second step ordinary least squares (OLS).

Independent variables	Description	Unit of measurement	Expected sign
GENDERHEAD[1 & 2]	1 if the household head gender is male , 0 otherwise	Dummy	+
HEADAGE [1 & 2]	Age of household in years	Years	+
HEADOCCUP [1 & 2]	1 if household head is employed off-farm, 0 otherwise	Dummy	+
HEADMERIT [1 & 2]	1 if head is married, 0 otherwise	Dummy	+
HEADSCHOOL[1]	1 if head has grade 8 and above ,0 otherwise	Dummy	+
HEADBASE [1 & 2]	1 if household head based locally ,0 otherwise	Dummy	-
GRANTRECE/ OINC [1 & 2]	1 if any of household member receives grant or other income source , 0 otherwise	Dummy	+
HSTEADCAR [1]	1 if house type is thatch under mud,0 otherwise	Dummy	+
LANDAREA [1 & 2]	Amount of arable land available	Hectares	+
CATOREASON/COMSALE [1 & 2]	1 if buy cattle for commercial purpose,0 otherwise	Dummy	+
CATOBENEF [1 & 2]	1 if farmer receives benefits from cattle, 0 otherwise.	Dummy	+
CATTSOME [1 & 2]	1 if household does keep someone else's cattle, 0 otherwise	Dummy	+
AVCATTLEPRICE[1 & 2]	Average price of cattle when selling	Rands	+
HHSIZETOT [1 & 2]	Total household size	Per head	+
HISTO[1 & 2]	1 if household had background of cattle ownership, otherwise	Dummy	+
FEEDCATT [2]	1 if household buys feed for cattle, 0 otherwise	Dummy	-

* Variables denoted by superscript of 1 were used in the first model (Logistic regression) and those variables with superscript of 2 were used in the second model (OLS) whilst the superscript 1 & 2 was for those variables used in both models.

3.6 Justification of the hypothesized variable signs

The variable gender is hypothesised to have a positive influence on the likelihood of cattle ownership and herd size. The researcher expected an increase in the likelihood of cattle ownership and herd size, for male headed households due to the historical favourability of males over the ownership of livestock by cultural customs. The historical impediments to women's empowerment encompass their lack of access to decision making processes, their low participation in local governance, as well as their limited access to technology inputs and credit.

The variable marital status is hypothesized to have a positive impact on the likelihood of cattle ownership and on the herd size. It is expected that married couples or household heads living together in a family create a favourable environment for proper livestock production. Older households tend to have reliable reputation and credibility in the homestead, thus they were much trusted in decision making. As reported by Barry (2001), age and ethnic background enhance the probability of livestock adoption. Thus a positive relationship between age and likelihood of livestock ownership is expected.

The benefits from cattle ownership include manure for fertilization, dignity, cash from animals and animal products, draught power for ploughing, ridging and weeding; not only on the fields of the cattle owner but also on those of other farmers. The extended benefits of livestock are detailed by Scoones (1990). The positive sign is expected to indicate an increase in the likelihood for owning cattle due to the benefits accrued, yet a negative sign reverses this statement. A study by Thys *et al.,* (2005), revealed that livestock keepers were motivated by income generation (65.5% of the respondents), food supply combined with revenues (21.1%) and home consumption (6.1%), thus a positive sign for these variables is expected.

Ainslie *et al.,* (2002), stated that, besides purchasing, the most common way of gaining effective control over cattle is through inheritance. Inheritance of cattle would signify the likelihood of cattle ownership due to the given background of previous cattle ownership. Thus; a positive sign is

hypothesized for the influence on the likelihood of cattle ownership. Barrett (1992) stated that, households owning cattle are often larger than households who do not (e.g. Steinfeld, 1988) and have more labour available for fieldwork in some cases farmers may own cattle because they are wealthy (e.g. through off-farm income) as opposed to them becoming wealthy by owning cattle. The household size explains the family labour supply for production and household consumption levels (Alene *et al.,* 2008). A positive sign is hypothesized to explain the likelihood of cattle ownership and herd size. In the pastoral system of Kenya, households larger than three members were more involved in pure livestock activities which might confirm the importance of manpower in livestock keeping (Kaimba *et al.,* 2011).

Nugent (2000) reported that low-income household heads in Ouagadougou might have pursued or started livestock production as a strategy to vary their sources of income. Thus a positive sign is expected for this variable on the likelihood of cattle ownership and herd size.

Ainslie *et al.,* (2002) in the study at Sand River catchments reported that two-thirds (66%) of households did not own any livestock at all. There was a range of reasons for this, the two most common being that: (1) they did not have sufficient capital to purchase an animal (60%), and (2) they did not have anyone to herd the animals during the day (24%). As such the expected sign for financial capital would be positive.

With reference to Thys *et al.,* (2005), the main indicators of living standard of pure livestock keepers were close but of higher value than those of the group dwellers not involved in crop/livestock production. A hypothesized positive sign is expected. Ngqangweni and Delgado (2002) indicated that, in attempting to characterize livestock keepers, the poorer households were likely not to decide to keep livestock, while the opposite occurs with the wealthier households. In addition, once the decision has been made to keep livestock, the wealthier households will tend to keep more livestock than the poorer ones. It shows that the state of being poor affects the ability of households to make investment decisions that might be useful in achieving positive livelihood outcomes.

Concerning the location of the households head, a hypothesized negative sign is expected to indicate that the further away the household head is from the family, the lesser are the expectations on cattle ownership. The hypothesized positive sign is expected to indicate that an assured income into the household would increase the probability of the household to own cattle. Such a situation was also reported by Kitalyi *et al.,* (2005) who observed that the ability of the poor to acquire cattle was constrained by the capital and maintenance costs of the livestock which were typically highest for large ruminants or cattle. It is expected that literate households are more likely to own cattle than those who are illiterate or simply with no education. Linked to the household resources are the farm resources which are the means by which the households require and pursue for a means of living; thus the hypothesized positive sign is expected for variable.

Pica-Ciamarra *et al.,* (2011) stated that, compared to non-participants in the market, the likelihood of a farmer participating in the cattle business as only a buyer was significantly higher if they had significantly larger land holding and significantly higher off-farm income, and mostly male household heads but about the same herd size, as such a hypothesized positive sign is expected for the availability of land as a variable. These differences also provide plausible explanation of the differences in behaviour of the two groups: larger land holding allowed raising more cattle which was affected through purchase, and having more off-farm income also might have allowed that purchase.

The average price of cattle is hypothesized to have a positive sign for the income as one of the benefits received by the farmers and an influential factor in determining the likelihood of cattle ownership. Joseph *et al.,* (2007) reported that the livestock ownership is indeed responsive to market signals. These results are in line with Barry (2001) who found in analyzing determinants of small ruminants' adoption in the peri-urban region of Khorogo, that sale and consumption of animal products, age and Peulh ethnic background enhance the probability of livestock adoption. Heffernan *et al.,* (2001) reported that for every benefit, there is a direct cost for the poor

households involved; thus a hypothesized negative sign is expected on the variable concerning the purchasing of animal supplementary feeds, further more livestock owners face increased household expenditures for animal healthcare, fodder and water. Poor marketing infrastructure in many countries also limits the profit margins for farmers and hence disposable income.

3.7 Challenges faced during data collection

Few of the respondents felt uncomfortable when they were asked about their age. Some were impatient and those were the respondents who had been part of the crop production research that had just been conducted a month earlier in some of the villages prior to this research. Some of the farmers could not recall the number of their cattle beyond a period of three years.

In rectification to such challenges: the enumerators had to practice the skills acquired from their training such as building of rapport in order to gain trust of the respondents and put respondents at ease. Some of the questions related to age were asked towards the end of the interview, since the respondent would have already gained trust on the enumerators. Some answers were acquired using indirect questioning approach e.g. how old were you when you started schooling, owning cattle/working? etc, leading to the possibility of capturing the age where possible. The respondents who could not recall numerical data on cattle numbers were prompted for agreeable average values, where possible.

With regard to the ethical considerations, the following procedure was used; the ethical forms were filled, signed and submitted at the committee that deals with ethical matters at the University of Limpopo prior to data collection. It was insured by the researcher that no harm occurred to the voluntary respondents/ participants and that all respondents/participants have made the decision to respond after receiving full information as to what is required from them and what, if any, potential negative consequences may arise from such participation. Those who choose not to participate were given the same information with which to make their decision not to be involved and were not to be disadvantaged by not participating.

Six broad ethical areas that need to be considered in social science researches were applied in this current study. These include; voluntary participation, informed consent, confidentiality and anonymity, the potential for harm, communicating the results, and more specific moral issues.

3.8 Summary

This chapter outlined the study area, data collection techniques and lastly explained the data analysis techniques including their justification. This study used more than one data analysis technique to process and to compare the results yet the main data analysis technique used was Heckman selection model/type II Tobit model.

CHAPTER 4

DESCRIPTIVE RESULTS

4.1 Introduction

This section presents the results of descriptive statistical analysis. The socio-economic characteristics of the sample in question are described. The findings of this chapter are presented as frequencies, percentages, mean, minimum and maximum values.

The importance of describing the socio-economic characteristics of the population that is being studied at a particular time has been emphasized by Pica-Ciamarra (2009), who revealed that the country and its population's specific features such as, assets, resources, together with other rural livelihood characteristics are the main determinants of the patterns of livestock ownership and their role in the household economy. Therefore, there is a need to outlay the characteristics of the population in order to understand and make inferences about the empirical findings attached to a particular population.

4.2 The composition of the small scale farmers

The farmers in Mutale Local Municipality consisted of two categories namely; (i) the farmers who kept cattle, and (ii) the farmers who did not keep cattle. Their farming system is quite similar to the system found in other rural South African villages where the predominant faming system is the subsistence farming system. The composition of the sampled farmers is presented in table 4.1.

Table 4.1 Composition of the sampled farmers

Category of farmers	Frequency	Percentage
Cattle farmers	90	49
Non cattle farmers	95	51
Total	185	100

4.3 Demographic characteristics

Analysis of the age categories of the sampled households shows that farmers who owned cattle in Mutale Local Municipality were dominated by the old age group, with the age group of 61-80 years constituting 44% of the cattle owner's group. The farmers who did not own cattle were predominantly in the age group of 41-60 years as opposed to the cattle owners (see Figure 4. 1).

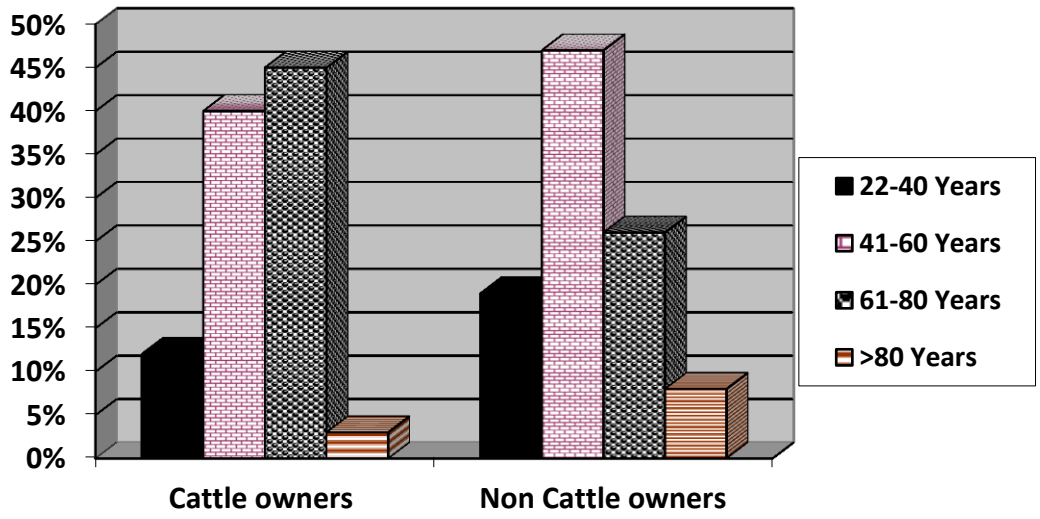

Figure 4.1 Age of household head

Survey results revealed that some of the households in the five villages (Tshixwadza, Mabulo, Matshavhawe, Mapuloni and Gogogo) of Mutale Local

Municipality were female headed. The percentage of female headed households was approximately 56% for cattle owners whereas the male headed households were 44%. When comparing the gender variable, the cattle owners were dominated by the female headed households, whereas the non cattle owning households were dominated by the male headed households (see Table 4.2).

Livestock keeping is mainly a family practice and gives women, elders and youth a voice and power in the household economy; this in turn provides empowerment of gender balance. Literally when the household head passes on, the asset (livestock) becomes the asset of the remaining household head, hence this would be a contributory factor to a higher number of women owning cattle. Women's role in agriculture and food security is critical and women contribute in agricultural production enormously. There might be a lack of visibility of women's participation, and contribution in agriculture and development in general, yet their contribution is vast. In general, cattle ownership and management in the smallholder areas were usually dominated by men. Men are generally the owners of large stock (cattle, goats and sheep) while women are confined to producing livestock species close to the homesteads, such as chickens and pigs (Andrew *et al.,* 2003).

The current study shows interesting or rather an arguable scenario, where women who own cattle are more in number than men who own cattle as opposed to the past studies. The root cause of this may be due to the fact that women have realized the importance of their role in livestock production and they are actively engaging themselves. Inarguably, livestock are a key means to facilitate the potential of the poor. Livestock can fulfil wider food security needs and enhance the nutritional status of the most vulnerable: women, children and the elderly.

Table 4.2 Gender of farmers

Gender of farmers	**Cattle owner %(N=90)**	**Non cattle owner % (N=95)**
Male	44	62
Female	56	38
Total	100	100

There were vast observed variations in case of the marital status between the cattle owners and the non cattle owners in Mutale Local Municipality. The households who were married constituted about 74% for cattle owners, whilst the households who were widowed were at minimal constituting about 6%. In case of the non cattle owners, the households who were single dominated with 92% whereas the lowest in statistics was the married households with 2% (see Table 4.3). As indicated by Rita (1996), the Venda people are very traditional and cultural preservative of most of the cultural activities that educate men and women on handling of family challenges. Such family challenges may sometimes if not well embarked upon lead to divorces or marriage separations as such this could perhaps be the core factor keeping the divorce level at such a low rate.

Such observations confirmed the idea that most of the households that own cattle were married couples/living with partners and having children who in normal village lifestyle take care of the livestock whilst the parents were off to other income earning opportunities. In addition, non cattle owners could also be younger people who had other income earning opportunities and did not engage in cattle keeping.

Table 4.3 Marital status of farmers

Marital status of farmers	**Cattle owners % (N=90)**	**Non cattle owners % (N=95)**
Single	6	92
Married	74	2
Widowed	20	6
Total	100	100

Farm size for the different households was also considered. The total number of farmers/households that ranged from family members of 5-8 households dominated in both farmer categories with 64% for cattle owners and 47% for non cattle owners. The least number of households was the family that had greater than 12 members and it had only 2% for cattle owners and 8% for non cattle owners (See Figure 4.2). Seemingly, the average group of family households has higher probability of owning cattle, yet the families with number of households that are extreme e.g. more than 12 households seem to be declining concerning the ownership of cattle. This may be due to the raised demands in the family as the size of the household increases, resulting in a decrease in the ability to afford cattle ownership and maintenance.

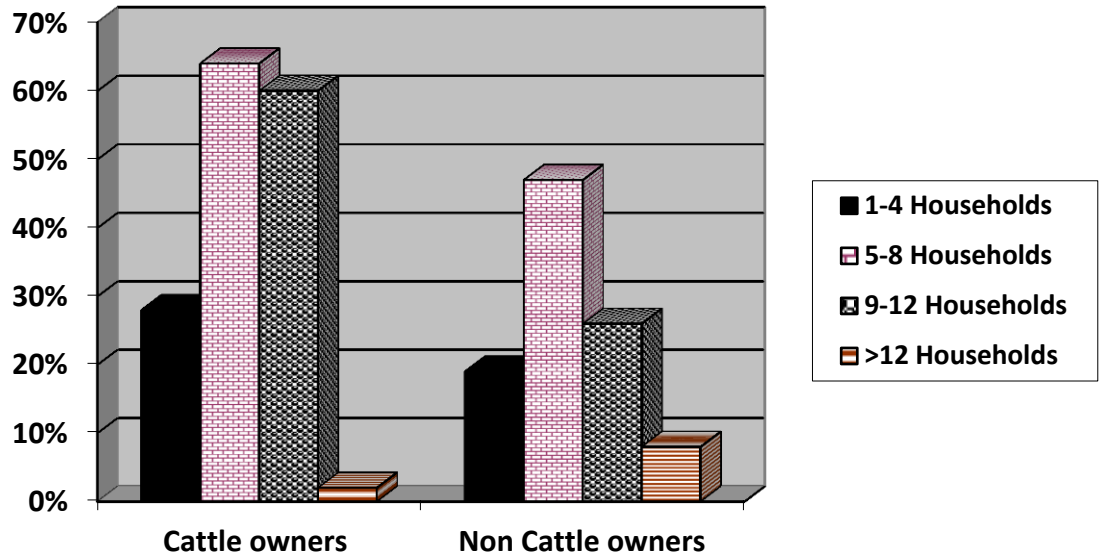

Figure 4.2 Total number of household size

Education plays a significant role in human life, enabling the household member to be able to interpret the literature whilst enhancing communication and the understanding of skills and policies that help in developing communities. It also enables the farmers to understand farming practices and farming for profit.

For both cattle owners and non cattle owners, most of the household heads had attended school but never reached matriculation level. In the cattle owners group more than 60% of the farmers fell in this category, whereas in the non cattle owners' group, almost 80% of farmers were in this category. In both groups, only a few of the household heads indicated that they had not been to school (See Figure 4.3).

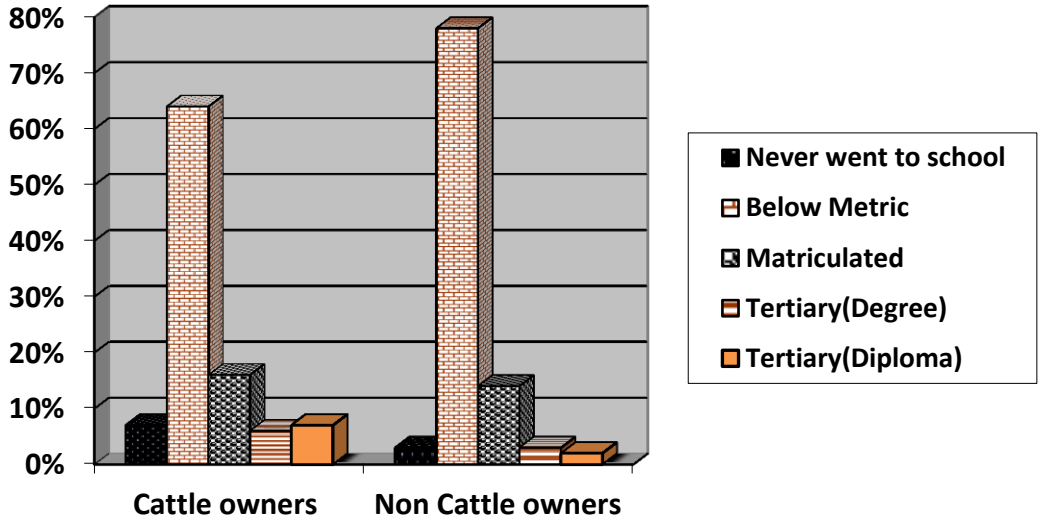

Figure 4.3 Educational level of the household heads

4.4 Livelihood sources

In rural areas of East Africa, a minimum herd size of two cattle or more per family member was estimated to be necessary for households to make a living above the poverty threshold if they relied exclusively on livestock farming (Lybbert *et al.,* 2004). The contribution of livestock to the livelihoods was also inherent as the households that kept livestock obtained between 2% and 24% of their income from such an activity, with the simple average across the 12 sample countries being 12% (Pica-Ciamarra *et al.,* 2011).

The livelihoods opportunities in the study area were quite limited, with limited formal job opportunities, the physical conditions were also harsh and unforgiving, with much marginal land suitable only for extensive grazing of livestock or hardy grain crops such as maize, sorghum and millet. These areas were rather suitable for cultivation of crops under irrigation. Consequently the great majority of households in the area were engaged in some form of farming such as; dry land cropping, irrigated cropping and extensive livestock production. Some of households however, depended on farming entirely for their livelihoods (see Table 4.4).

As in other parts of rural Venda and the other former homelands, farm incomes were supplemented by various combinations of remittances from

other family members working elsewhere, local wage employment, state pensions, and small-scale trading in fresh produce, beer and other goods (SME).

Opportunities for paid employment were extremely rare in Mutale area, with the exception of Tshikondeni Mine and the civil servant/government service (see Table 4.4). Skilled government posts such as police, agricultural officers, nurses, teachers, clerks were very limited, and do not necessarily go to local people, although a small number of such officials settled in the area because of their work.

A limited amount of unskilled government work was available for cleaners, watchmen and labourers of various sorts. Beyond the mine and the government service, however, there were virtually no formal employment opportunities within the area. Some casual employment was available on irrigated plots. The majority of farms and a few small shops and other businesses that existed in the locality could only hire a few workers, and some depend on unpaid family labour.

With the evidence from this study conducted in five villages of Mutale Local Municipality; the main source of income for the households was dominantly pension/old age grants with 71% for cattle owners and 54% for non cattle owners. The households who received child grants constituted 2% for both the cattle owners and non cattle owners.

Table 4.4 Household head occupation

Household head occupation	**Cattle owners % (N=90)**	**Non cattle owners % (N=95)**
Unemployed	10	23
Full time farmers	6	2
Part time farmers	3	15
Pensioner	46	27
Civil servant	25	14
Employed privately	2	15
SME	8	4
Total	100	100

Most household heads for both cattle owners and non cattle owners were pensioners. The proportion of household heads who indicated they were unemployed was 10% and 23% for the cattle owners and non cattle owners respectively. Other occupations indicated were farming, civil servants and small business enterprises (see Table 4.4).

Between cattle owners and non cattle owners, 79% and 92% respectively were based locally (see Table 4.5). Interestingly, most of the non cattle farmers indicated that they were based locally, despite being generally younger than those farmers with cattle.

Table 4.5 Household head base

Household head base	**Cattle owners %(N=90)**	**Non cattle owners %(N=95)**
Locally	79	92
In town but comes home weekly	7	2
In town but comes home monthly	14	6
Total	**100**	**100**

4.5 Household assets

Analysis of household asset distribution is a key to the description of the population in question as this will establish a better understanding of livelihood systems and the assets that the farmers or rural people posses in a particular area. This is important in an attempt to reveal the precise picture of the community whilst avoiding the average figures and amalgamation at national level.

The dwellings/homesteads categories of farmers were recorded under the following categories; brick under tile, brick under iron sheets, brick under thatch and mud under thatch (see Table 4.6).

Table 4.6 Homestead categories

Homestead type	**Cattle owners %(N=90)**	**Non cattle owners %(N=95)**
Brick under tile	1	25
Brick under iron sheets	97	57
Brick under thatch	1	13
Mud under thatch	1	5
Total	**100**	**100**

The households also owned other resources; from as small as daily farm equipment such as wheel barrows, hand hoes, forks etc. to more costly items such as ploughs, tractors, delivery vehicles and many more. All the resources formed part of the farming practices that have been and are still being carried out to sustain the livelihoods of rural small scale farmers.

4.6 Agricultural production characteristics

The crops grown included maize and vegetables produced mainly for consumption at the homestead with some of the farmers selling part of their produce for financial rewards. The cattle farmers also practised crop farming using kraal manure which was abundant for them, with some donating to the non cattle owners. In addition the non cattle owners had some other small stock and were also involved in crop production as well. The grazing land available to the farmers was mainly the communal land ranging in size from 150-300ha per village, varying with each of the villages consisting of an average of about 200ha per village. In addition, households had access to cultivation land in the form of backyard gardens, orchards, and also gardens that were situated away from homesteads averaging about 2ha per household.

There were no payments made to gain use of the available communal grazing lands and also there were no farmers who were renting any land for either cattle grazing or crop farming. It appeared that the land was not under any control system for monitoring its viability for sustainable utilisation.

The cattle farmers mentioned several constraints to the expansion of their production. These included the shortage of animal forage in the grazing lands, the lack of finance to purchase dip chemicals and drugs for disease prevention and control. The challenges were dealt with in several ways, for shortage of forage; some farmers mentioned that they purchased supplementary feeds in the form of lucerne bales, mineral supplements such as salt lick, maize stover, cutting and feeding with tree branches, cutting and feeding with pricklepear, use of maize grain residues after milling. About 33% of the farmers reported that the challenge of fodder shortage alone ended with a slow and painful death of their animals.

Seemingly, the challenge of forage shortage was accelerated by the environmental factors since this area is mountainous with lack of vegetation cover with a lot of steep slopes. Furthermore there has been heavy grazing on such vulnerable areas causing the vegetation cover to be destroyed as many cattle pass, graze and trample on their way. The irregular rain patterns of the region appeared to be a contributing factor to problems occurring when forests have been overgrazed.

The pouring rain washes away the soil and the immediate consequences are landslides or gullies making silt deposits in the lower lying areas. If all these are not minimized, the results may be devastating in the near future, for example, leading to more permanent land degradation or even desertification. Overstocking, as an inappropriate farming method is also an accelerating factor behind such conditions. Concerning overgrazing; farmers mentioned that there is no proper structure or a village organisation which controls or which is in charge of controlling the grazing lands. No farmer controls another’s herd size, as they mentioned. Thus; overstocking is a serious current challenge which will have an impact in the future of these villages, as such this requires serious attention.

Animal parasites and diseases control was at the farmers own cost since there were no subsidies of that nature being provided to them by the government. Furthermore 49% of farmers had lost their cattle to diseases and lack of proper animal husbandry practices in the three years prior to the study. About 87% of the farmers had formed farmer groups. These groups were normally distributed according to their villages and they collected a certain amount of money for purchasing the dip chemicals and these could last them up to half a year, yet those who did not form or join groups of such nature were about 13%.

Another challenge was that the dip water took too long to be replaced; hence chemicals became dysfunctional due to the poor state of water. It was mentioned that such challenges were not a problem during the 1990's and early 2000's since the government used to regularly provide medications for the animals. Currently the government only focussed on provision of free service for the vaccines against certain diseases that were controlled by the state such as foot and mouth disease, rinderpest and anthrax (viral diseases). Farmers suggested state interference as one of the solutions, especially in the case of provision of animal feed subsidy and also animal medication subsidy.

About 87% of the farmers indicated that they purchased supplementary feed for their animals in drought periods. This indicated additional costs associated with cattle farming and showed a dire need for feed supplement as the natural grazing lands deplete easily and quickly especially during dry seasons.

4.7 Reasons for owning cattle

The majority of farmers (73%) indicated that they started owning cattle through purchasing of the initial animal, whilst 20% of the farmers inherited the cattle from their family members and about 4% were given cattle as a gift (see Figure 4.4).

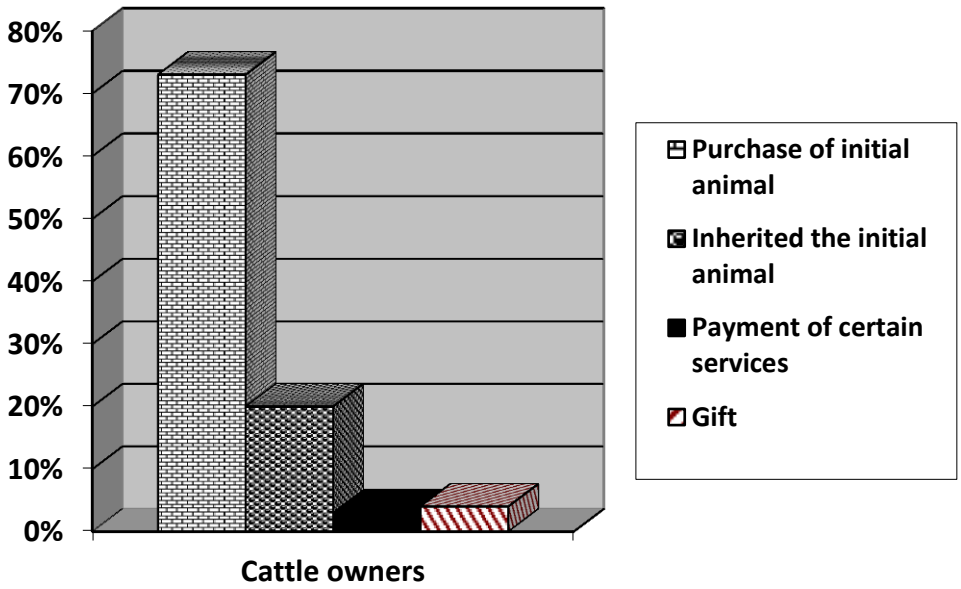

Figure 4.4 How farmers started owning cattle

Farmers gave different and multiple reasons for owning cattle; about 24% of the farmers indicated that they owned cattle for traditional purpose, whereas the farmers who owned cattle for commercial purpose constituted 76% (see Figure 4.5). Further discussions with the farmers revealed that many of those who did not keep cattle for commercial purpose agreed that they would sell cattle only due to emergency situations. Yet the commercial orientated cattle owners mentioned that they keep cattle for selling in order to have some cash and also indicted that a herd of cattle was a great investment to their families.

The commercial oriented farming in this case referred to the farmers who kept cattle with the main motive being selling within a period of three years. Whereas the traditional orientated farming was referred to the farmers whose motive was not for selling cattle within similar period of three years, in addition their motive was to keep cattle for a period beyond three years without any sales made, yet agreeing to sell only when there are ad hoc or forceful situations such as death and traditional ceremonies.

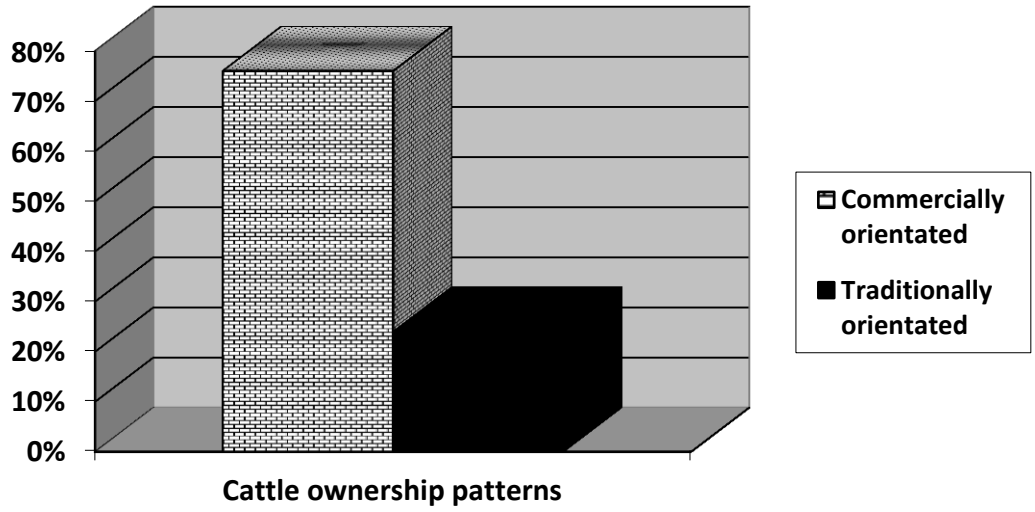

Figure 4.5 Reasons for owning cattle

The total number of cattle owned by surveyed farmers at the time of the survey was 1060. The ownership of these animals was spread over five villages of Mutale local municipality, for the 90 cattle farmers in total. On average each cattle farmer owned about 12 cattle. The average number of cattle sold in those villages was about 17 in the three years period prior to the survey, whereas the prices associated were R 3766.00 on average (see Table 4.7)

Table 4.7 Average number of cattle owned, average number of cattle sold and their average prices.

Variable	Minimum	Maximum	Mean	Std. Dev	N
Average number of cattle owned	1	65	12	10	90
Average number of cattle sold three years prior to the survey	0	7	17	1.2	90
Average price of cattle (R)	0	8000	3766	2454	90

Respondents acquired cattle through purchasing (70%), inheritance (20%) and other sources (10%). Over 60% of the respondents that inherited cattle were female widows. Adult males dominated all cattle production activities (feeding, herding, breeding, milking, purchasing, treating, slaughtering and selling) across production systems. Male youths and hired labour participated in cattle production activities more than adult females, except in purchasing, slaughtering and selling. Female youths were minimally involved in all cattle production activities.

4.8 Cattle marketing

About 30% of the cattle farmers interviewed indicated that they had not sold any cattle three years prior to the survey, whereas about 67% of farmers had sold cattle and the remainder 3% had indicated to have exchanged cattle for other services during the similar period of three years prior to the survey.

There were considerable amount of cattle sales from the farmers to the consumers and even from a farmer to another farmer. About 81% of the farmers had sold up to three cattle in the three years period prior to the survey, whereas only 2% had sold more than seven cattle (see Table 4.7).

These results showed that in a period of three years an average of 2 cattle were sold per individual from each of five villages of Mutale local municipality. The average total number of cattle owned per farmer at that particular time was 12.

The cattle prices have escalated enormously in these rural areas. Some of the farmers mentioned that they used to sell a cow from as little as R1000.00 to R1500.00 six years ago prior to this study, whereas recently (three years ago prior this study) farmers mentioned to have sold a cow for as much as R4500.00 to R8000.00 as shown in table 4.7.

The results in this study revealed that the possibility of cattle ownership for an individual who was from the background of cattle ownership was as high as 48% and that particular individual was likely to be involved in cattle farming .

The possibility of owning cattle for an individual who was from a family that did not own cattle was as low as 16% (see Figure 4.6).

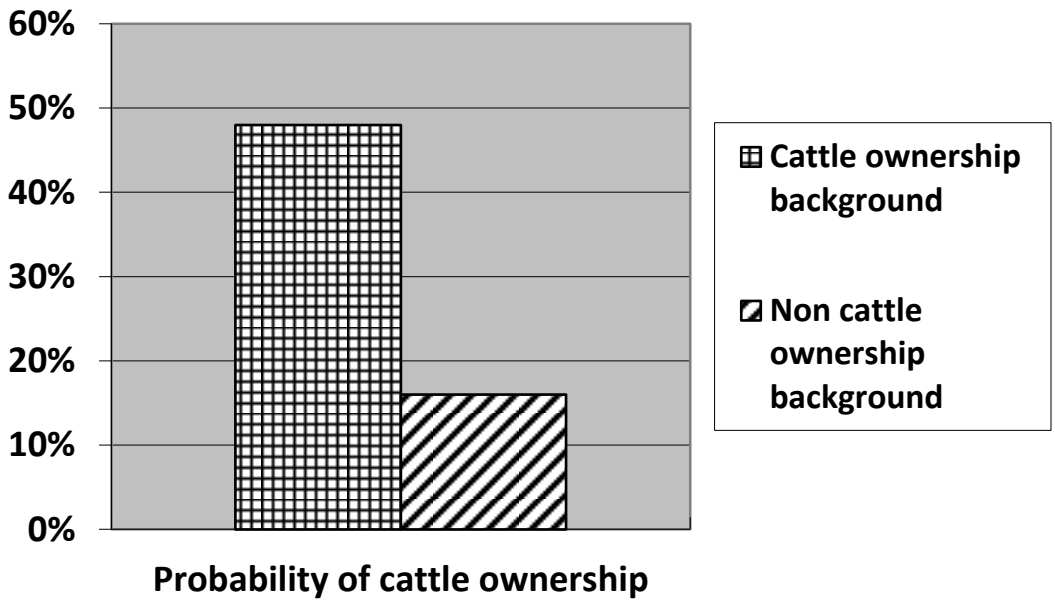

Figure 4.6 Previous background on cattle ownership

4.9 Livestock farming systems in Mutale Municipality

This section describes a classification of the livestock systems in Mutale Local Municipality. In order to achieve this, there was a need to outline and define the elements of a classification of livestock production systems (Lahiff, 1997) The classification of these systems can be achieved through quantitatively or qualitatively describing this livestock production system in terms of; livestock feed, livestock resources, livestock commodities, production technology, product use and livestock functions over specific geographic locations and human populations supported. All these elements are outlined thoroughly in livestock system of Mutale Local Municipality.

Types of production systems noted:

i. **Solely livestock production system:** this system is where the farmer owns livestock only with very little or no arable farming practiced.
ii. **Crop-livestock production system**: this is where the farmer owns livestock and is also involved in arable farming.

iii. **Non-livestock production system:** this is where the farmer does not get involved in any livestock production activity.

4.9.1 Exploration of the livestock farming system in Mutale area

The justification for applying a concept of livestock production systems lies in its usefulness for livestock development. The potential for change and improvement is likely to be different in different production systems due to constraints imposed by factor endowment, livestock functions and management standards. Different development efforts are required to reduce the constraints and to make best use of the opportunities. Development may also call for the concentration of efforts on one system at the expense of another or for the transformation of one system into another. The concept of livestock production system allows the discussion of livestock development in terms of concrete policies, strategies and projects as they ultimately affect the individual livestock producer.

The study covered nearly 90% of cattle owners in five surveyed villages, making about 5% of total households from each village. The farmers had an average of 12 cattle owned over the year 2012. The approximate total number of cattle in all five villages was about 1060. This was also supported by the official dipping records, and the statements of veterinary officers in the area, hence these records also suggested that total cattle numbers in the area increased considerably during the 1990s and early 2000's. This expansion was reversed by the break out of heart water disease and also drought coupled with the retirement in cattle keeping, although it was a few farmers.

4.9.2 Carrying capacity

Nowadays, pasture scientists from the department of agriculture make their own estimates of carrying capacity, based on the veld types, seasonal changes and the extent of overgrazing or erosion, yet, apart from encouraging farmers to adopt good practices, they have no means of enforcing any limits on cattle numbers. The carrying capacity of the area has been estimated at various times by the Department of Agriculture, based on the quality and quantity of grazing available. Efforts were made by the authorities in the

1990s and early 2000 to limit the numbers of cattle kept by each household, ostensibly in order to conserve soil and vegetation, but these measures were extremely unpopular and were widely evaded.

4.9.3 Livestock water supply

Rainfall is the key limiting factor in livestock production in Mutale area. The volume of rainfall effectively determines the rate at which rivers, streams and groundwater reserves can be replenished, and at which grazing can be restored. Seemingly, drought-like periods always occur almost every year, furthermore this cause the quality of grazing on the veld to deteriorate rapidly leaving rivers and springs in danger of drying up. Farmers interviewed in this study reported sizeable losses of livestock throughout this dry season which resembles drought, yet the ability to withstand unfavourable conditions varied.

Some farmers mentioned that they were sometimes left with no option but to enter into the distress sales when faced with the prospect of losing their herds. Cows, calves and middle aged cattle die from a combination of starvation and thirst. Farmers who were better off as compared to others always had the means to buy supplementary feed; hence they were constantly in a position to withstand the severe period.

The Department of Agriculture also offered the drought relief programme during these periods. The programme allowed farmers to purchase supplementary feeds at a highly subsidized prices (e.g. a bale of lucerne at R12.00 in the year 2011 and 2012), thus almost 80% of subsidy although this was not enough with some farmers left unassisted due to departmental budget constraints versus a large number of farmers.

Amongst the cattle owners and also the crop-livestock farmers there were a number of them who owned donkeys and small stock especially goats, this was just an observation, hence it did not form part of the study. Every household in each village is entitled to keep livestock, and there were no limits on the numbers that can be held. The Department of Agriculture once

attempted to introduce a system of rotational grazing, whereby the forest beyond the villages were fenced so that the grazing could be controlled allowing the veld to recover. Yet this system was agreed to by just a few farmers and others resisted. That caused the strategy to collapse as fences were cut and some infrastructures were vandalized, this happened just a few years after implementation.

4.9.4 Livestock markets and interaction with other systems

Livestock theft is also a problem in these five villages of Mutale Local Municipality. There were reports that almost 10-15 cattle disappear in every three years on average. This was also accelerated by the lack of grazing camps, hence cattle are forced to graze further away from the villages. Given the geographical conditions of these villages, the area caused cattle to scatter as they graze these mountainous areas. Farmers reported the different desires for keeping cattle (i) commercial purpose, and (ii) traditional purpose. The main markets for the cattle were the local villagers, people who sell at the pay-points, local butchers, and also cattle farmer to cattle farmer sales were recorded.

There were no auction activities taking place and a number of cattle were also consumed within the producing households, but many farmers, especially those with smaller herds, stated that they had not slaughtered an animal for their own use in many years. There were cases reported on livestock damaging the crops of other farmers. This was also accelerated by the condition that during the dry season, crop farmers plant their crops along the river banks for the ease of irrigation; this caused the competition for water between the fields and the livestock.

4.9.5 Livestock produce and functions

The functions of livestock refer to the mode of action or activity by which livestock fulfil their purpose. Partially the functions of livestock are attached to the livestock products. In the case of meat and milk, the related function of livestock is to provide income and subsistence through their sale or consumption while with manure, the function of livestock is to provide an input to crops thereby increasing production and income.

The differentiation of products and functions allows the differentiation of livestock production systems even if they are based on the same product, e.g. herd growth for security, for social reasons (prestige) or for a pure income objective. The following functions can be fulfilled by livestock (i) The output function (subsistence, income and nutrition), (ii) the input function (crop inputs and farm integration), (iii) the asset and security function, (iv) the social and cultural functions.

4.9.6 The grazing land tenure

Almost all of the grazing lands were communal property without proper care or controlled grazing. Maintaining an appropriate level of livestock numbers is the crucial element in good management of the rangelands. However, when livestock are owned by individuals and when land is common property, no individual has adequate incentive to contain the number of his stock so that together with his neighbour's stock, the aggregate numbers on the common land would be optimal.

4.10 Summary

This chapter presented the basic socio-economic characteristics of the small scale cattle farmers. The sampled farmers were the small scale farmers that consisted of two categories ;(i) small scale cattle farmers, and (ii) small scale non cattle farmers. The descriptive analysis revealed that the age of the household in Mutale Local Municipality were dominated by the age group of 61-80 years constituting 45% for the sample size of 90 farmers and 41-60

constituting 47% for the sample size of 95 farmers for the cattle farmers and the non cattle farmers respectively.
The dominant and the highest level of education was among the farmers who attended school but never reached matriculation level with a figure of 64% for cattle owners and a figure of 78% for non cattle owners. The gender of the farmers who owned cattle was mostly dominated by female with 56% as compared to 62% of male farmers for the non cattle owners.

The livestock production system of Limpopo province with focus on Mutale Local Municipality was also explored and described. These focused on the livestock feed, livestock resources, livestock commodities, production technology, product use and livestock functions and their environmental conditions.

The sample size of the study was 185 small scale farmers wherein the cattle owners were 90 in number and the non cattle owners were 95 in number. These results showed that in a period of three years, an average of 2 cattle was sold per individual farmer from each of the five villages of Mutale Local Municipality. The average total number of cattle owned per farmer in the period of three years was 12. The next chapter presents the results of the empirical analysis of the survey data.

CHAPTER 5

EMPIRICAL RESULTS

5.1 Introduction

This section presents the results of econometric analyses aimed at revealing the determinants of cattle ownership and herd size. The empirical results were expected to inform the discussion and conclusion regarding improvements in livestock farming systems and inform efforts aimed at improving herd sizes.

Two approaches are used to analyse the data. In the first approach, data is analysed using a logistic regression model thereafter a multiple ordinary least squares model. The logistic regression model was used to predict the probability that a given household would own cattle or not, thereafter determinants of herd size, conditional on livestock ownership was determined in the second step through the OLS model. The second approach involves analyzing the data using a Tobit II or Heckman selection model. The results of the two approaches and their effectiveness are discussed.

5.2 The logistic regression results

All of the explanatory variables that were hypothesised to influence the likelihood of an individual farmer to own cattle were included in the model. In the analysis, the relationship of the explanatory variables with the dependant variables was determined.

5.2.1 The goodness of fit (GOF) for logistic regression (Logit) model

The LR test shows whether the model as a whole predicts the percentage contribution of the explanatory variables to the dependent variable or not. In this case the LR test was as high as 95% with the p-value of 0.000 and these in turn indicated that most of the independent variables had a significant influence on the probability of farmers to own cattle or not. The significance of the model is normally presented by a "p-value" signifying the probability that random chance could explain the result. In general, a 5% or lower p-value is

considered to be statistically significant. The log likelihood is -78.135 indicating that the model has more parameters that fit the model. The log likelihood‘s significance is determined by deriving the probability or p-value.

The coefficients which measured the strength and the direction of the relationship between the cattle ownership and the explanatory variable are outlined in table 5.1. Coefficients with the negative sign implicate the negativity of the relationship e.g. for every change in the location of the household, there is a decrease in the probability of a household in cattle ownership, whilst a positive sign indicates an increase in the probability of a household in cattle ownership (see Table 5.1).

5.2.2 Rationalization of the logistic regression results

Nine of the thirteen hypothesized variables were found to have a significant effect on the decision by households to own cattle. These were; gender of household head, marital status of household head, age of the household head, household total size, benefits from livestock, previous cattle ownership in the family, homestead category, other income source, and land area. Of these variables, only land area was found to have a significant negative effect on the probability of the household owning cattle. This means with an increase in private cropping land area, there was an expected decrease in the likelihood of cattle ownership.

The significance of the variable age reveals that older household heads are likely to keep cattle than the younger household heads. The descriptive statistics showed indeed that cattle owning household heads were generally older than those without cattle. Age generally corresponds with experience and decision making responsibilities. Thus age of the household head is used as a proxy for experience in farming. Thys *et al.,* (2005) also indicated that elderly age and cattle ownership may also be justified by the fact that it takes long to acquire assets, and to build a herd of cattle takes longer due to its lengthy production cycle.

A family’s history of cattle ownership is significant with a positive coefficient in determining the likelihood of a person to own cattle. Such observation has

been reported elsewhere by Ainslie *et al.,* (2002), stating that, besides purchasing the most common way of gaining effective control over cattle is through inheritance. Most of non cattle owning households mentioned that should they have any other means of finance, they would definitely own cattle. Hence the results showed that the likelihood to own cattle increases with an increase in income earning opportunities elsewhere. In this case income would increase the affordability and also the chances of an increased head size, hence the coefficient for this variable is also positive.

A household's assets present the wealth and the ability of affording the desired livelihoods opportunities; thus the results revealed the positive likelihood associated with the ownership of cattle in rural households. The results highlighted a strong association of gender of household head with cattle keeping in the study area supported by a positive coefficient. The history concerning the social norms or moral standards that prevail in rural communities would be associated with the similar situations where gender of the household head still holds decisions in livestock keeping.

Birner (1999) indicated that cattle are associated with a positive social valuation furthermore the decision of households to keep cattle can be explained by their desire of recognition within the society and to maintain their social status. These findings are similar to those of earlier studies in the Northwest Province of Cameroon (Ndamukong *et al.*, 1989) and in many communities in southern Nigeria (Okali and Upton, 1985). Such findings indicate a need to clearly understand the traditional beliefs associated with each livestock species, particularly when planning for a livestock development program in a community.

The variable marital status forms part of the determinants of livestock ownership. The importance of marriage to livestock ownership has long been documented. An investment in cattle ownership eases the marriage arrangements since it also presents readily available cash. This study also reveals the association between family's marital status and cattle keeping.

The benefits from livestock ownership proved to be a significant determinant in the decision to own cattle corroborated with a positive coefficient. These

benefits range from income, meat, milk, dung, draught power, manure and social status. Manure plays a key role in crop production by providing essential crop nutrients (Chimonyo *et al.,* 2000). In addition, the use of chemical fertilizers is now becoming unattractive due to their effect on the environment. This creates a big demand for manure as source of organic nutrients for food and fodder crops. Cow dung can be a source of income in some communal areas where fire wood and electricity are unavailable.

The variable average household size had influence on the likelihood of cattle ownership, with larger households more likely to own cattle. The availability of land is another significant determinant of cattle ownership, this may be due to the fact that land especially the privately owned one presents the security of tenure and the assurance to the infrastructure development attached to the cattle production.

The variables such as head occupation, education level, household head base, ownership of resources did not have any significant effects on the probability of cattle ownership by a farmer at a particular time.

Table 5.1 Logistic Regression Results

Explanatory variables	**Coefficient**	**Standard error**	**Significance**
GENDERHEAD	1.5004***	0.3365	0.001
HEADMERIT	0.5276***	0.1717	0.002
HEADAGE	0.0322***	0.0110	0.003
HHSIZETOT	0.8235***	0.2641	0.002
CATOBANEF	1.7425***	0.5041	0.001
HHISTO	3.3414***	0.4267	0.000
HSTEADCAR	0.6880***	0.2479	0.006
GRANTRECE/OINC	0.7273***	0.2690	0.007
HEADOCCUP	0.1147	0.0925	0.215
FARMRESOURCE	0.2199	0.2770	0.427
HEADSCHOOL	0.0121	0.1036	0.906
HEADBASE	-0.0910	0.4115	0.825
LANDAREA	0.1159*	0.2081	0.078
Constant	3.5590	0.7676	0.000
Number of observations = 185			
Log likelihood = -78.135395			
LR chi2(3) = 95.84			
Pseudo R2 = 0.3801			

Note: ***, **, and * are significant levels at 1%, 5%, and 10%, respectively.

5.3 The ordinary least square results (OLS)

The OLS model was used to estimate the factors that determine the herd size, thus this model was limited to the cattle owners only. For this model, the adjusted R-square/ R^2, the F-test, the significance score and the overall p-value of the model indicate the goodness of fit of the model. The significance of the use of the adjusted R-square becomes important since as R-squared values increase when more variables are added to the model, the adjusted R-squared is often used to summarize the fit of the model as it takes into account the number of variables in the model.

5.3.1 The goodness of fit (GOF) for ordinary least square (OLS) model

The goodness of fit (GOF) of a statistical model describes how well it fits into a set of observations. GOF indices summarize the discrepancy between the observed values and the values expected under a statistical model.

In this study, the adjusted R^2 was 35%, the F-test was 4.39 and the overall p-value of the model was 0.001, indicating the overall model was significant in the explanation of the dependant variable (total number of cattle /herd size). The rest of the results for the OLS model are summarised in table 5.2. Possible reasons for the rather low levels of the adjusted R^2 could be the fact that the study focussed on socio-economic determinants whereas bio-physical variables such as mortality rate, birth rate and availability of grazing could have greater impact on the herd size. Thus a number of important variables affecting herd size could have been left out resulting in model misspecification.

5.3.2 Rationalization of the OLS results

Nine out of the 14 hypothesized variables namely; gender of household head, marital status of household head, age of the household head, household total size, previous cattle ownership in the family, homestead category, other income source, head occupation, farm resourses had an impact on herd size. The negatively significant variable was farm resources, whereas the rest were positively significant. The positive coefficients show that an increase in any of the positive explanatory variable, also results in a positive change in the herd size of cattle.

Notably, variables that were influential in determining the likelihood of cattle ownership still have more or similar influences in the explanation of the herd sizes to be kept by the farmer. Consequently the age of the household head has a positive coefficient and still remain as a positive significant determinant of herd size, thus the cattle herd size is expected to increase with an increase in the age of a household. With focus on gender and history of cattle ownership in the family, Kaimba *et al.,* (2011) reported that male-headed

households were more likely to keep larger herds of livestock. Also, households with bigger family sizes and those that had inherited livestock were more likely to own larger herds of livestock.

The household total size positively influenced the herd size to be kept, thus the size of the household represents the productive and consumption unit of the household (Makhura, 2001). The significance of the household total size was corroborated by a positive coefficient. Traditional agrarian studies show that household members represent labour resources and were hence subjected to be directly related to engagement in agricultural activities. It is therefore sensible to expect that a household with large household members to produce more marketable output of which in this case was cattle production.

The occupation of the household head also positively influenced the herd size to be kept and consequently this was supported by a positive coefficient; concurring with findings of Kaimba *et al.,* (2011). The results indicated an increase in the herd size of cattle kept associated with the access to finance from other sources excluding livestock rearing. It was noted that the households that had more valuable homesteads, had relatively larger cattle herd sizes.

The availability of land as a variable was not a significant determinant in cattle herd size under this model. In addition, the variables such as education level, commercial sale/average cattle price, household head base and provision of supplementary feeding did not have any significant effects in defining the herd sizes that a farmer keeps at a particular time.

Households who consider commercial sale/average cattle prices were likely to make use of market information and sell their animals for commercial purposes or for profit purpose or other reasons such as school fees, leaving them with little or no livestock, hence playing a speculative role in buying and selling cattle rather than owning them.

Table 5.2 Ordinary Least Squares (OLS) Results

Explanatory variables	**Coefficient**	**Standard error**	**Significance**
GENDERHEAD	0.3534***	0.0705	0.000
HEADMERIT	0.1261***	0.0397	0.002
HEADAGE	0.1355*	0.0718	0.063
HHSIZETOT	0.1829***	0.0563	0.001
HHISTO	0.6579***	0.0545	0.000
HSTEADCAR	0.0908***	0.0321	0.005
GRANTRECE/OINC	0.1716***	0.0579	0.003
HEADOCCUP	1.8293***	0.6666	0.007
FARMRESOURCE	-0.0650**	0.0331	0.051
HEADSCHOOL	0.0243	0.0775	0.763
HEADBASE	-0.3293	0.2943	0.266
AVCATTLEPRICE	0.0117	0.0462	0.103
FEEDCATT	0.3039	0.3277	0.356
LANDAREA	0.0811	0.1315	0.539
Constant	0.2981	0.0868	0.001
No of observation =90			
Adj R-square=35%			
R-Square=46%			
F-test =4.39			

Note: ***, **, and * are significant levels at 1%, 5%, and 10%, respectively.

5.4 The Heckman Selection Model results

This model is also called the type II Tobit sample selection model. This model consists of the participation/selection and the outcome equation. The participation equation was estimated using the entire sample of 185 farmers with the dependent variable recorded as “1” for all non limit observation/observed variables, whereas the limit observations/unobserved variables were recorded as “0” in the outcome equation. The participation equation concerned the whole sample size of the study (Cattle owners and Non cattle owners), whereas the outcome equation concerned the participants selected in the first equation (Cattle owners).

The parameter ρ (rho) is the correlation coefficient between residuals of the participation/selection equation and the outcome equation. The value of ρ (rho=1) is however significantly different from zero, indicating that the residuals of both equations are related, so there is sample selection problem in the model specification and OLS alone cannot be used as the predictor of the positive value of cattle herd size in the outcome equation. The Heckman's technique is thus more appropriate to avoid bias. The results in full are presented in table 5.3.

Table 5.3 Results of Type-II Tobit Model (Heckman Selection Model)

Explanatory variables	**Selection phase (likelihood of cattle ownership)**			**Outcome phase (cattle herd size)**		
	Coefficient	**SE**	**Sig.**	**Coefficient**	**SE**	**Sig.**
GENDERHEAD	2.4114***	0.4265	0.004	16.4152**	0.8389	0.021
HEADMERIT	0.3014***	0.0321	0.008	111.352***	0.4778	0.004
HEADAGE	2.0257***	1.0110	0.006	0.6632**	0.7512	0.045
HHSIZETOT	0 .6253**	0.6421	0.023	0. 2978*	9.0345	0.063
CATOBANEF	3.5736**	0.5041	0.011			
HHISTO	3.3412**	0.3647	0.021	66.5563***	125.540	0.001
HSTEADCAR	1.6630***	0.7429	0.006	0.2761**	35.6235	0.012
GRANTRECE/ OINC	0.6267**	0.6926	0.017	0.9236***	2.0794	0.006
HEADOCCUP	0.2274	0.2905	0.315	13.638***	0.0375	0.001
FARMRESOURCE	2.1996	2.7720	0.226	0.956**	65.1573	0.011
HEADSCHOOL	0.2141	1.0136	0.607	63.705	53.892	0.208
HEADBASE	-0.0820	0.1146	0.726	-2.845	1.434	0.115
LANDAREA	-0.1285**	-0.3081	0.021	-0.3826**	5.3748	0.032
FEEDCATT				17.345	0.8968	0.303
CATOREASON /COMSALE				4.5163***	9.0531	0.001
Constant	2.6680	2. 3384	0.011	1. 6495	16.781	0.004
Sample size = 185						
Number unobserved = 95						
Number observed = 90						
Log likelihood = -484.0459						
Wald Chi-square = 451.53						
rho =1						

Note: ***, **,* are significance levels at 1%, 5% &10% respectively.

The empirical analyses presented in table 5.1, 5.2 and 5.3 were describing the relationship between the dependent variable and the independent/explanatory variables. The conclusion of the findings are made reasonable or concrete by the results on table 5.3 which eliminated the sample selection bias, that arises when OLS is used alone. Therefore, table 5.3 presented the empirical results wherein there were fifteen hypothesized variables anticipated to explain the probability of households to keep cattle

(selection phase) and their herd sizes (outcome phase). The implications of using this model will be discussed in section 5.7.

5.5 Factors influencing the decision of a household/farmer to own cattle or not in the rural areas of Limpopo province.

The results revealed that there were only nine variables found to be significant on the determination of the participation of the household in cattle ownership. The significant variables were; gender of the household head, marital status of household head, age of the household head, household total size, benefits from livestock, previous cattle ownership in the family, homestead category land area and income source . The rest of other variables were not significant and these were variables such as, educational status of household head, location of household head, household head occupation and, and farm resources.

5.5.1 Gender of the household head

Male ownership rights over animals has always been guaranteed by a near universal set of inheritance rules that were gender biased and rooted in religion and patriarchal kinship systems (Dahl, 1987). Gender of the head of the household had an impact on the decisions made concerning the livestock production; perhaps that was due to the notion that male farmers were historically more involved in agricultural activities than their counterparts. Female farmers were known to face constraints such as weak land rights, limited access to livestock resources, and limited access and contact with agricultural extension officers and lower levels of education (IFAD, 2001; Matungul *et al.,* 2001).

The gender of the household was significant in the current study as one of the determinants of cattle ownership. These findings were corroborated by the study of Nenghanjwa (2005) which highlighted the gender disparities in livestock ownership in Teso Farming System (TFS) households in South Africa, with the women being disadvantaged, whereas men owned 62% compared to women who owned only 14% with the joint ownership being 19% and the remainder being the children.

The findings in this study showed that predominantly male household heads were involved in livestock ownership decision making ,furthermore this was in accordance with general observations made in Burkina Faso during the National Survey for Agricultural Statistics in 1993 (Thys *et al.,*2005). In another study, the percentage of female households that kept livestock was low i.e. 33% in Addis Ababa and 29% in Nairobi on 16 out of 56 surveyed households (Tegegne, 2004). Analysis of cattle ownership patterns was conducted on a large sample size of 736 households in Kenya, and the results showed that 66.9% of owners were husbands, 18% were the spouse and 13.8% for the children (Onim, 2003). Such findings were similar or comparable to the results of this current study.

5.5.2 Marital status of the household head

The marital status was significant as a determinant of cattle ownership. It was possible that many families of couples living together had access to more organised labour available in the household created by giving each other respective household tasks. Such a situation reduced the payments that could have been made to the hired cattle headman and the costs of impoundment when cattle get into people's fields. From the survey of this study some households went as far as mentioning that paying an adult man for looking after two or three cattle was economically not prudent. It was easy and cheaper when the cattle belonging to the parents were looked after by their children, since cattle served as a big investment to the family.

5.5.3 Age of the household head

Age of the household head normally provides a proxy for experience in farming. Age was a crucial factor since it determined whether a household head could make a concrete final decision in the homestead or not. Older households heads tend to have a reliable reputation and credibility in the homestead, thus they were much trusted in decision making. These results were in line with Barry (2001) who analysed the determinants of small ruminants' adoption in the peri-urban region of Khorogo discovering that age and ethnic background enhance the probability of livestock adoption. As confirmed by Joseph *et al.,* (2007), cattle owners were generally older and

also wealthier than non owners as indicated by ownership of assets. The likelihood of owning livestock increased with the age of the household head. Normally, cattle take some years to reach maturity and their life span were accompanied by their use for draught power and for milk and perhaps mainly as a form of wealth which may take time to accumulate, hence most cattle owners were older. So, it was not surprising that livestock owners were, on average, older than non owners.

Younger people will tend not to have the capacity to make decisions in ownership of resources in the homestead. This was maybe promoted by the common tendency in the rural areas of South Africa whereby younger people lack interest in agricultural activities, moreover they were likely to migrate in search for urban employment, while older households remain behind and supervise livestock farming (FANRPAN, 2012; Adebayo, 1999). The situation of lack of interest in agricultural activities in addition to urbanization played a part in the reduction of likelihood of the youth owning cattle.

5.5.4 Household total size

The household total size was another indicator associated with high probability of desire to invest in the livestock farming. Where there were higher numbers of household members in the family unit; the higher the likelihood of such a family unit to own cattle. This could have been due to the abundance of the free or cheaper family labour that could look after the cattle, whilst the cattle owner was off to work or other income earning opportunities. More household members reduced the costs for employing people to look after cattle since they provide family labour.

5.5.5 Benefits received from livestock

The benefits received from cattle, either consumable or non-consumable were of greater significance in determining the decision for cattle farming. As emphasized by the households i.e. both the cattle owners and the non cattle owners, these benefits (manure, dung & draught power) were mentioned to be influential by almost 65% of the respondents.

Cattle production was closely interrelated with crop production. Cattle manure and draught power were the inputs to crop production which were utilised across the household owning the cattle and also the households that do not own cattle, with additional benefit being the improvement of soil quality. Consumption of milk and meat from local slaughter and local butcheries also took place largely within the households for which quantitative data was very limited.

Significant proportion of slaughter as an off-take occurred within the communal lands providing meat and animal by-products to the local community. Other cattle were sold for fattening or slaughter in the commercial sector to raise cash. Investment of crop income in cattle ownership can lead to capital growth as the herd grew through purchasing and reproduction.

Scoones (1990) compared livestock production in areas of sand and clay veld and found that the benefits of manure application were much higher on the poor granitic sands than in areas of heavier soils. The value of manure on sandy soils has also been noted by other workers particularly when applied in conjunction with fertiliser. The main source of manure was from the kraals in which the animals were kept overnight. From actual measurements, Scoones (1990) estimated that the average quantity of manure recoverable from kraals per annum amounted to 2.6 cartloads (880 kg on a dry basis) although this may be an overestimate because of the time of year of the study.

The agricultural work of draught animals in communal areas can include ploughing, ridging and weeding, not only on the fields of the cattle owner but also on those of other farmers. However, respondents from this did not mention the use of animals for carrying and pulling goods as an important aspect. The full utilisation of draught animals in field work was constrained by limited availability of implements such as ploughs, ox-drawn cultivators, harrows and scotch carts, whilst with time it was being replaced by technology.

5.5.6 Previous history of cattle ownership in the family

This study revealed that the probability of the household to own cattle was high especially if the household head is from a family that has a history of owning cattle. Some households indicted that inheritance can largely explain why they easily own cattle for instance; amongst other respondents, two households from Mabulo village managed to inherit heads of about 18 cattle each as the relatives of the late household heads.

The experience of having grown in a family where cattle were owned, milked, and used for draught power gave an ideal liking or desire to a person exposed to such condition to have no hesitation in starting such an enterprise.

5.5.7 Land area

The availability of land area for cropping per household head in the villages was negatively significant when associated with the household probability to keep cattle, meaning that there was an indirect relationship between land availability and cattle ownership. This finding confirms finding by Joseph *et al.,* (2007) that the larger the land area exploited, the greater was the household's income, and the less likely was the household to own cattle. Greater land area exploited might also indicate a specialization in crop agriculture, and in this case livestock ownership may be less likely.

5.5.8 Availability of other income opportunities to the household head

Additional income was positively associated with the household's increased probability of keeping livestock. The additional income helped households to be able to acquire their livestock as assets as well as allowing a household to acquire some physical assets. It was observed that households with additional income always had the records of purchasing additional cattle into their herds.

The presence or absence of monetary capital in a household generally set the categories in the living standards of people. It was observed that the ability of the poor to acquire cattle was constrained by the capital and maintenance costs of the livestock which were typically highest for large cattle or ruminants (IFAD, 2001; Kitalyi *et al.,* 2005). This supported the information that the

presence of household opportunity to earn additional income increased the household's interest and ability to invest in livestock, through buying the initial livestock, additional livestock and maintenance of livestock's health. Consequently, wealthier households were more likely to keep cattle than poorer households.

Nugent (2000) stated the fact that pure livestock keepers were wealthier related to the observation that households would keep animals independently from their financial status for socio-cultural purposes or that livestock would be more considered as a source of revenues than crop production. Indeed, such case study seemed to prove that the annual financial return of livestock can be very high. Low-income household heads might have pursued or started livestock production as a strategy to vary their sources of income.

5.6 Determinants of herd size in cattle owning households

From the results (see Table 5.3), most of the variables used in explaining the decision of a household to keep cattle are also associated with explaining the decision of a household to keep a given number of cattle. For herd size, the results revealed that eleven out of fourteen variables were found to be significant. The significant variables were; gender of the household head, marital status of household head, age of the household head, head occupation ,household total size, previous cattle ownership in the family, homestead category, farm resource endowments, income source, commercial sale of livestock and land area.

5.6.1 Gender of household head

From the decision to own cattle, the herd size of cattle owned should also be decided on. This shows the influence that gender of household head has on the control of livestock herd size. The household head would be the one in charge of control over the cattle herd as an asset, and thus the household head is entitled to decide when to purchase additional animal and when to cull the animals. For example, a study conducted by Lahiff (1997) indicated that men treated cattle as their own personal asset rather than the household asset.

Nevertheless, some similarities can be found across several countries and ethnic groups with respect to gender patterns for ownership and care of livestock. The family members who keep backyard poultry and other small stock near the home are often the women and girls. In most parts of the world, women can decide about vaccinating, slaughtering and selling of poultry without consulting their husbands, and they control the income from selling poultry products (IFAD, 2007).

5.6.2 Age of the household head

It usually takes longer for an individual to acquire financial capital that can purchase an animal, particularly cattle. This also supports the fact that cattle take relatively longer to build up a larger herd size due to their reproductive nature. Thus an older individual cattle owner would be expected to have larger herd size as compared to a younger cattle owner, when holding other factors constant. For instance Alary *et al.,* (2011) showed that, in Niger, 60% of households rely on sale of animals to cope with food shortages or unexpected medical expenditures, thus herd sizes vary with respect to such dependency on events.

5.6.3 Household total size

Lahiff (1997) reported that a sizable average household's number keeps larger herd size than the larger household total size e.g. household size of 5-7 members and a household size of 8-10 members owned 11-20 cattle and 1-10 cattle respectively. Also some of the household heads lost their cattle through sale as their children grew up to become independent somewhere else. The numbers of people in the homestead were also associated with the costs to nourish them and also this holds in this study where a certain optimum herd size is being kept in an optimum household size, once the household size increases; there was also a decrease in the herd size noted. With such results it seems that the herd size increases with the maintenance costs, hence the family costs also increase until reaching a point where the herd size decreases in order to care for the family (sales and other related benefits). On the other hand however, larger households could have more manpower to keep more cattle.

5.6.4 Previous cattle ownership in the family

The significant positive relationship between livestock inheritance and herd size noted in this study suggested that household heads who have inherited livestock are likely to have larger herds than those who have not; similar evidence had been reported by Kaimba *et al.,* (2011). In some cultures such as pastoralists, a man's ownership of livestock starts at birth, where the father gives the child at least one female animal often symbolized by tying his navel cord to the animal soon after being born, and thereafter his herd builds up. Amongst the Somali community, this practice is known as wahad (Kaimba *et al.,* 2011). As such some of the probabilities of increased herd size were accelerated through the inheritance and the respondent's background.

In some societies, women may own some animals in several ways such as through (e.g. having brought them into the family upon marriage or acquiring them later through inheritance) yet they have little say about selling or slaughtering them, thus little or no control over herd size variations (Oboler, 1996).

5.6.5 Homestead category and farm resources

Conditional on keeping livestock, one would expect poor households to keep smaller herds than better-off households. Ellis and Freeman (2004) found that mean livestock herd size grows along income quartiles in Kenya, Malawi, Tanzania and Uganda. USAID (2007) observed a positive correlation between mean income and cattle herd size in Botswana. World Bank (2008) reported a positive association between livestock herd size and household well-being in Nicaragua.

In this study, larger herd sizes were reported from better-off households based on the type of their dwellings and related belongings. Lahiff (1997) reported that during drought seasons, the households who saved almost all of their cattle from death due to hunger and thirst were those who had recognisable assets, with some having their own boreholes for harvesting underground water and also those with cars and tractors who managed to convey water from far away. The homesteads that had valuable dwellings

always had larger herd sizes, perhaps due to their ability to limit disaster from mortality through diseases, drought and also increasing herd size through buying additional cattle.

5.6.6 Other income source and the occupation of household head

Additional income sources create extra cash flow to the homestead, which in turn creates chances for the purchase of additional cattle especially for those who have cattle. The household heads that had such income sources generally had larger herd sizes. The positive correlation between other income source/non-livestock income and herd size suggested that households generating income from activities outside livestock rearing were likely to keep larger herds of animals. This was perhaps an indication that herders may invest their non-livestock income into increasing their herd size.

When a household head has a secured occupation/work, this is imperative for various reasons including increased family security, ease of access to cattle herd increment, management and also other household needs such as food, school fees, medical treatment, etc. Thus when the household heads had some sort of employment one would expect an increase in the likelihood of increasing the herd size through the purchase of the additional animals (Lahiff 1997).

5.6.7 Land area

The availability of land to the community is of great importance for humans' continued existence (Maura *et al.,* 2003). Rural people use the available land in order to meet various livelihoods options such as land cultivation for crops, livestock rearing, and other options. With regard to livestock, land availability favours the availability of forage and other livestock needs such as water sources and many more. The availability or unavailability of land as one of the resources determine the ease or struggle by the cattle owners and cattle themselves in the need for grazing (e.g. more available forage simplifies the grazing distances, yet the opposite is just true). Given the fact that the availability of land in the study area was quite limited, one would expect a

decrease in the livestock numbers and also less desire by the households in owning cattle, thus a negative relationship.

Other factors that were also observed were a lot of mountainous landscape, garden and homestead fences over several portions of the limited land, consequently these exerted great impediments to livestock production as the livestock movements to access feed were increased. The reality of the scarcity of land and its livestock supporting resources reach the peak during the winter months. This period is coupled with a negative impact on livestock productivity (Maura *et al.,* 2003). Appropriate measures in these systems would be to develop flexible responses to drought and seasonal forage deficits that would allow livestock owners to more accurately align their animal numbers to drought cycles, and thus ensure that they do not either lose their animals through large-scale die-offs during droughts or have to dispose of them cheaply in an oversupplied market.

5.6.8 Commercial sale

The need for cash in the homestead directly affects the herd size through sales of cattle in order to satisfy such needs. Some of the household heads have sold their animals whenever they face some complications (death and shortage of finance at home) or celebrations in the family (wedding and bride payments). Alary *et al.,* (2011) indicated that an investment in livestock would therefore enable them to earn extra-income to meet their personal requirements, enhance the household's capacity to cope with shocks (i.e., to purchase staple foodstuffs), and continue the enrolment of children into primary education.

5.7 Discussion of the analytical techniques used

Two analytical approaches were used in this study. First the household decision to keep cattle and their herd size were determined using logistic regression and OLS respectively. Thereafter, the Heckman selection model (type II Tobit model) was applied to the analysis. The logistic regression investigated the determinants of cattle ownership throughout the whole sample of 185 households. The determinants of herd size were conditional

upon the ownership of cattle, thus: it was limited to those households who own cattle and this was analysed using the OLS model. Thirdly, for the suppression of biasness that may prevail in the logistic regression and OLS, the Heckman selection model was applied to the data.

The results of the logistic regression model were in line with the participation/selection phase of the Heckman selection model; whereas the results of the OLS were also in line with the outcome phase of the Heckman selection model.

The Heckman selection model was best suited for the examination of this research since this research had two elements namely ; (i) the first stage is the choice model (is the farmer participating in cattle ownership or not?) and for this, the predictor components of the model were used to determine such likelihoods. (ii) The second stage then examines the influence of the independent variables on the outcome following the participation (cattle herd size for cattle owners). Therefore, Heckman model is capable of running two models at a time. This model has proved to be the hybrid solution especially when used with the logistic regression or probit and the OLS (Tobin, 1958; Makhura, 2001).

The parameter ρ (rho) is the correlation coefficient between residuals of the participation/selection equation and the outcome equation. When the value of ρ (rho=0), the OLS estimates are not biased, hence OLS can be used as a predictor alone, yet when the value of ρ (rho=1) is however significantly different from zero, indicating that the residuals of both equations are related, so there is sample selection problem in the model specification and OLS alone cannot be used as the predictor of the positive value of cattle herd size in the outcome equation. The Heckman‘s technique is thus more appropriate to avoid bias. The results in full are presented in table 5.3.

The constraints of these models were that; the logistic regression best described the likelihood of participation and not the value resulting from participation, whereas OLS can best describe the influence/value resulting from participation, hence the latter would result in sample selection bias if

used alone for the whole sample size that involved the participants and non participants.

In conclusion of the findings, overall model results were similar with the significant variables being quite analogous. The variables that were significant in determining a household's decision to keep cattle were as follows: gender of household head, marital status of household head, age of the household head, household total size, benefits from livestock, previous cattle ownership in the family, homestead category, other income source and land area. The variables that were significant in determining the herd sizes of cattle on the households who keep cattle were as follows: gender of household head, marital status of household head, household total size, previous cattle ownership in the family, homestead category, other income source, farm resources and head occupation.

It was revealed throughout this study that the use of these models should be based on reference to other research that has similar objectives. For instance, the research that involves the choice of participation and the value resulting from participation by the participants. The use of all three techniques is recommended for proper comparison, hence the decision differ with individuals and are subject to the available budgets, time and the availability of the software that are able to run such models. If budget and time are part of constrains, it is recommended to apply the hybrid model for logistic regression/probit and OLS, which is Heckman selection model.

5.8 Summary

This chapter was the core of the research as it presented and addressed the objectives and findings of the whole study. All the findings were attributed to the analytical techniques which were generated by the computerised model of the software. Once the results of the research have been explored, this gives the opportunity for the proceeding chapter that concerns the conclusions and ways of correcting and improving the research findings.

The overall conclusion of the findings was substantiated by the results of the Heckman selection model which asserted to give the outcomes which were

more precise, moreover as it eliminated the possible sample biasness, for instance: having selected the cattle owners only or non cattle owners only, in this situation some of the data would be missing and their effects would be omitted in the outcomes of the study.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the overall summary on the findings of the study and concluded the findings derived from the econometric analysis. Conversely, this chapter discusses the extent to which research objectives and hypotheses demonstrated at the beginning of the study have been addressed by the empirical analysis. The chapter also suggests recommendations on the best ways to improve commercialised cattle farming, whilst reducing the negative effects on the environment in order to enhance the livelihoods of rural small-scale farmers in Limpopo Province.

This chapter is presented in three sections starting with the summary of the research followed by the conclusions of the key findings of the research and lastly, the policy implications intended for enhancing the cattle farming whilst improving sustainable production in the dry land areas of Limpopo Province.

6.2 Research summary

The study was conducted in Mutale Local Municipality located in Vhembe District of Limpopo Province in South Africa. Mutale Local Municipality is one of four local municipalities in Vhembe District and it is situated in the far north-eastern corner of Vhembe District, approximately 35 kilometres from Thohoyandou town. Mutale Municipality consists of 13 wards, and it shares borders with Musina Local Municipality to the north, Makhado Local Municipality to the south. The municipality has a population of 95 712 spread over 150 Villages which are completely rural. The total land cover of the municipality is 2,375,782.12 hectares with the great Limpopo River forming the north-eastern boundary.

The research used the primary data collected in 2012 using the standardised structured questionnaire. The data was collected from five villages of Mutale Local Municipality in the Vhembe District namely: Tshixwadza, Mapuloni, Gogogo, Matshavhawe and Mabulo. The sample size was 185 which was

made up of 5% of each village population. The sampling method used was the stratified random sampling. In addition, proportional stratified sampling procedure was used to justify the inconsistency that would occur since sampled villages had populations of different sizes. These allowed the different village population sizes to become more equally represented in the sample size.

The aim of the study was about finding the determinants of cattle ownership and herd size in Vhembe District of Limpopo province. There were two main objectives in the study which were; to determine the socio-economic factors affecting the household decision to keep cattle and also to analyse the determinants of herd size in livestock keeping households.

The programme used to analyse the data was STATA 2010. The descriptive analysis which revealed the characteristics of the population was also conducted using the same programme and these were in a form of means, frequencies, percentages and standard deviations. For empirical analysis, the study used the logistic regression model and the OLS model separately there after the two models were substantiated by the Heckman selection model. The logistic regression model was used to predict the probability that a given household would own cattle or not, there after determinants of herd size, conditional on livestock ownership were determined in the second step through the OLS model, afterwards the Heckman selection model was used and this model concluded the initially applied models.

The empirical results revealed that nine variables were significant in determining the probability of a household to own cattle namely; gender of household head, marital status of household head, age of the household head, household total size, benefits from livestock, previous cattle ownership in the family, homestead category, other income source and also the land area. The rest of the variables that explained the decision of a household to keep cattle were also associated in explaining the decision of a household to keep a given number of cattle, with the latter bearing the limit to those households who keep cattle.

6.3 Conclusions

In conclusion, the overall research intended to address the main two objectives and two hypotheses. The objectives were: (i) to determine the socio-economic factors affecting household decision to keep cattle and (ii) to analyse the determinants of herd size in livestock keeping households. The hypotheses were: (i) there were no socio-economic factors influencing household decisions to keep cattle and (ii) there were no significant socio-economic determinants of herd size in livestock households. Arguably there were socio-economic factors that affected the probability of a household to keep cattle and these were: gender of household head, marital status of household head, age of the household head, household total size, benefits from livestock, land area, previous cattle ownership in the family, homestead category, and other income source. These findings allowed the rejection of the first hypothesis which stated that there were no socio-economic factors influencing household decisions to keep cattle.

Concerning the second objective and hypothesis of the study, the results concluded that there were socio-economic determinants of herd size in livestock households and these were: gender of household head, marital status of household head, age of the household head, household total size, head occupation, benefits from livestock, commercial sale/cattle price, previous cattle ownership in the family, homestead category, farm resources, land area and other income source. These findings consent to the rejection of the second hypothesis which stated that there were no significant socio-economic determinants of herd size in livestock households. The findings validated the final statement which articulated that the size of the herd kept, conditional on the decision to keep cattle having been made by the household, was influenced by the similar variables that influence the decision to keep cattle in the first place.

6.4 Policy implications and recommendations

This study suggested ways in which the livestock farming especially cattle farming, in the small holder sector can be improved or can be commercialised hence alleviating poverty in rural areas of South Africa whilst making an

endeavour to improve food security and to reduce the negative effects of livestock on the environment. The policy implications suggested in this study cut across several sectors and institutions such as: the government sectors, parastatals and other non-governmental sectors.

- **Encouragement of youth participation in agriculture**

With evidence from this study, the majority of farmers were of old age group. Most young people tend to understand agriculture in a different dimension e.g. having a notion that agriculture is dirty and time consuming work suitable for older rural people as well as a notion which depicts that rural farmers are unable to become anything above the social class of poor subsistence farmers.

Farmers' organisations that consist of successful small scale farmers should be formed and in addition, they should include the youth as their members in order to attract and motivate young people into farming. Setting examples with successful farmers easily attracts the interests of young farmers, overcoming the historically negative perceptions.

Most of the youth were associated with greater concern for the need of better work opportunities in towns and cities. Thus; another approach would be the creation of work opportunities in rural areas in order to retain the youth in villages so that those interested in farming can still be involved in agricultural production.

- **Promotion of gender equality and improvement of women's consideration on decision-making in agricultural production.**

The involvement in cattle ownership by women in this study has been found to be low as compared to that of men. This was supported by the observation that women were often time constrained by unpaid household duties such as care giving to children, spouses, collecting firewood and water and lower levels of human capital. All of these affected women's contribution, visibility and labour productivity in agriculture. In addition, female-headed households had less labour available for cattle heading than male-headed households because they typically had fewer working-age adult members.

Women do play an important role in activities dealing with livestock ownership, management, and marketing although they have limited time and resources. Identifying and supporting these roles; decision-making and capabilities of women as livestock owners, processors and users of livestock products; would be the key aspects to promote women's economic and social empowerment and consequently rural women's ability to break the cycle of poverty.

The priority areas for gender reform include eliminating the discrimination against women in access to agricultural resources, education, extension and financial services based on traditional norms. Investing on production enhanced technologies and village infrastructure such as: closer water taps and use of electricity as an alternative to fire wood would free women's time for more productive agricultural activities.

Increasing women's confidence in decision making, access to land and livestock would boost their involvement and productivity hence generate gains in agricultural output, food security, economic growth and social welfare. Such policy interventions can help close the gender gap and improve consideration of women in agriculture and rural labour markets.

- **Provision and conservation of agricultural grazing land and livestock infrastructural development.**

In general for semi-arid areas, the rule of thumb was that for one cattle to grow and produce appropriately, 8ha of undisturbed grazing land per cattle per year is needed. The research has shown that there were about 1060 cattle within five villages that had the communal grazing land of less than 500ha each. This revealed a significant shortage of grazing land in those villages which also lead to overgrazing. The availability of grazing land directly affected agricultural production, particularly cattle production.

The solution to this problem would be through the provision of stringent controlled livestock numbers through the agricultural officers and environmental conservationists. Also the grazing lands can be protected by

provision of the fences around each village's grazing area which will promote re-growth of forage and controlled utilisation.

In addition, interest in livestock keeping could also have been affected by lack of proper legal control system specifically related to livestock keeping. The communal tenure arrangement is such that households share common grazing land. Maintenance of the land is non-existent and its use is disorganised as seen in lack of proper fencing, watering points and grazing rotation programmes. Part of the consequence of this is overgrazing and soil erosion.

Institutions need to be set up to control the use of the grazing resources. Investments need to be made in maintenance of facilities on the grazing land. Extension officers could act as an important link between the government and rural communities, hence they could also act to monitor the use of grazing land once proper investments have been made.

- **Intensification of the cattle input support schemes (feed, water and disease control)**

Cattle farmers experienced severe losses of their animals in winter season which was typically associated with shortage of forage and water. The shortage of forage was linked to unavailability of the land in which the forage should grow and the water that should nourish it.

In addition to that was the poor control of diseases through dipping and vaccination which was accelerated by the expensive prices of cattle medications. A number of farmers stated this as a major challenge since some gave up on purchasing medications causing the quick recurrence of diseases and ticks to the herd of those who purchase medication.

Considering such challenges, the solution would be the provision or intensification of the animal feed subsidy schemes and also the provision of ground water points for animals in villages. The latter will improve stock water availability throughout the seasons of surface water shortage; hence reduce the reliability on the streams that eventually dry out in harsh seasons. The

provision of subsidy on livestock medication products would encourage farmers to purchase and apply medications to their cattle.

- **Encouragement of cattle farmers to consider farming as a business than just a cultural norm.**

There were about 60% of farmers who sold cattle in the three years period investigated. This could indicate that farmers have the idea of commercialising cattle in those villages. There should be assistance in the provision of information on the livestock markets by the agricultural advisors and other parastatals. This can also reduce the tendency of keeping an animal for sentimental purposes, although this cannot completely be reformed immediately but over time, and would be expected to fade away gradually.

Efforts should be vested in exposing the farmers to auctions and other cattle markets that give prime profits as to encourage them to farm for profit and perceive livestock farming as a profitable business.

- **Provision of job opportunities in homelands**

The majority of households who had the opportunity to earn additional income were most likely to own cattle. As such, increasing the opportunities of rural people to get employment especially in the rural areas would increase the chances of households to engage in cattle farming.

In addition, this would also reduce the migration of people from rural areas to urban areas leaving few people to carry-on with agricultural production as the source of livelihood. Thus, provision of employment opportunities in rural areas would also boost agricultural practices in general.

6.5 Need for further studies

Much agricultural research has been done since the advent of a democratic government in South Africa but there is still a long way to go. Opportunities for pro-poor rural growth should be explored and exploited further more in order to establish mitigation strategies to those challenges. Therefore there is still a need to research about other factors that affect cattle production, ownership and environmental sustainability from different dimensions.

6.6 Summary

The need for the study was presented in the beginning of the research and the determinants of cattle ownership and herd size have been explored and exploited. Such findings would help the policy makers to make the mitigation strategies to help enhance commercialisation of cattle production and combat environmental degradation in the rural areas. All this was compiled through initially gaining the understanding of the livestock farmer's characteristics and ownership patterns including the factors affecting or influencing their perceptions.

Collectively with other related studies, the findings from this study provide useful insights towards the designing and implementation of policies and strategies to improve the commercially orientated cattle production, whilst promoting sustainability and providing the additional livelihoods opportunities to the rural people.

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APPENDICES

Appendix 1: Questionnaire for cattle owners

TO BE FILLED BEFORE THE INTERVIEW COMMENCES

Name of the enumerator ……..

Village of household…….

Date of interview ……

Full name of respondent.……

Relationship to the household head ……

Gender of respondent	1.Male		2. female	

Is the respondent the head of the household?	1.yes		2. no	

SECTION 1

BASIC HOUSEHOLD INFORMATION

This section focuses on the people living in the same homestead and also includes people who leave away from the homestead but still come back: example; people who come **back on regular basis like in a week, month or a year who contribute to the income used at the homestead.**

1. What is the name of household head?……
2. Gender of household head?

1.male		2.female	

3. What is the Year of birth for the household head? ……
4. What is the main occupation of the household head?

1	2	3	4	5	6	7	8
Fulltime farmer	Part-time farmer	pensioner	Employed civil servant	Employed private company	Small medium business enterprise	unemployed	Other.

8: specify SMME……..

5. Where is the household head based (*only 1 choice possible*)

1	2	3	4
Locally	In town comes on weekend	In town comes on monthly	Other (specify)

4: specify ……

6. What is the marital status of the household head? (*1 Answer possible*)

1	2	3	4
Single	Married	Widowed	Divorced

7. How many years did the household head go to school? (1 *Answer possible*)

1	2	3 Grade	4	5	6	7
0	1-4	5-7	8-10	11-12	Tertiary–diploma/certificate	Tertiary–degree & above

8. Are there any cattle that do not belong to the household that are being looked after here?

   1. Yes / 2. No. **(*Circle the right answer)***

9. If yes, how many are they……

10. Are you paid for it?**1.Yes /2.No (*circle the right answer)***

The following questions are about the cattle owner: if the owner of cattle is only the household head skip this section to Q12.

11. Gender of cattle owner

1.male		2.female	

12. What is the main occupation for cattle owner?(1 *Answer possible*)

1	2	3	4	5	6	7
Fulltime farmer	Part-time farmer	Pensioner	Employed civil servant	Employed private company	Small medium business enterprise(SME)	unemployed

6: Specify SME……

13. Where is the cattle owner based?

1	2	3	4
Locally	In town comes on weekend	In town comes on monthly	Other (specify)

4: Other (specify)……

14. How many people live in your household? (*Answer all categories: fill in 0 if none*)

Adult male(18 years & above)	Adult female (18 years & above)	Boys (10-17)	Girls (10-17)	Children (less than 10years)	Total

15. Which of the following activities do you have in the household?

Activity	Growing crops	Livestock farming	Formal employment	Small & medium business enterprise	Other

Other activities (specify them) ……

16. Which of the following other sources of income do you have in the household?

Source of income tick if yes	***(Tick if yes)***	**frequency**
Receiving grants		
Remittance from non-household members		……...per…….
Private pension(not-pension grant)		……. Per……..

17. How many people in the household receive each of the following types of grants?

Grant type	Pension	Child	Disability grant	Other grant (specify)…….
No of members				

SECTION 2

THE NEXT SECTION OF QUESTIONS ARE SPECIFICALLY FOR CATTLE OWNERS

18. For each of cattle herd that the household has, complete the following table.

	How many do you have now?	**How many , 3 years ago?(in 2011)**
Breeding cows		
Breeding bulls		
Heifers		
Oxen & bulls under		

2 years		
Unweaned calves		
Total		

19. For how long have you been keeping your cattle ?……years
20. Have you been raising your parent's cattle before you had your own cattle? **1.Yes /2.No (*circle the right answer)***
21. Initially, how did you start owning cattle?

1	2	3	4	5	6
Bought	Present	Inherited from family member	Payment from services provided	Exchange for other valuable things	Other

6: other (specify)……

22. Where did you get the initial money to start keeping cattle? (**Only if the cattle were bought**)

……

23. Dou you regard tradition as the main reason for keeping cattle? **1.Yes /2.No (*circle the right answer)***
24. *Do you regard commercial sale of cattle as the main reason for keeping cattle?* **1.Yes /2.No** (*circle the right answer)*
25. Beside **tradition** and or **commercial sale**, What were the other reasons for keeping cattle ?**(more than one answer possible)**

1	2	3	4	5	6	7	8
milk	Meat	security	manure	drought power	hides	other (specify)	Other (specif

							y)

8. Specify …….

26. Can you give the most important 3 reasons for keeping cattle?**(1 is the most important)**

1	2	3

27. Do you buy extra feed for the cattle? **1. Yes/2. No (*circle the right answer)***,
28. If yes, what type of supplement do you buy?

Product bought	**Cost (R)**	**Where do you buy the feed?**

29. Do you dip your cattle? **1.Yes /2.No (*circle the right answer)***,
30. If no, how do you prevent diseases?…….
31. In the last three years, did you buy cattle? **1.Yes /2.No (*circle the right answer)***
32. If yes, what is the main reason for buying cattle?

1	2	3	4	5	6
Commercial sales of cattle	Sale of cattle product(milk, meat, dung)	Dignity Just for ownership	Home consumption	Traditional norm	Other(specify)

		of cattle			

33. How much did you buy it for? R.....

34. How many cattle did you buy-in the last three years?

1	2	3	4	5
0	1-3	4-6	6 and above	Other (specify)

35. Do you sometimes purchase cattle with the income that you earn? **1.Yes /2.No (*circle the right answer)***

36. If yes, how many cattle do you buy-in a year?

……

……

SECTION 3

FARM RESOURCES

37. Is the availability of the following resources a limitation the total number of cattle that the farmer keeps?

1	2	3	4	5
Water	Animal medications	financial support	theft	Other

4. Specify ……

38. What is the size of the land available to you that can be used for or that you have access to for cattle production? .....ha

39. Do you pay for cattle to graze at that land **1.Yes /2.No (*circle the right answer)***

40. If yes how much do you pay per ha?R.....(***any other measurement acceptable)***

41. Do you have any farm resources? **1.Yes /2.No (*circle the right answer)***

42. If yes what type of resources?

1	2	3	4	5
Tractor	Ox-drawn	cart	Hand hoe, hand	Other(

	plough		fork, spades e.t.c	specify)

5: specify ……

43. If no, what may be the cause?

1	2	3	4	5
Lack of interest	Lack of time to do farming	Inability to afford	Use of rental equipments	Other (specify)

44. Have you lost cattle in the past 3 years? **1.Yes /2.No (*circle the right answer)***

45. If yes, how many cattle have you lost to? (**write on the third row**)

1	2	3	4
Theft	Diseases	Accidents(motor, injuries, wild animals.tc)	Other specify

THE NEXT QUESTIONS ARE ABOUT SELLING AND BUYING OF CATTLE

46. Have you ever sold any live cattle in the last three years? **1.Yes/2.No**
47. If yes, How many animals were sold during the last three years?.....

Animal	**Number sold**	**Reason sold(more than 1 answer possible)**	**Price per head (more than 1 answer possible)**
Breeding cows			
Breeding bulls			
Heifers			

Oxen & bulls under 2 years			
Unweaned calves			
Total			

48. To whom did you sell the cattle?(more than 1 answer possible)

1	2	3	4	5
People from this village	Local butcheries	People from other villages	Butcheries from far	Other(specify)

49. From whom did you buy the cattle ?(more than 1 answer possible)

1	2	3	4	5
People from this village	People from other villages around mutale municipality	People from other villages outside mutale municipality	Auctions	Other(specify)

5:specify……
……

50. Is the grazing available in the area sufficient for the cattle**? 1. Yes / 2.No (*circle the right answer)***.
51. In what ways do you think people without cattle in this community benefit from your cattle farming? ……
52. What do you think are the problems that may limit livestock farming in future in this village?.....

SECTION 4

THE LAST THING WE WANT TO TALK ABOUT IS THE ACTIVITIES THAT GENERATE INCOME FOR A LIVING IN THIS HOUSEHOLD

53. which of the following activities generate income or food in this household?(use information from earlier on to reach an agreement (more than one answer possible)

1	2	3	4	5	6	7	8	9
Crop farming	Cattle farming	Other livestock farming	Grants(pension etc)	Employment income	remittances	Private pension	Small business income	Other(specify)

54. How do you value livestock in relation to other sources of income?

1	2	3	4	5
Livestock 0%others100%	Livestock 25% Others 50%	Livestock 50% Others 50%	Livestock 75% Others 25%	Livestock 100% Others 0%

55. Which of the following resources/ assets do you have?(ask each one individually and circle appropriate)

1	2	3	4	5	6
Tractor	Wheelbarrow	plough	cart	Car	None

56. Type of the main houses in the homestead

1	2	3	4	5
Brick under tile	Brick under iron sheets	Brick under thatch	mud under thatch	Other

Number of rooms in main house……

57. Is there anything that you would like to say/ask?

……

……

……

WE HAVE COME TO THE END OF THE INTERVIEW, THANK YOU FOR YOUR TIME AND ASSISTANCE. Once again I would like to remind you that we will share with you the results of the study through workshops and pamphlets. All the information you gave in this study will be anonymous.

ASSESSMENT OF INTERVIEW:

1.EASY	**2.AVERAGE**	**3.DIFFICULT**

Appendix 2: questionnaire for non cattle owners

TO BE FILLED BEFORE THE INTERVIEW COMMENCES

Name of the enumerator ……

Village of household……

Date of interview …….

Full name of respondent……

Relationship to the household head ……..

Gender of respondent	1.Male		2. female	

Is the respondent the head of the household?

1.yes		2. no	

SECTION 1

BASIC HOUSEHOLD INFORMATION

This section focuses on the people living in the same homestead and also includes people who leave away from the homestead but still come back: example; people who come **back on regular basis like in a week, month or a year who contribute to the income used at the homestead.**

1. What is the name of household's head?……

2. Gender of household head? **(*tick the right answer)***

1.male		2.female	

3. What is the Year of birth for the household head? ……

4. What is the main occupation of the household head?

1	2	3	4	5	6	7	8
Fulltime farmer	Part-time farmer	pensioner	Employed civil servant	Employed private company	Small medium business enterprise	unemployed	Other.

7: specify SMME……..

5. Where is the household head based? (***Only 1 choice possible***).

1	2	3	4
Locally	In town comes on weekend	In town comes monthly	Other (specify)

4: specify

…….

6. What is the marital status of the household head? (***1 Answer possible***).

1	2	3	4
Single	Married	Widowed	Other (specify)

7. How many years did the household head go to school? (**1 *Answer possible***).

1	2	3	4	5	6	7	8
0	1-4	5-7	8-10	11-12	Tertiary– diploma/certificate	Tertiary– degree & above	Other ..

8. How many people live in your household? (Answer *all categories: fill in 0 if none*).

Persons	Number
Adult male(18 years & above)	
Adult female (18 years & above)	
Boys (10-17)	
Girls (10-17)	
Children (less than 10years)	
TOTAL	

SECTION 2

PREVIOUS LIVESTOCK OWNERSHIP

9. Did the household own cattle in the past three years? **1. Yes/2.No. (*Circle the right answer)***.

10. Did any close relative of the household own cattle in the past? **1. Yes/2.No. (*Circle the right answer)***. Number of years……..

11. Does the household own any livestock excluding cattle? **1. Yes/2.No (*circle the right answer)***.

12. If yes, what type of livestock does the household own and how many are they?.

Type of animal	Tick if yes	Number currently
Goats		
Donkeys		
Chicken		
Sheep		
Pigs		
Total		

13. How many cattle did the household own? ***Conditional on question 9 if the answer was yes.***

1	2	3	4	5
1-5	6-10	11-15	16 and above	Other

Specify 5: other……

14. Where there any cattle that did not belong to the household, that were being looked after here? **1 Yes /2 No. (*Circle the right answer)***.

15. What was the reason for you to stop cattle farming? ***Conditional on question 9 if the answer was yes***

1	2	3	4	5
Expenses associated with maintenance	Riskiness associated (mortality & theft)	Shortage of grazing space	Community rules and regulations	Other

Specify 5.other:……

16. Which of the following activities do you have in the household?

Activity	**Tick If yes**
Growing crops	
Livestock farming(excluding cattle)	
Formal employment	
Small & medium business enterprise	

Other activities (specify them)……

17. Which of the following other sources of income do you have in the household?

Source of income tick if yes	***(Tick if yes)***	**frequency**
Receiving grants		
Remittance from non-household members		……...per…….
Private pension(not-pension grant)		……. Per……..

If no one receives grant, go to question 19

18. How many people in the household receive each of the following types of grants?

Grant type	**no of members**
Pension	
Child	
Disability foster	
Other grant (specify)…….	

19. How much arable land do you have?……ha(if in other size mention)

20. Do you have to pay money to get the arable land? **1.Yes /2.No (*circle the right answer)***

21. How much do you pay to get a 1ha of land?

R……

SECTION 3

ACTIVITIES THAT GENERATE INCOME FOR A LIVING IN THIS HOUSEHOLD

22. Which of the following activities generate income or food in this household?(use information from earlier on to reach an agreement (more than one answer possible)

1	2	3	4	5	6	7	8
Crop farming	Other livestock farming	grants	Employment income	Remittances	Private pension	Small business income	Other(specify)

23. How do you value agricultural income **(excluding cattle)** in relation to other sources of income?***(tick the right answer)***

1	2	3	4	5
Agricultural income 0%others100%	Agricultural income 25% Others 50%	Agricultural income 50% Others 50%	Agricultural income 75% Others 25%	Agricultural income 100% Others 0%

24. Which of the following resources/assets do you have? (***more than one answer possible***)

1	2	3	4	5
Tractor	wheelbarrow	plough	cart	car

25. Is there anything that you would like to say/ask?

……
……
……
……

26. Type of main house (***observable by the interviewer and can be answered without asking***)

1	2	3	4	5
Brick under tile	Brick under iron sheets	Brick under thatch	mud under thatch	Other

Number of rooms in main house……
……

WE HAVE COME TO THE END OF THE INTERVIEW, THANK YOU FOR YOUR TIME AND ASSISTANCE. Once again I would like to remind you that we will share with you the results of the study through workshops and pamphlets. All the information you gave in this study will be anonymous.

ASSESSMENT OF INTERVIEW:

1.EASY	**2.AVERAGE**	**3.DIFFICULT**