POTENTIAL FOR DESTOCKING AND COMMERCIALIZATION OF PASTORAL AND AGRO-PASTORAL FARMING SYSTEMS IN KILOSA DISTRICT MOROGORO REGION, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

Keeping agro-ecologically highly productive cattle breeds remains critical to the transformation of pastoralists and agro-pastoralists in developing countries from subsistence to commercial cattle production. A study was conducted to investigate the probability and potential for destocking, cattle commercialization and livelihood diversification in Kilosa district, Tanzania. Data were gathered from 132 households randomly selected from pastoral and agro-pastoral communities. Likert scale and descriptive statistics were used to evaluate the perception of smallholder farmers towards destocking larger herds of local cattle breeds. The results revealed that both pastoralists and agro-pastoralists perceived destocking of local cattle and keeping of improved cattle breeds as a viable alternative. Further, a Multiple Linear Regression Model was used to analyse factors influencing commercialization. The number of cattle owned, land for grazing and age of household head were found to be statistically significant in influencing input commercialization at ($P < 0.05$). For output commercialization, the number of cattle owned, age of household head at ($P < 0.05$) and experience in cattle keeping at ($P < 0.01$) were found to be statistically significant. In addition, CBA approach was used to compare profitability of keeping improved and local cattle breeds. Keeping of improved cattle breeds for beef and milk was found to be more economically viable (with BCR of 1.60 and NPV of TZS 32 143 948.24) and average milk yield of 7.7 litres per cow per day than both keeping local cattle breeds, such as Boran (with BCR of 1.43 and NPV of TZS 23 705 381.59) and TSZ (with BCR of 1.35 and NPV of 18 741 230.18 TZS) with average milk yield of 1.9 litres per cow per day. The uptake and keeping of improved cattle breeds for sustainable and improved household income, food security and livelihoods of pastoral and agro-pastoral communities is highly recommended.

DECLARATION

I, Leakey Maganga Madale, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

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(MSc. Candidate)

The above declaration is confirmed by:

_____ _____

Prof. Reuben M. J. Kadigi Date

(Supervisor)

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DEDICATION

I dedicate this work to my beloved parents Mr. Michael Madale Lwambo and Ms. Margret Francis Bundala; and to all members of my family for their sacrifices and enormous support.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASDP	Agricultural Sector Development Programme
BCR	Benefit Cost Ratio
BoT	Bank of Tanzania
CAADP	Comprehensive African Agriculture Development Programme
CBA	Cost Benefit Analysis
DM	Dry Matter
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GM	Grams
GoT	Government of Tanzania
ILRI	International Livestock Research Institute
IRR	Internal Rate of Return
KDC	Kilosa District Council
KG	Kilograms
LSDS	Livestock Sector Development Strategy
MT	Metric Tons
NBS	National Bureau of Statistics
NLP	National Livestock Policy
NPV	Net Present Value
OLS	Ordinary Least Squares
SAEBS	School of Agricultural Economics and Business Studies
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences

SSA	Sub Saharan Africa
SUA	Sokoine University of Agriculture
TSZ	Tanzania Shorthorn Zebu
TZS	Tanzania Shillings
UN	United Nations
URT	United Republic of Tanzania
VIF	Variance Inflation Factor
WBG	World Bank Group

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Globally, livestock keeping contributes directly to the livelihoods of millions of people, including an estimated 70% of the world's rural poor (FAO, 2015). In Sub-Saharan Africa, livestock sector including pastoral and agro-pastoral farming systems constitute an important economic activity for many rural communities (Shikuku *et al*., 2017). In this regard, capitalizing on livestock subsector may harness greater benefits to many households in the world and contribute to the United Nations (UN) efforts of eliminating poverty and hunger by 2030.

According to the latest United Nations estimates (of April, 2018), Tanzania has a total population of 58 742 315 people. Approximately 37% of the rural households keep livestock specifically cattle, poultry (largely chicken), goats, pigs, sheep and donkeys, which make livestock to be one of the most important subsectors in the country. Currently, Tanzania is estimated to have 11% of the total cattle population in Africa (ILRI, 2017).

Despite the significant role played by the livestock sector, livestock-related activities contribute only 7.4% to the Tanzania's GDP and the growth of the livestock sector is estimated at only 2.6%, which is low (Njombe *et al.,* 2012; ILRI, 2017). Furthermore, about 94% of the total national cattle herd is kept by pastoralists and agro-pastoralists, and the remaining, 6% comes from the commercial ranches and the dairy sector (URT, 2015). It is envisaged that, if more commercialized, the sector would contribute significantly to the national economy (through employment creation and income generation to households) and promote human health through increased milk and beef consumption. The available

literature shows that on average, the sector contributes only about 14% of the total household annual income in rural areas (Njombe *et al.,* 2011).

The production coefficients of the indigenous cattle are reported to be low with calving rate put at 40 and 50% and calving interval at 18 and 24 months (URT, 2015). Pre-weaning and adult mortalities are estimated to range from 30 to 40% and 8 to 10% respectively (URT, 2015). The mature weight from 200 to 350 kilogram (kg) and carcass weight ranges from 100 to 175 kg (URT, 2015). Off-take rates are low estimated to range from 8 to 10% per annum (URT, 2015). On average, milk yield is estimated at 400 litres per lactation and (URT, 2015) for small ruminants, off-take rates and the average carcass weight are reported to range from 15 to 25% and 12 to 15 kg respectively per annum (URT, 2015).

The low off-take rates for the indigenous cattle imply low levels of commercialization and reluctance on the part of pastoral and agro-pastoral communities to destock and keep few but improved cattle breeds. Low productivity of the indigenous cattle breeds is also exacerbated by the challenges of climate change which affect the availability of pasture and water resources (Tumbo *et al.,* 2011). The available estimates show that adequate investment in the development of crossbred dairy cows in the country would lead to a 35% surplus of milk production over domestic demand and export earnings (ILRI, 2017). The replacement of low yielding cattle with improved or high yielding breeds while taking care of the carrying capacity of the available grazing land would have helped to improve significantly the incomes of pastoral and agro-pastoral households (URT, 2015). The underlying assumption for this assertion is that improved cattle are more productivity than the local cattle in terms of milk and beef quantity. For example, improved cattle proved to have an average live weight ranging from 450 to 600 kg with improved dairy cattle yielding about 1 700 litres of milk per lactation (Katyega, 1987; URT, 2015). The

substitution of local cattle with improved or cross-bred cattle would therefore not only enhance commercialization among pastoral and agro-pastoral communities but also serve as one of the adaptation strategies against scarcity of resources such as rangelands. This is consistent with the National Livestock Policy (NLP) of 2006 and Tanzania Livestock Master Plan (TLMP) of 2018 which seek to enhance sustainability and profitability in the livestock sector. In this respect, investigating the potentials for destocking of large herds of less productive cattle with high yielding cattle breeds for commercialization is important in promoting livelihood diversification at the household level among pastoral and agro-pastoral communities.

1.2 Problem Statement and Justification

Despite the huge livestock population in Tanzania, the current subsector contribution to the national economy is still far below its potential. The commercial value of livestock is limited to a few live and product/by-product sales to the domestic market (especially in big cities such as Arusha, Dar es Salaam, Mwanza and Mbeya) and across the borders to neighbouring countries, such as Kenya (URT, 2010). As important actors in the livestock subsector, pastoralists and agro-pastoralists, participate in the market primarily as part of adaptation strategies against adverse weather and disease incidences (Barret *et al.,* 2004). They minimize risk by maintaining large herds so that production does not drop below subsistence level (consumption smoothening) and the risk of total loss of the herd rather than maximizing benefits per animal. This situation accentuates erratic supply and price disincentive for producers as well as traders (Kadigi *et al*., 2013). This has been manifested by the continued reluctance to destock the herds leading to an overall increase of local and unproductive cattle population that catalyse resource use conflicts between crop producers and livestock keepers (Kirui, 2016). There is empirical evidence of conflicts between crop farmers and livestock keepers in Tanzania (Benjaminsen *et al.,* 2009). Yet, there is also a

dearth of empirical evidence of farmers' reluctance to destock their large herds of local cattle and participate in input and output markets (commercialization).

Furthermore, little is known regarding the benefits and costs associated with commercialization and the factors that influence the decision of farmers to shift from keeping local cattle breeds to keeping improved cattle breeds. Therefore, this study was designed to provide valuable insights regarding these important aspects and thus inform policies and strategies for sustainable livestock production and commercialization in Tanzania.

The study intended to fill the knowledge gap with respect to the farmers' reluctance to destock large herds of local cattle and compare the benefits and costs associated with keeping of both local and improved cattle breeds in the study area. Further, the study sought to analyse factors influencing commercialization. This was deemed important especially now where more efforts are directed towards commercialising the agriculture sector in Tanzania as stipulated in the Agricultural Sector Development Programme phase two (ASDP II) and region-wise in the Comprehensive African Agriculture Development Programme (CAADP).

1.3 Objectives of the Study

1.3.1 General objective

The general objective of the study was to evaluate the potential for destocking local cattle breeds, commercialization as well as adoption of improved cattle breeds and diversification of livelihoods of the pastoral and agro-pastoral farming communities in Kilosa district, Morogoro region.

1.3.2 Specific objectives

The specific objectives of the study were:

i. To assess the perception of pastoral and agro-pastoral farmers in the study area about destocking, commercialization, and keeping of improved cattle breeds,
ii. To examine the factors influencing commercialization of livestock production by pastoral and agro-pastoral farmers in the study area and
iii. To evaluate the costs and benefits of practising indigenous versus improved cattle production in the study area.

1.4 Hypotheses

The following hypotheses were put forward and tested:

i. Pastoralists and agro-pastoralists in the study area do not perceive destocking of indigenous cattle and adoption of improved cattle as a viable alternative.
ii. Socio-economic, institutional and cultural factors do not influence commercialization and adoption of improved cattle breeds by pastoral and agro-pastoral farmers in the study area and
iii. There are no significant differences in the costs and benefits between indigenous and improved cattle production in the study area.

1.5 Organization of the Dissertation

This dissertation is organized into five chapters. The first chapter presents the background information, problem statement, and justification of the study, general objective, specific objectives, as well as the hypotheses of the study. The second chapter reviews the literature relevant to the study while the third chapter describes the methodology and research approach used in the study.

The findings and discussion of findings are presented in Chapter Four. Conclusive remarks and recommendations emanating from the major findings of the study are presented in Chapter Five.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Perception

The perception of smallholder farmers is their ability of recognizing (being aware of), organizing (gathering and storing), and interpreting (binding to knowledge) sensory information; hence this input of meaningful information results in decisions making and or actions taking (Barroso, 2013). It is important to focus on smallholder farmers perceptions of different challenges or technologies as it provide a better understanding of how concerning a challenge is or for a technology adoption since they are ones who are faced with challenges and or deal with the technologies and probably perceive the intensity of challenges and technologies differently from researchers and extension agents (Sinja *et al.,* 2004).

2.1.2 Pastoral farming systems

Pastoral farming systems are categorized by the degree of movement, from highly nomadic through transhumant to agro-pastoral (Blench, 2000). Exclusive pastoralists or nomads are livestock producers who do not grow crops but simply depend on the sale or exchange of animals and their products to obtain foodstuffs. The movements of nomads are opportunistic and follow pasture resources in a pattern that varies from year to year. On the one hand, transhumance is often associated with the production of some crops, although primarily for herders' own use rather than for the market. These have a regular movement of herds between fixed points to exploit seasonality of pastures, whereas agro-pastoralists are described as settled pastoralists who cultivate sufficient areas to feed their families from their own crop production (Blench, 2000).

2.1.3 Agro-pastoral farming systems

Agro-pastoralists hold land rights and use their own or hired labour to cultivate land and grow staple crops while livestock are still valued property. Their herds are on average smaller than the herds of other pastoral systems, this is possibly because they no longer solely rely on livestock; rather depend on a finite grazing area around their village and which can be reached within a day (Blench, 2000).

2.1.4 Agricultural commercialization

Commercialization involves a transition from subsistence oriented to increasingly market oriented patterns of production and input use (Demeke and Haji, 2014). Commercialized farmers target markets in their production decisions while subsistence farmers' base on production feasibility, subsistence requirements, and selling only whatever surplus product is left after household consumption requirements are met. The proportion of value sold is less than 25% for subsistence farmers; between 25 and 50% for transition farmers and above 50% for commercialized farmers (Demeke and Haji, 2014).

Commercialisation can be explained in terms of participation in input and output markets using commercialization index as a proxy. According to Hagos and Geta (2016), commercialization index on output markets has several limitations. For instance, when a farmer produces one sack of any cereal crop or one cattle and sells that all and another one produces ten sacks of the same cereal crop or cattle and sells only two sacks or two cattle, the index will show that the first farmer is fully commercialized (100%) while the second is semi-commercialized (20%). Although the interpretation does not make sense in such circumstances, it can be used in the context of developing countries where it is less likely for smallholders to sell all output and very large farms selling none of their farm output (Hagos and Geta, 2016).

In the cognizance of this shortfall, Negassa and Jabbar (2008) put forward the net livestock off-take rates index as a proxy for measuring the level of smallholder commercialization. This is the proportion of the difference of sales and purchases of livestock as a percentage of the annual average stock (Negassa and Jabbar, 2008). It further categorizes births, gifts received, and purchases as incoming animals whereas deaths, sales, gifts, and slaughters as outgoing ones. The index considers only the sales and purchases of livestock per household per specific period and does not account for the inputs used. Jaleta *et al.* (2009), in their study of smallholder commercialization, observe that when measuring commercialization both the input and output sides of production should be considered.

The index of measuring commercialization is the proportion of agricultural output sold to the market and input acquired from the market to the total value of agricultural production is to be used as proposed by Gebremedhin and Jaleta (2010). In their study of commercialization of smallholders, Jaleta *et al.* (2009) compared the level of commercialization among farmers in both output market and inputs market sides.

2.1.5 Destocking livestock

Livestock destocking is a typical reduction of the number of livestock especially cattle, goats, and sheep in pastoral and agro-pastoral communities (Bett, 2018). It is one of the emerging interventions oriented to mitigate drought and climate changes for sustainability in many areas, including Africa.

2.2 Theoretical Review

2.2.1 Theory of the firm

This study is guided by the theory of the firm whereby the objective of a farmer is assumed to be maximization of profit. Theory of the firm assumes that farmers are profit

maximizing economic agents hence they are efficient producers in minimizing the costs of inputs as far as possible in order to maximize profit (Dutta and Radner, 2003). The Profit (π) formula;

$(\mathrm{p};\mathrm{w}) = \mathrm{Maxim}_{\gamma,\chi}\{\mathrm{py} - \mathrm{wx}\}$

Where; the total profit (π) of a business (livestock keeping) is calculated by taking the difference between the total revenue (py = sales of milk, meat, live animals, manure, and plowing services) and the total cost (wx = costs of labor, feeds, vet services); *p* = output price; *w* = inputs price; y = output; x = inputs. The decision making process among smallholders involves production (output) and consumption (inputs) aspects.

2.2.2 Welfare theory

With these aspects of welfare such as inequality, poverty, and vulnerability; the economic efficiency and income distribution are keys on how they affect the overall well-being of smallholder farmers (Baujard, 2013). The main goal of improved technologies (improved cattle husbandry) dissemination to pastoralists and agro-pastoralists communities is to improve smallholder farmers livelihoods and hence poverty reduction through reduction of inequalities (WB, 2016). This study was intended to fill the knowledge gap with respect to the farmers' reluctance to destock large herds of local cattle, and compare the benefits and costs associated with keeping of both local and improved cattle breeds in the study area.

2.3 Empirical Review of Literature

There is vast empirical literature on the perception of agricultural producers across the globe. For instance, Onyemekihian *et al.* (2017) examined farmers' perception on the value of commercialized agricultural extension system in the Delta State, Nigeria. The authors used descriptive statistical tools of frequency count, percentage and mean to analyse farmers' perception. They further used a multiple linear regression to analyse the

relationship between farmers' characteristics and their value for commercialized extension system. The results revealed that age, educational level, and farming experience were positively significant characteristics in influencing farmers' value towards commercialized extension system (Onyemekihian *et al.*, 2017).

Elsewhere, Silvestri *et al.* (2012) in their study on climate change perception and adaptation of agro-pastoral communities in Kenya, they employed descriptive statistics and a logistic regression to analyse the factors influencing perception. The authors identified the key adaptation strategies of livestock producers as including mixing crop and livestock production, destocking, diversifying livestock feeds, changing animal breeds (adoption of improved animal breeds), and moving animals to other sites. They identified the main barriers to adaptation to include lack of access to land and inputs, absence of markets, particularly for the purchase of additional improved animal breeds or species.

Moreover, there is a rich body of literature on agricultural commercialization and determinants of the same. For example, Siyaya and Masuku (2013) analysed the factors affecting commercialization of indigenous chickens in Swaziland. In this study, sales rate (proportion of chicken units sold to the total stock produced per year) was used as a proxy for commercialization in their Tobit regression model. They found that prices of alternative products, the quantity of chickens sold, the quantity of chickens consumed by the family, and supplementary feeds significantly affected the rate of commercialization.

Additionally, Agwu *et al.* (2013) used the proportion of gross value of crop sales to gross value of all crop production in a particular year as a proxy of household commercialization. They used a multiple regression model to analyse the level of commercialization among smallholder farmers in Abia State and found that household size,

income, farming experience, farm size, distance to the market, membership of society and access to credits significantly influenced commercialization among smallholder farmers. Nmadu *et al.* (2014) used household commercialization index and multiple regression analysis to analyse the effects of credit on poultry output and level of commercialization among poultry farmers in Minna Metropolis, Niger State in Nigeria. They suggested that poultry farmers should be encouraged to use credits in order to enhance initial capital, medication costs, farm size, output and hence significantly increase their level of commercialization.

Since agricultural households are presumed to be rational economic agents intending to maximize profit or minimizing costs, many researchers apply project worthiness measures to determine profitability of farm enterprises. For example, Islam *et al.* (2015), analysed the BCR of Vanaraja and local chicken of Assam under backyard system of rearing. In this seminal work; BCR was computed and the results revealed that Vanaraja birds' (improved birds) rearing was profitable with BCR of 2.60 while that of local chicken was 2.27. Furthermore, a study by Narayanamoorthy and Devika (2018) on the assessment of economic and resource impacts of drip method of irrigation on okra cultivation, NPV and BCR were used in the analysis of profitability or viability of the project. The NPV and BCR estimated using discounted cash flow technique reveals that the drip investment (technology adopted) in okra cultivation is economically viable.

With Onyemekihian *et al.* (2017) examined farmers' perception on the value of commercialized agricultural extension system and overlooked the aspects of inputs and output commercialization, Silvestri *et al.* (2012) in their study on climate change perception and adaptation of agro-pastoral communities in Kenya overlooked the aspect of pastoral communities, Siyaya and Masuku (2013) analysed the factors affecting

commercialization of indigenous chickens on sales bases and Nmadu *et al.* (2014) used household commercialization index to analyse the effects of credit on poultry output as well as Agwu *et al.* (2013) analysed household commercialization based on crops sales while both overlooked the inputs side, Islam *et al.* (2015) analysed the BCR of improved birds and local chicken but overlooked the aspect of NPV while Narayanamoorthy and Devika (2018) assessed economic and resource impacts of drip method of irrigation on okra cultivation but did not mention about commercialization aspect, hence this study aimed on the assessment of perception of pastoral and agro-pastoral farmers in the study area about destocking, commercialization, and keeping of improved cattle breeds, examination of the factors influencing commercialization (on inputs and output side) of livestock production, and evaluation of the costs and benefits of practising indigenous versus improved cattle production.

2.4 Conceptual Framework of the Study

Previous studies have found that the major determinants of smallholder farmers' choice to participate in available technologies (improved cattle husbandry) are mainly due to socioeconomic dimensions of households and institutional factors (Sithole *et al*., 2014). The conceptual framework of the study was adopted and modified from Sithole *et al.* (2014). As visually illustrated in figure 1, the cultural, socio-economic and institutional factors of households constitute some of the key factors that may influence the choice of technologies (Sithole *et al*., 2014; Jamilu *et al.,* 2015). In this regard, the cultural, socio-economic and institution factors are shown in the conceptual framework as independent variables and the keeping of improved cattle breeds and commercialisation index were treated as dependent variables. The presence of livestock multiplication units, livestock dip facilities, access to extension and veterinary services influences pastoralists and agro-pastoralists towards destocking indigenous cattle breeds and keep improved cattle breeds

since they will be able to get improved cattle breeds easily from the livestock multiplication units around them as well as technical help on raising their improved cattle breeds properly through available extension and veterinary services however the household decision to destock indigenous cattle and participate in keeping improved cattle breeds can be supplemented by age of household head, education level, household size, grazing land owned and experience in years of cattle keeping (Sithole *et al*., 2014; Jamilu *et al.*, 2015). This will lead to increased output and employment opportunities to increased income and purchasing power and hence improved livelihood of pastoralists and agro-pastoralists. The interaction of these variables was assumed to determine commercialisation of the pastoralists and agro-pastoralists in the study area.

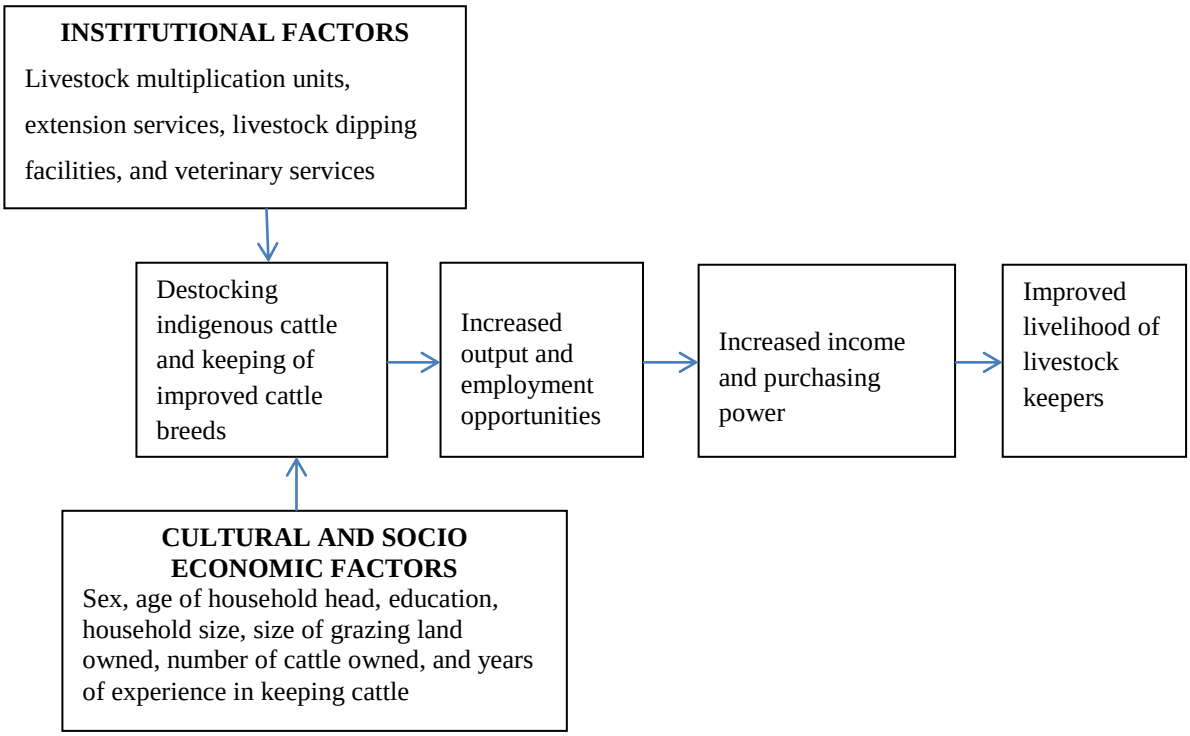

Figure 1: Conceptual framework of the study

Adopted and modified from (Sithole *et al*., 2014)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

Kilosa district is located in the east central Tanzania, about 148 km from Morogoro town. Kilosa extends between latitude 5°55’ and 7°53’ south and longitudes 36°30’ and 37°30’ east. To the east, the district shares borders with Morogoro and Mvomero districts; to the south, the district is bordered with Kilombero and Kilolo districts and to the west, it shares borders with Mpwapwa, Kongwa and Gairo districts. The district is divided into 35 wards and 118 registered villages with 752 hamlets (KDC, 2012).

Kilosa district has a total population of 438 175 people, where by male are 218 378 and female are 219 797 with the average household size of 4.2, however the total number of pastoralists and agro-pastoralists is 6 558. Kilosa district is located at an elevation of 604 meters above sea level, with the average annual rainfall of 1 194 mm and the average annual temperature of 18.5 °C. The variation in the precipitation between the driest and wettest months is 237 mm while the variation in temperatures throughout the year is 4.8 °C. The climate of Kilosa is classified as warm and temperate; the summers are much rainier than the winters. With a diverse of opportunities in Kilosa district, 536 590 kilometers is an area of farmland where there is irrigation and conventional agriculture and the most widely cultivated crops are such as rice, beans, sunflower, peas, maize, bananas, and cassava.

The district is estimated to have 564 000 cattle, 1 780 000 goats and 96 790 sheep, livestock operations are being majorly conducted in Parakuyo, Kimamba, Bwerebwere and Madoto counties. Also the people of Kilosa district are engaged in other various activities

being business of commodities such as sugar cane, rice, potatoes, onions, sesame, maize, peas, vegetables and trees harvesting for building and producing charcoal through a sustainable charcoal program hence it help them to earn a living (KDC, 2012).

The selection of the study area was based on the fact that, the district is known to be with agricultural activities especially pastoralism and agro-pastoralism with limited grazing land. In this regard, frequent land conflicts between crop farmers, pastoralists, and agro-pastoralists, have been reported (Benjaminsen *et al.*, 2009). It is therefore an interesting study area to investigate the potentials of destocking large herds of local cattle and uptake of fewer improved cattle. In this regard, it is plausible to suggest evidence based strategies to destock large herds and keep productive cattle for commercialization and subsequently improved incomes.

3.2 Research Design

The cross sectional research design was used in this study to solicit data from pastoralists and agro-pastoralists of Kilosa district in Morogoro region. In this research design, data are collected at a single point in time from the selected respondents to represent the target population. This design is the most appropriate one in a descriptive study and it is less time consuming (Babbie, 1995).

3.3 Sampling Procedure and Sample Size

A multistage sampling procedure was used whereby in the first stage Kilosa district in Morogoro region was purposively selected. The second stage involved random selection of six wards in the district in which six villages were then randomly selected, one village from each ward. The last stage involved the random selection of pastoralists and agro-pastoralists households proportionately from each of the selected villages. By conducting a

random selection from ward level down to the interviewed respondents, it qualified the scope of generalization of study results for the entire Kilosa district.

The target population for this study was pastoral and agro-pastoral households in the study area, and the sample size was obtained through the following formula:

$n = \frac{N}{1+N(e^2)}$ ……...…….. (1)

Where:

n = sample size,

N = population of pastoralists and agro-pastoralists,

e = error term (Yamane, 1967).

Therefore, sample size $= \frac{6\,558}{1+6\,558(0.05^2)}$ = 377

A sample size of 132 respondents was appropriate for this study. This is also attested by Matata *et al.* (2001) who argue that 120 respondents are adequate representatives for statistical analysis in socio-economic studies. Furthermore, Sudman (1976) posits that a minimum of 100 respondents is enough to generate meaningful analysis when executing a comparative study.

Table 1: Sample size by villages

District	Ward	Village	Sample
Kilosa	Parakuyo	Parakuyo	36
	Dumila	Matongolo	12
	Kimamba "A"	Kimamba "A"	40
	Mvumi	Gongwe	8
	Madoto	Mbwade	26
	Magole	Mandela	10
Total			**132**

In this regard, a sample of 132 pastoralists and agro-pastoralists in the study area was considered sufficient to generate the intended information for meaningful statistical analysis. Adding to that, this sample is ideal due to limited time and funds.

3.4 Source of Data

3.4.1 Primary data

The unit of analysis was pastoralists and agro-pastoralists households in Kilosa district. In that regard, the sources of primary data were collected from heads of household or from the spouse or elder child if the household head is not available. The collection of primary data in the study area was done through face to face interviews, structured questionnaire, and observations.

3.4.2 Secondary data

Secondary data were obtained by reviewing relevant literature on the subject matter. The sources of secondary data were books, research papers, and journals in the libraries, from the internet, and from the district agricultural office of Kilosa district. Major types of information obtained from the secondary sources include major economic activities of the households in Kilosa, the types of livestock breeds largely kept, the population of pastoralists and agro-pastoralists and availability of grazing land.

3.5 Data Analysis

The data collected from the aforementioned were coded for different statistical analyses. The responses for the close ended questions were assigned numbers while all possible answers in the open ended questions were identified, summarized, and coded. The Statistical Package for Social Science (SPSS Version 20) software was used to generate descriptive results such as frequency, percentage, mean and range. Econometric analysis,

specifically multiple linear regression model was estimated through ordinary least square (OLS) to analyse factors influencing commercialization of cattle in the study area. Additionally, the CBA by using Microsoft Office Excel 2010 was used to compare profitability of keeping the two different cattle breeds.

3.5.1 Perceptions of cattle keepers on destocking of larger local cattle herds

To assess the perception of pastoralists and agro-pastoralists on destocking larger number of local cattle and keep improved cattle breeds in the study area a likert scale and descriptive statistical analysis was used to aggregate frequencies, variable mean scores, and percentages of the answers provided by pastoralists and agro-pastoralists. This approach has been used by many researchers (e.g. Silvestri *et al.,* 2012; Boone and Boone, 2012; Onyemekihian *et al.,* 2017) to come up with the interpretable results.

The variable mean score to each variable item was determined by the following formula:

$$\bar{X}_i = \frac{\sum fx}{n} \quad \text{..... (2)}$$

Where: $\bar{X}_i$ = variable mean score,

f = number of respondents chosen a particular scale point,

x = numerical value of the scale point, and

n = total number of the respondents to the variable item.

For the cut-off point (critical mean score) to each variable item was determined by the following formula:

$$\bar{X} = \frac{\sum x}{N} \quad \text{..... (3)}$$

Where:

$\bar{X}$ = critical mean score, Σx = total scale score that is (1, 2, 3, 4, 5), and N = scale points.

If mean score ≥ 3 accept the variable item as positively perceived.

3.5.2 Determinants of commercialization

To analyse the factors influencing commercialization of livestock production in the study area, the study used the approach suggested by Gebremedhin and Jaleta (2010), whereby both output and input side indices were taken as proxy of commercialization. Further, a multiple linear regression model is employed to analyse the factors affecting the level of commercialization (Agwu *et al.,* 2013).

In that regard, a multiple linear regression model estimated using OLS was used to analyse the determinants of commercialization. The household's level of commercialization was modelled as a function of the number of cattle owned, the age of the household head, experience in keeping cattle, education level, household size, grazing land owned, distance to the nearest cattle market, sex, extension visits and off farm income. To describe this model, y represents the respondent's inputs and output commercialization indices and *x* denotes a set of explanatory variables included in the model.

The empirical model is expressed as follows:

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + B_5 X_5 + B_6 X_6 + B_7 X_7 + B_8 X_8 + B_9 X_9 + \varepsilon_i \quad \text{..... (4)}$$

Where; i = 1, 2 and y_1 = input commercialization index

$$y_1 = \frac{\text{(Value of inputs acquired from market per year)}}{\text{(Value of the cattle herd)}} \text{x}100 \quad \text{..... (5)}$$

y_2= Output commercialization index

$$y_2 = \frac{\text{(Sales of live cattle,their products and byproducts per year)}}{\text{(Value of the cattle herd)}} \text{x}100 \quad \text{..... (6)}$$

β_0 = The intercept of the regression model

$\beta_1 - \beta_9$ = Are the coefficients associated with the explanatory variables

ε_i= The error term, and X_1 - X_9 = Are explanatory variables of the multiple linear regression model with their prior expectation specified below:

Table 2: Explanatory variables of multiple linear regression and prior expectation

Variable name	Description	Expected sign
CATTLE (X_1)	Number of cattle	$+$
AGE (X_2)	Age of household head (years)	$+/e$
EXP (X_3)	Experience of pastoralists and agro-pastoralists in cattle keeping	$+$
EDU (X_4)	Education level of household head (number of years of formal education)	$+$
HSIZE (X_5)	Household size	$+$
GRAZLND (X_6)	Acres of grazing land owned	$+/r$
DISTCM (X_7)	Distance to a nearest cattle market (kilometres)	$+$
SEX (X_8)	Sex of household head (Dummy; 0 Female, 1 Male)	$+/x$
EXTENSION (X_9)	Pastoralists and agro pastoralists contact with extension officer (Dummy; 0 No, 1 Yes)	$+$

3.5.3 Explanatory variables for commercialization

3.5.3.1 Number of cattle owned

This is continuous variable measured in terms of the number of live cattle kept by a household**.** It is expected that the larger the number of herd of cattle the higher the frequency of sales by farmers, since larger herds of cattle have good number of marketable surplus which tends to increase commercialization (Lubungu *et al.*, 2016).

3.5.3.2 Age of household head

This is also continuous variable measured in terms of number of years. It is assumed that the older the farmer the higher potential of making decisions in managing and marketing activities, it is more likely for older farmers to have more experience of managing cattle. Older farmers are expected to have more capital assets thus, higher sales rate which leads

to increased commercialization (Siyaya and Masuku, 2013). Therefore, age is positively associated with cattle management and commercialization since older farmers may be more experienced in marketing and may have stronger networks.

3.5.3.3 Experience in cattle keeping

The number of years a farmer has in the production of cattle can positively influence his or her management expertise and skills, as well as his or her potential to commercialize both on inputs and output side (Siyaya and Masuku, 2013).

3.5.3.4 Education level of household head

Education of the household head is a number of years of formal education where by many years of formal education are positively and significantly associated with higher sales rates, as the farmer may understand business concepts better (Siyaya and Masuku, 2013).

3.5.3.5 Household size

This is a continuous variable measured in terms of the number of members in a family. This is a useful unit of analysis given the reality that within the household resources are pooled, income shared, and decisions are made jointly by responsible household members (Negassa and Jabbar, 2008). Additionally, an increase in the household size was expected to increase the demand for market goods thus an increased demand for cash that would subsequently increase the cattle keepers' sales rate. In this regard, households with more members tend to have more labour, which in turn increases cattle production and commercialization (Siyaya and Masuku, 2013).

3.5.3.6 Size of land owned for grazing

The size of the household land holding for grazing is a continuous variable that reflects the pasture used for grazing the owned cattle by the farmers. Large areas owned by the cattle keepers are presumed to have had negative effect on the household decision to participate in the market as a seller but had a positive effect to participate as the buyer (Negassa and Jabbar, 2008).

3.5.3.7 Distance to cattle market

This is a continuous variable measured in terms of the distance in kilometres to the nearest market. It has been hypothesized that longer distances require transport of cattle to the markets which results in imperfect and inefficient integrated markets. This in turn reduces profit margins among cattle keepers as it leads to high transaction costs (Holloway and Ehui, 2002). In this regard, the closer a household to the mainstream markets, the higher the tendency of cattle keepers to sell more proportions of their herds in the cattle markets (Holloway and Ehui, 2002).

3.5.3.8 Sex of household head

Sex of the household head is a dummy variable where the male household head was coded as 1 and 0 if otherwise (female). Male headed households were likely to have higher sales rates as opposed their counterpart female headed households. Similar observation was recorded by Siyaya and Masuku (2013) who identified obstacles such as lack of capital, and access to institutional credit and extension service, as constraints, which may hinder women's participation and limit their efficiency in livestock production.

3.5.3.9 Extension services

Extension service is a dummy variable where a farmer who received extension services was coded as 1 and 0 if otherwise. Assistance and advice received by farmers from Livestock Extension Officers enable farmers to manage their cattle well, resulting to higher productivity; hence, selling higher proportions of the cattle stock (Siyaya and Masuku, 2013).

3.5.4 Profitability of keeping improved cattle over local cattle breeds

To evaluate the costs and benefits of practicing indigenous versus improved cattle production in the study area; different measures of project or enterprise worthiness specifically the Benefit Cost Ratio (BCR), Net present value (NPV) and Internal Rate of Return (IRR) can be used (Chichilnisky, 1977). According to Narayanamoorthy and Devika (2018), NPV and BCR can be used to measure the profitability and viability of a certain project. On the other hand, Hanley and Spash (1998) urged that IRR has a tendency of generating multiple IRRs from the same data sets and thus becoming unreliable when comparing performance across many project portfolios. In this regard, only NPV and BCR were opted and computed to determine profitability of cattle keeping.

Furthermore, the opted life cycle for a standard cattle shed was seven years (Asimwe *et al.* 2016) and a social value discount rate of 10% was used according to the Bank of Tanzania (BoT, 2018). Again, Freeman and Groom (2016) suggested that the lowest and highest possible value of social discounting rate range from 0% to 19%, hence using a 10% social discount rate is ideal. Each of the three compared groups in beef cattle fattening (improved cattle breeds vis-a-vis local cattle breeds particularly Boran and TSZ); had 15 cattle. The estimation of costs and benefits used to compute BCR and NPV for improved and local beef cattle fattening followed (Creek, 1972; Mwilawa, 2012; Asimwe *et al.*, 2015

and Asimwe *et al.*, 2016). Additionally, to reflect the economic analysis in this study, the prices, which were used to value the inputs and the output, were obtained from the average market prices, where beef were sold and inputs were purchased. The computation of daily milk yield per cow for both improved and local cattle employed descriptive statistics (Mondal *et al.*, 2010).

3.5.4.1 Net present value

The NPV expresses the difference between the discounted present value of cash inflows and the discounted present value of cash outflows. Cash inflows are revenue obtained from selling beef while cash outflows are inputs costs associated with beef cattle fattening and the initial investment costs.

$$NPV = \sum_{t=1}^{T} \frac{B_t - C_t}{(1+r)^t} \quad \text{..... (7)}$$

Where; $\boldsymbol{B_t - C_t}$ = net cash inflow during the period **t**, **r** = discount rate, and **t** = number of years. The only investments that should be made are those with positive NPV values.

3.5.4.2 Benefit cost ratio

BCR is among the three measures of determining project worthiness using discounted values. It expresses the discounted value of incremental benefits generated by the specific technology or project per discounted value of incremental costs expressed by that particular project:

$$B/C = \frac{\sum \frac{Bt}{(1+r)^t}}{\sum \frac{Ct}{(1+r)^t}} \quad \text{..... (8)}$$

Where Bt = benefit at time **t**, Ct = cost incurred at time t, r = interest rate and **t** is the time horizon. If B/C >1 accept the project because it was economically viable; and if B/C <1 reject the project because it was not economically viable. BCR varies with the discount rate chosen, the higher the discount rate the smaller the BCR.

3.5.4.3 Sensitivity analysis

In sensitivity analysis, the aim is to make predictions concerning the future of the project or business venture subject to changes or market stress. The prediction is not made with perfect foresight, hence the assumptions made for this study was that market stress occurred in social value discount rate for three levels (from 10% to 15% to 30%) and price for output dropped by 30% with the constant project or business life span of 7 years. Thus means recalculation of BCR and NPV assumed the values from a stressed market. The intention is to discover to how the BCR and NPV are sensitive and will respond to the market stress so the project or business venture.

3.6 Limitations of the Study

This study encountered some limitations during field survey in the study area and thus led to a delay in the completion of data collection and dissertation writing. Major limitation emanated from the poor record keeping amongst some of the respondents on the exact number of cattle sold, the exact expenses used to purchase veterinary drugs and cattle supplements so it took me time to ask the questions in short period of time (two months) then did the computation to aggregate the information and came up with the accurate data I needed. Further, in some occasions, the heads of household failed to remember the exact milk yield produced by cows per day; as a result, other members (especially spouses) of the family responded accurately since they remembered.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1 Socio-economic and Demographic Characteristics

4.1.1 Age of the household head

The overall average age of the household head in the study area as presented in Table 3 was 47.29 years with the range of 25 to 80 years with a standard deviation of 13.3 years. This implies that pastoralists and agro-pastoralists in the study area are still energetic and able to manage the cattle effectively and profitably. Previous evidence shows that the age category of farmers between 41 to 50 years is more involved in cattle farming (Sarma *et al.,* 2014).

4.1.2 Household size

On average, a household had 11.27 members with a minimum family size of 2 members and a maximum of 103 members with a standard deviation of 10.78 members as shown in Table 3. This shown that there was enough available family labour for taking care, feeding the cattle and all other activities relating to cattle keeping. Although the figures are not similar to the findings with a study by Kabunga (2014) who reported that households of cattle keepers were relatively large, with an average of 8 members and some households had as many as 29 members, but the idea was aligned.

4.1.3 Household head's experience in cattle keeping

The overall average number of years that pastoralists and agro-pastoralists have been engaged in cattle keeping was 15.95 years with the range from 2 to 60 years with a standard deviation of 11.75 years as shown in Table 3. This implied that most of the cattle keepers in the study area were well experienced in cattle keeping hence they were able to

employ best practices accumulated over time in managing cattle, controlling diseases, and thus being able to operate profitably. However, Mlote *et al.* (2013) found that the average experience in beef fattening was 5.4 years with a standard deviation of 4.6 years which implied that most of the farmers are relatively new in the beef fattening enterprises since the most experienced operator had only 26 years in the business.

Table 3: Age, household size, experience in cattle keeping and herd size

Variables	Average	Minimum	Maximum	Standard Deviation
Age	47.29	25	80	13.3
Household size	11.27	2	103	10.78
Cattle keeping experience	15.95	2	60	11.75
Cattle herd size	89.6	2	1 260	165.8

4.1.4 Cattle herd size

On average, a household had 89.6 cattle with a minimum herd of 2 cattle and a maximum herd of 1 260 cattle with a standard deviation of 165.8 cattle as shown in Table 3. The large value of standard deviation implied that the pastoralists and agro-pastoralists were raising different numbers of cattle. This is well evidenced with Mlote *et al.* (2013) who reported that the large value of standard deviation (76 animals) implied that the beef cattle fattening operators were raising different numbers of animals with a minimum of 4 animals and a maximum of 330 animals.

4.1.5 Sex of the household head

The study findings in Table 4 show that both male-headed (91.7%) and female-headed (8.3%) households were engaging in cattle keeping activities, although female-headed households were very few compared to male-headed households who were dominants. The

reason may be that, in most places or locations the male-headed households dominate. This is evidenced with previous studies by Ochieng *et al.* (2016) who shown that about 20% of households which engaged in commercialization of food crops and farm productivity were female headed, meaning that in that region, male headed household still remained dominant.

Table 4: Sex and education level

Variables	Frequency	Percentages
Sex		
Female	11	8.3
Male	121	91.7
Total	**132**	**100**
Education level		
Primary education	119	90.1
Secondary education	9	6.8
Tertiary education (College and University)	4	3.1
Total	**132**	**100**

4.1.6 Education level of the household head

On education level of the household heads, the findings in Table 4 show that 90.1% of household heads had attained primary school education, only 6.8% had completed secondary education and 3.1% of them attained tertiary education (college and or university). These findings imply that the majority of household heads in the study area had low level of education (primary and secondary) which may sometimes be difficult for them to appreciate and or adopt improved technologies (improved cattle husbandry). This is supported by Onyemekihian *et al.* (2017) who reported that higher levels of education had been found to increase agricultural production by speeding up the rate of adoption of farm innovations or technologies.

4.2 Cattle breeds, purpose of cattle keeping and production systems

4.2.1 Cattle breeds kept

Cattle breeds have implication on beef and milk productivity, diseases resistance and growth rate. The study findings in Table 5 show that 81.8% of the households were keeping local breeds, while 12.9% were keeping improved breeds, and 5.3% were keeping both local and improved breeds. Majority of the households (81.8%) kept local cattle breeds which are less productive compared to improved cattle breeds. The reason is that out of the 25 million cattle found in Tanzania, 98% of them are indigenous cattle breeds URT (2015) and Mlote *et al.* (2013) reported that most of the farmed cattle are indigenous cattle breeds.

4.2.2 Purpose of cattle keeping

As shown in Table 5, the households indicated that there was a wide range of reasons for which households kept cattle which varied across households reflecting the individual household‘s needs being directly (for food) or indirectly (for income). These results revealed the low importance attached to keeping cattle for commercial purposes (3.8%) as opposed to provision of food (6.0%) followed by being a store of wealth (31.7%) and source of income (58.5%) to finance the some expenses whenever necessary such as school fees, animal drugs, acaricides and payment of labour and or extension services.

This implied that most of the cattle keepers in the study area keep cattle for security rather than for commercial purposes. This can be clearly evidenced by Ruhangawebare (2010) who found that most of pastoralists keep cattle for food, source of income, prestige, way of life, security, store of wealth and commercial purposes.

4.2.3 Cattle production systems

As shown in Table 5 below, it was found that 11.36% of the households practiced zero grazing system while 88.64% practiced extensive system. The reason for the majority of households to practice extensive system is that it is difficult for them to practice zero grazing system with large herds of cattle averaging 89.6 cattle while others had a herd of 1 260 cattle.

Table 5: Cattle breeds, purpose of cattle keeping and production systems

Variables	Frequency	Percentages
Cattle breed type		
Local	108	81.8
Improved	17	12.9
Improved and local	7	5.3
Total	**132**	**100**
Purpose of cattle keeping		
Source of income	77	58.5
Store of wealth	42	31.7
Food	8	6.0
Commercial	5	3.8
Total	**132**	**100**
Production system		
Zero grazing	15	11.36
Extensive	117	88.64
Total	**132**	**100**

This could be supported by Nalubwama *et al.* (2016) who revealed that only 20% of households kept cattle under zero-grazing system and majority of them owned 1 or 2 dairy cows, while the remained 80% were practicing extensive system.

4.3 Perception on Destocking and Keeping Fewer Improved Cattle Breeds

As shown in Table 6, there were different perceptions (levels of agreeing and disagreeing). About 60.6% of households strongly agreed, 22.7% agreed, 6.1% did not know, 4.5%

disagreed and 6.1% strongly disagreed that shortage of water and pasture could influence them to destock larger local cattle herds and keep fewer improved cattle breeds. This imply that, all the two groups were willing to engage in keeping fewer improved cattle breeds which are more beneficial and minimize the incidences of land conflicts. Although some farmers prefer larger herds of local breeds and or varieties because they thrive in worst climatic conditions as well as being able to cope with pests and diseases (Ochieng *et al.,* 2016), in drought scenarios livestock producers destock some of their livestock and keep only few (Silvestri *et al.,* 2012; Lubungu *et al.,* 2016).

Table 6: Perception of farmers on destocking and keeping fewer improved cattle breeds

Variable Items	Strongly Disagree	Disagree	Not Know	Agree	Strongly Agree	Mean Score
Shortage of water and pasture caused destocking of larger local cattle herds	8(6.1)	6(4.5)	8(6.1)	30(22.7)	80(60.6)	4.3
Awareness about the benefits of improved cattle motivated destocking of larger local cattle herds	10(7.6)	9(6.8)	10(7.6)	25(18.9)	78(59.1)	4.2
Keeping fewer improved cattle was more profitable than keeping larger local cattle herds	39(29.5)	10(7.6)	17(12.9)	36(27.3)	30(22.7)	3.1
Presence of livestock multiplication units motivated keeping fewer improved cattle	3(2.3)	11(8.3)	9(6.8)	10(7.6)	99(75.0)	4.4
Availability of reliable extension services motivated keeping fewer improved cattle	15(11.4)	6(4.5)	3(2.3)	12(9.1)	96(72.7)	4.3

Note: Figures in the parenthesis indicates percentage

Moreover, awareness about the benefits of keeping improved cattle over local cattle was expected to have motivated livestock keepers to destock larger local cattle herds and keep

fewer improved cattle breeds as proved by the findings. About 59.1% of households strongly agreed, 18.9% agreed, 7.6% did not know, 6.8% disagreed and 7.6% strongly disagreed. With the majority agreed that meant when awareness or education was provided majority of the households could have been willing to destock larger local cattle herds and kept fewer improved cattle breeds. Previous studies by Onyemekihian *et al.* (2017) reported that training or education had been found to increase agricultural production by speeding up the rate of adoption of farm innovations or technologies, also Yamano *et al.* (2015) reported that farmers who were educated on practices of improved or profitable agricultural technologies had higher scores of agreeing on the adoption of new agricultural technologies than their counterpart farmers.

About 22.7% of households strongly agreed, 27.3% agreed, 12.9% did not know, 7.6% disagreed and 29.5% strongly disagreed that keeping fewer improved cattle was more profitable than keeping larger local cattle herds. This implied that, about half (50%) of the households agreed on the claim that keeping fewer improved cattle was more profitable than keeping larger local cattle herds while the rest did not.

The reason could be that only few households were keeping fewer improved cattle breeds, hence others did not know the compelling benefits of keeping fewer improved cattle breeds over larger local cattle herds. In some part this could be supported by Silvestri *et al.* (2012) who reported that most pastoralists they like improved cattle breeds but they fear to keep them in fewer numbers as they may lose them in diseases outbreaks and or severe droughts hence they prefer larger herds. Also Oladele and Fawole (2007) and Adenle *et al.* (2014) revealed that farmers perceived improved varieties or technologies as more relevant over local technologies, this was due to the reason that those farmers had the time to experience both local and improved agricultural technologies and seed varieties.

About 75.0% of households strongly agreed, 7.6% agreed, 6.8% did not know, 8.3% disagreed and 2.3% strongly disagreed that presence of livestock multiplication units motivated keeping fewer improved cattle breeds. This imply that, majority (82.6%) of households were willing to destock larger local cattle herds and keep fewer improved cattle breeds if there were livestock multiplication units near their localities as this could have been easier for them to access improved cattle breeds. This was supported by Lubungu *et al.* (2016) who revealed that majority of farmers had limited number of marketable surplus due to smaller herd sizes as a result of limited access of number of improved cattle as well as Silvestri *et al.* (2012) revealed that one of a desired adaptation option for agro-pastoralists was to introduce new or improved cattle breeds from animal breeding stations.

About 72.7% of households strongly agreed, 9.1% agreed, 2.3% did not know, 4.5% disagreed and 11.4% strongly disagreed that availability of reliable extension services motivated pastoralists and agro-pastoralists to keep fewer improved cattle breeds. This imply that, majority (81.8%) of households agreed that availability of extension services could have helped them in the keeping of fewer improved cattle breeds since they could have been getting the services of treating their cattle and how to well feed them from the extension agents. This finding was comparable with the finding by Onyemekihian *et al.* (2017) who observed that commercialized extension services enhance farmers' productivity and hence increasing farmers' income.

Also Patti *et al.* (2010) and Bawa *et al.* (2009) revealed that households strongly agreed that extension services delivery helped farmers to have greater access and involvement in improved farming practices that benefits farmers.

4.4 Regression Results

4.4.1 Evaluation of model accuracy

Various tests were conducted to elucidate accuracy of the multiple linear regression model in this study. Multicollinearity test was carried out in order to examine the correlation among explanatory variables included in the model. The Variance Inflation Factor (VIF) was estimated to test multicollinearity and results showed that VIF for all the explanatory variables were less than 5, implyed that there was no multicollinearity problem from the data in the model. Furthermore, the Breseuch Pagan post estimation test for heteroscedasticity was used to observe variation of residuals of the model. The results show the presence of heteroscedasticity in the variables thus the robust OLS analysis with heteroscedasticity consistent was estimated to overcome that problem.

4.4.2 Determinants of pastoralists and agro-pastoralists commercialization

From the previous chapter, various factors were presumed to affect commercialization level of pastoralists and agro-pastoralists. The dependent variables were (i) commercialization of inputs side and (ii) commercialization of output side and the independent variables were the number of cattle owned and age of the household head. Others include experience or number of years in cattle keeping, education level of household head, household size, grazing land owned and distance to the nearest cattle market, sex and access to extension services.

The results of multiple linear regression analysis showed that the levels of commercialization for both input and output markets were low averaging at 14.3% and 13.7% respectively. This implied that the involvement of pastoralists and agro-pastoralists in cattle sales and purchases of inputs for taking care of their cattle was considerably low. This finding is in line with the finding in URT (2010), which shows that cattle off take

from the traditional smallholder sector were expected to improve from 8% to 15% leading to meat production increase from 449 673 MT to 809 000 MT. Further, Gebremedhin and Jaleta (2010) revealed that there was the average crop output and crop input market participation of 25% and 20% respectively, which indicated moderate commercialization. Moreover, as Negassa and Jabar (2008) reported, the commercial off take rate of cattle was considerably low (8%) and the bulk of this commercial off take was of low quality cattle such as that of culled animals.

The results of multiple linear regression analysis summarized in Table 7 show that, three out of the nine variables considered explanatory variables in the study, namely the number of cattle owned, the age of household head and grazing land were statistically significant. The number of cattle owned by farmers was negatively associated with commercialization in input markets and this was significant at ($P < 0.05$). This implied that commercialization decreased with herd size.

Table 7: Regression results for determinants of pastoralists and agro-pastoralists inputs commercialization

Independent variables	Coefficients	P value
(Constant)	18.236	.007***
Number of cattle (herd size)	-.022	.023**
Age of household head (years)	-.230	.033**
Experience or number of years in cattle keeping	.209	.142
Education (number of years of formal education of household head)	.028	.761
Household size	.035	.805
Grazing land owned (acres)	.026	.017**
Distance to a nearest cattle market	-.002	.995
Sex Dummy (0 Female, 1 Male)	5.156	.236
Extension Dummy (0 No, 1 Yes)	-1.677	.521

Note: (***) (**) (*) significant at 1%, 5% and 10% level respectively,
R square = 0.29
Adjusted R square = 0.24

Stated differently, the farmers with huge herd sizes were less buying inputs and hiring veterinary services for their cattle than their counterpart farmers who owned smaller herds. Gebremedhin and Jaleta (2010) and Demeke and Haji (2014) reported that, farmers with huge herds were struggling in handling higher input requirements and costs associated with large cattle herds. Elsewhere Nmadu *et al.* (2014) reported that high costs of medication for farmers with large number of birds reduced their purchasing power in input markets since it was difficult to buy the required drugs for a larger group of birds compared to their counterpart farmers.

The results of regression analysis also indicate that commercialization (in input markets) has been decreasing with an increase of the age of the household head at ($P < 0.05$). This can be due to when pastoralists and agro-pastoralists grow older their orientation of buying inputs and paying for veterinary services for their cattle decreased due to their limited access on some on-farm and off-farm activities that could channel more income to cater for their families and high costs of veterinary services. This finding is in line with the findings of various scholars (Mahelet, 2007; Demeke and Haji, 2014) who reported the age of household head had negative and significant influence on the degree of market participation. They attribute this to the fact that older household heads or farmers have limited access to market information since they could not walked long distances to the markets to acquire information.

Furthermore, ownership of grazing land (measured in terms of size of grazing land owned) had a positive effect on commercialization or participation of pastoralists and agro pastoralists in input markets ($P < 0.05$). This implied that, commercialization in input market increased with the size of grazing land owned by farmers. Pastoralists and agro pastoralists with larger holdings of grazing land had more chances of buying inputs and

hiring veterinary services for their cattle, as they would be worrying less about the availability of enough pasture for their cattle and land use conflicts than pastoralists and agro pastoralists with smaller holdings. This finding is consistent with the findings of other scholars such as Gebremedhin and Jaleta (2010) and Agwu *et al.* (2013) who found that farmers with bigger grazing land holdings were more likely to purchase inputs than were their counterpart farmers without or with smaller land holding. The results of the analysis of determinants of commercialization or participation in output markets are summarized in Table 8. Out of the nine independent variables hypothesized to influence commercialization (measured in terms of participation to output markets), only three (i.e. the number of cattle owned or herd size, age of household head and experience in cattle keeping) were found to be statistically significant at P = 0.15: P = 0.037: and P = 0.000 respectively.

The results in Table 8 suggested that commercialization or participation in the output markets for pastoralists and agro-pastoralists increased with herd sizes at ($P < 0.05$). This can be associated with the fact that, although pastoralists and agro-pastoralists perceive cattle as a safe storage of value than real cash, and cattle can only be converted to cash during times of pressing needs by selling few and remain with a reasonable number of cattle. This finding is in line with the findings by various scholars who revealed that the rise in chicken population translates to increased output commercialization (Nmadu *et al.,* 2014). In addition, those farmers with larger herds of cattle have good number of marketable surplus, which tends to increase commercialization (Lubungu *et al.,* 2016), also Gebremedhin and Jaleta (2010) revealed that an increase in ownership of cattle increases the proportion of output sold. Commercialization also increased with age of the household head ($P = 0.037$). This can be attributed to the fact that, as pastoralists and agro pastoralists grow older the tendency of selling their cattle increases since their ability of working in

order to earn more income to take care of their family's basic needs decrease due to less physical energy hence one of the remaining option is to off take some of their cattle. This is in line with the findings by Demeke and Haji (2014) that showed that the probability of farmers to be subsistent declined with age. Similarly, Onyemekihian *et al.* (2017) also suggested that the older the farmers become the more they develop positive perception towards commercialized farming since they tend to become more committed to their farming activities than the young ones who usually see farming as a tedious and dirty job.

Table 8: Regression results for determinants of pastoralists and agro-pastoralists output commercialization

Independent variables	Coefficients	P value
(Constant)	16.676	.001***
Number of cattle	.018	.015**
Age of household head	.172	.037**
Experience: Number of years in cattle keeping	-.383	.000***
Education (number of years of formal education of household head)	.018	.390
Household size	-.046	.672
Grazing land owned	.007	.376
Distance to a nearest cattle market	-.135	.570
SexDummy (0 Female, 1 Male)	-2.336	.482
Extension Dummy (0 No, 1 Yes)	.940	.632

Note: (***) (**) (*) significant at 1%, 5% and 10% level respectively,
R square 0.12
Adjusted R square 0.05

Furthermore, the results of analysis in Table 8 indicated that commercialization decreased with experience or number of years in cattle keeping (P = 0.000). This suggested that pastoralists and agro pastoralists with more years of cattle keeping have lower chances of commercializing their cattle than pastoralists and agro pastoralists with fewer years of cattle keeping. The reason was that, households would rather store their money in herds of cattle and convert them to cash during times of pressing needs. This is in contrast with the

findings of many studies (e.g. Agwu *et al.,* 2013; Kabiti *et al.,* 2016) that revealed a positive relationship between farming experience and an increase in output commercialization. This contrast could be due to the difference on crops and livestock, since experienced farmers may commercialize 40 bags of their crops at once due to the good price in the markets or pests were destroying their stored harvests rather than cattle keepers who may sell 2 or 6 cattle but not 40 cattle at once. However, Lubungu *et al.* (2016) explained that some farmers often use cattle as their saving accounts from which they draw to address specific types of family needs.

4.5 Cost Benefit Analysis of Cattle Fattening

The economic returns from cattle fattening for beef as shown in Table 9, the results show that the NPV was positive and the highest for farmers who fattened and sold improved cattle (TZS 32 143 948.24) and the BCR was 1.60. The NPV for keeping Boran (local cattle) was TZS 23 705 381.59 and the BCR was 1.43. The NPV for fattened TSZ (local cattle) was TZS 18 741 230.18 and the BCR was 1.35. The results shown a significant difference in both NPV and BCR of these three cattle breeds, while the fattening of improved cattle was more economically viable and rewarding followed by that of Boran cattle with TSZ cattle as the least rewarding. These results are consistent with the results in a study by Mondal *et al.* (2010) who reported a BCR of 3.16 for crossbred cattle and a BCR of 1.80 for local cattle. Islam *et al.* (2015) also found that rearing of improved chicken was a profitable venture with BCR of 2.60 as opposed to that of local chicken with BCR of 2.27. This difference can be attributed to the difference in their growth genetic potential (Creek, 1972; Casas *et al.,* 2011). Improved cattle had an average daily weight gain of 1 384 gm (Creek, 1972). Also Creek (1972) and Mwilawa (2012) reported Boran cattle had an average daily weight gain of 1 023 gm. Mlote *et al.* (2013) and Asimwe *et al.* (2016) reported an average daily weight gain of 700 gm for the TSZ, which imply that all

cattle breeds respond to fattening although their respective gain in weight differ. The results of the analysis indicate that pastoralists and agro-pastoralists will benefit more from keeping improved cattle breeds and Boran cattle than TSZ breed. In turn, this will translate into improved livelihoods of livestock keepers (Mondal *et al.,* 2010; Nalunkuuma *et al.,* 2013).

Table 9: Net Present Values (NPVs) and Benefit Cost Ratios (BCR) for beef fattening

Breed type	Life span	Discount rate	NPV	BCR
Improved cattle	7	10%	32 143 948.24	1.6
	7	15%	27 251 212.95	1.6
	7	30%	17 864 422.83	1.5
Boran	7	10%	23 705 381.59	1.43
	7	15%	20 039 840.94	1.42
	7	30%	13 007 443.15	1.4
TSZ	7	10%	18 741 230.18	1.35
	7	15%	15 797 610.71	1.35
	7	30%	10 150 230.14	1.31
Price change of output 30% decrease (Improved cattle)	7	10%	10 729 649.96	1.31
	7	15%	8 990 175.15	1.28
	7	30%	5 700 537.33	1.17
Price change of output 30% decrease (Boran)	7	10%	6 812 648.66	1.2
	7	15%	5 031 390.52	1.14
	7	30%	2 765 048.18	1.06
Price change of output 30% decrease (TSZ)	7	10%	3 836 329.82	1.1
	7	15%	2 827 996.75	1.08
	7	30%	1 216 036.82	1

As shown in Table 10, improved cattle are better in milk production than local cattle breeds; improved cattle had an average milk production of 7.7 litres per cow per day ranging from 3.3 to 13.5 litres while local cattle had an average milk production of 1.9 litres per cow per day ranging from 0.7 to 8.7 litres. This finding is in line with Mondal *et*

al. (2010) who reported an average yield of 7.68 litres of milk per cow per day for crossbred cattle and 1.89 litres of milk per cow per day for local cattle breeds. This makes improved cattle breeds better than the local cattle breeds in terms of both beef fattening and milk production projects (Mondal *et al.*, 2010; Islam *et al.*, 2015).

Table 10: Daily milk yield per cow in liters

Breed type	Mean	Minimum	Maximum
Improved cattle	7.7	3.3	13.5
Local cattle	1.9	0.7	8.7

4.6 Sensitivity Analysis

Using different discount rates, the NPVs and BCRs were computed for the improved and local beef cattle fattening. Two scenarios were taken into consideration: a) the normal market price and the variation of the discount rates and, b) the price of the output decreased by 30%. The results in Table 9 show that when discount rate was increased to 30% for improved cattle keepers the NPV significantly decreased while BCR slightly decreased same to the local cattle keepers. This means that NPV and BCR were highly affected with high discount rates since the benefits and costs were highly reduced by high interest rates. When output price decreased by 30% the NPV for improved cattle dropped to TZS 10 729 649.96 from TZS 32 143 948.24 and BCR of 1.31 from BCR of 1.6 at 10% discount rate, this significant change occurred to local cattle keepers as well. Generally, both improved cattle and local cattle keepers should be prepared for various shocks like decreased discount rates or decreased output prices or increased inputs prices which can have a significant decrease of the income from livestock business.

4.7 Challenges Associated with Cattle Keeping

At production and keeping of both local and improved cattle breeds, pastoralists and agro pastoralists in the study area reported to have experienced a number challenges in the keeping of cattle as shown in Table 11. About 78.1% of pastoralists and agro pastoralists in the study area had experienced shortage of pasture and water for their cattle, 12.9% had experienced high costs of veterinary services and 9.0% experienced shortage of dipping facilities for their cattle. This finding is similar to the finding reported by Ruhangawebare (2010), who revealed that diseases, inadequate veterinary services, pasture and water scarcity were the potential constraints in keeping cattle. In another study, Patti *et al.* (2010) revealed that animals were typically raised in harsh environments where drought and theft were common and that commercial feeds and veterinary services were beyond the means of most farmers.

Table 11: Challenges facing pastoralists and agro-pastoralists in cattle keeping

Variables	**Frequency**	**Percentages**
Shortage of pasture and water	103	78.1
High costs of veterinary services	17	12.9
Shortage of dipping facilities	12	9.0
Total	**132**	**100**

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Majority of the pastoralists and agro-pastoralists households (more than three quarter) in the study area practice free range or extensive system of keeping their cattle with less than a quarter performing zero grazing system. The findings on the households' willingness to destock larger herds of local cattle revealed that pastoralists and agro-pastoralists in the study area were willing to destock their larger herds of local cattle breeds and start keeping fewer improved cattle breeds which are more profitable than local cattle breeds.

Commercialization level of pastoralists and agro-pastoralists in both inputs and output markets was considerably low at 14.3% and 13.7% respectively. Inputs commercialization was statistically significant and negative for the two variables namely the number of cattle owned and the age of household head. It means that both large numbers of cattle owned by household as well as older age of cattle keepers hindered input commercialization. Further, size of land owned for grazing cattle influenced inputs commercialization positively.

Furthermore, the results on multiple linear regression analysis on output commercialization revealed that the number of cattle owned by a household and the age of household head were statistically significant and positively influencing commercialization. This means that, *ceteris paribus,* the larger the number of cattle the higher the number of cattle or milk sold to the markets. Additionally, experience of farmers in cattle keeping was significantly and negatively influencing output commercialization. Moreover, the results of cost benefit analysis revealed that improved cattle were more economically viable with BCR of 1.60 and NPV of TZS 32 143 948.24 compared to Boran (local cattle) with BCR of 1.43 and

NPV of TZS 23 705 381.59. The benefits from TZS was also lower that was BCR of 1.35 and NPV of TZS 18 741 230.18 as opposed to the benefits obtained from keeping improved cattle. It was further observed that, the economic viability of keeping improved cattle emanated from fattening venture and milk production. This was verified by the findings in the study area whereby an average milk yield per improved cow per day was 7.7 litres while that of local cow was 1.9 litres.

Despite the observed benefits of keeping improved cattle breeds and local cattle breeds in the study area, there were multiple challenges that were reported to impede the current potential of the subsector. These included the shortage of grazing land and water, which frequently perpetuated land use conflicts amongst farmers, pastoralists, and agro-pastoralists in the study area. Other challenges were high costs of veterinary services, shortage of dipping facilities and multiplication units in the proximity of the pastoralists and agro-pastoralists.

5.2 Recommendations

Based on the findings of this study, the following recommendations were suggested for the improvement of pastoralists and agro-pastoralists commercialization in cattle.

5.2.1 Recommendation for smallholder farmers

i. Pastoralists and agro-pastoralists should destock local cattle and start raising improved cattle breeds which are more beneficial and cost-effective to them than local cattle. This will foster multiple advantages such as livelihood diversification and increased ability to pay for basic needs such as health insurance, school fees for their children, and general livelihoods support. It can be achieved through

improved trainings and extension services improvement in pastoralists and agro-pastoralists communities.

5.2.2 Recommendations for policy makers

i. There is a need for the government to invest in livestock multiplication units in different areas in order to ease accessibility of improved cattle breeds to a large number of pastoralists and agro-pastoralists as possible.

ii. There is a need for the government to invest in awareness sensitization to the pastoralists and agro-pastoralists communities through provision of trainings on the importance of commercialization (especially in keeping of improved cattle breeds) and improvement of extension services.

5.3 Areas for Further Research

Although this study generated information on the level of commercialization among pastoralists and agro-pastoralists, the challenges of keeping cattle in the study area as well as profitability of improved cattle over local cattle breeds, further research should be conducted on economies of scale to investigate as what exact number of improved cattle breeds for beef give optimum profit as well as the exact number of improved cattle to be kept so as to commercialize.

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APPENDIX

Appendix 1: Questionnaire for Pastoralists and Agro-pastoralists

Potential for Commercialization of Pastoral and Agro-pastoral Farming Systems in Kilosa District, Tanzania.

Dear respondent; I am Leakey M. Madale, a student of Sokoine University of Agriculture pursuing MSc. Agricultural Economics. I am conducting a research on the topic "Potential for Commercialization of Pastoral and Agro-pastoral Farming Systems in Kilosa District". I kindly ask for your corporation and support in responding to the questions. The information obtained from this interview will be handled confidentially.

A: BASIC INFORMATION

1. Date of interview……. 2. Name of enumerator..……

3. Ward...……. 4. Village……

5. Name of respondent …….... 6. Phone number of respondent.....

7. Relation of the respondent with the household head…….. 0 = Household head, 1 = Wife, 3 = Son, 4 = Daughter, 5 = Grandchild.

B: SOCIOECONOMIC, CULTURAL, AND INSTITUTIONAL INFORMATION

8. Age of the household head …..…Years

9. Sex of the household head …… 0 = Male, 1 = Female

10. Marital status of the household head……. 0 = Single, 1 = Married, 2 = Separated, 3 = Divorced, 4 = Widow, 5 = Widower

11. Highest education level of the household head……. 1 = None, 2 = Primary level, 3 = Ordinary secondary level, 4 = Advanced secondary level, 5 = College certificate, 6 = Diploma, 7 = Bachelor, 8 = Masters, 9 = PhD

12. What is the primary and secondary occupation of the household head? (1= farming, 2= livestock keeping, 3 = employed, 4 = seasonal wages, 5 = regular wages, 6 = business)

Primary……., Secondary……

13. Land size owned by the household head……..acres

14. Value of the owned land…….Tzs

15. Household size and composition (number of people living together and share both the same kitchen and decision making) …… Number

Age group	**Number**	**Male**	**Female**
0 - 7			
8 - 19			
20 - 39			
40 - 64			
65 +			

16. Family assets

Asset type	**Value of asset**	**Number of assets in 3 years ago**	**Number of assets currently**

17. Have you ever accessed loans for livestock/farming activities? ……. 1 = Yes, 2 = No

18. If **yes,** where did you access loans for livestock/farming activities?….. 1 = friends, 2 = family relatives, 3 = NGOs, 4 = VICOBA, 5 = Bank, 6 = N/A

19. Do you receive extension services? 1 = yes, 0 = no,

20. If **yes** how often do you receive extension services? 1 = regular, 2 = once per month, 3 = once per 3 months, 4 = once per 6 months, 5 = once per 9 months, 6 = once per year

21. What are the constraints you face in keeping your cattle? 1 = Drought (shortage of water and pastures), 2 = High costs of veterinary drugs/services, 3 = Agro vet shops are far away from residential areas, 4 = Shortage of cattle dipping facilities in the near areas, 5 = Lack of credit facilities

22. What is the average distance from farm to main point of sale/market? ……km

23. Type of road from farm/home to market…….. 1 = tarmac, 2 = earth road, 3 = gravel

24. What is the status of the road? …… 1 = good, 2 = average, 3 = bad

25. Crops production

Land size in acres	Crops cultivated	Purchased seeds 1 = yes; 2 = no	Amount of seeds purchased in kgs	Cost of those seeds (Tzs)	Amount of seeds saved from previous season/from a friend in kgs	If could have been purchased, what could be the cost?	Manure used in carts	Cost of manure used (Tzs)	Mineral fertilizer used in kgs	Cost of mineral fertilizer used (Tzs)	Herbicides/ pesticides used in litre	Cost of herbicides/ pesticides used (Tzs)

26. Hired labor for crops activities

Land size in acres	Crops cultivated	Plowing costs (Tzs)	Planting costs (Tzs)	Weeding costs (Tzs)	Fertilizer/manure /herbicides/pesticides application costs (Tzs)	Irrigation costs (Tzs)	Costs of harvesting/transportation of crops to home (Tzs)	Costs of processing harvest and bagging for storage (Tzs)	Costs of taking harvests to the market and selling (Tzs)

27. Family labor for crops activities

Land size in acres	Crops cultivated	Plowing costs (man days)	Planting costs (man days)	Weeding costs (man days)	Fertilizer/manure /herbicides/pesticides application costs (man days)	Irrigation costs (man days)	Costs of harvesting/transportation of crops to home (man days)	Costs of processing harvest and bagging for storage (man days)	Costs of taking harvests to the market and selling (man days)

28. Crops harvests, prices and markets

Crops cultivated	Amount harvested last season (kgs)	Amount sold last season (kgs)	Price per kg (Tzs)	Total value (Tzs)	Amount used at home/given to a friend (kgs)	Remained amount of harvests in storage (kgs)	Buyers come from… 1=within the village, 2=near village, 3=district level

29. Total number of cattle you have ……..

29b. How many are; (Improved cattle: Bulls….., Cows….., Heifer……., Calves…..;

Boran: Bulls….., Cows….., Heifer……., Calves…..;

TSZ: Bulls….., Cows….., Heifer……., Calves…..).

30. For what purpose do you rear these cattle? 1 = commercial purpose, 2 = prestige, 3 = store of wealth, 4 = security/insurance, 5 = Food, 6 = source of income, 7 = way of life

Years	Cattle	No of cows sold	Price per animal (Tzs)	No of heifers sold	Price per animal (Tzs)	No of bulls/oxen sold	Price per animal (Tzs)	No of calves sold	Price per animal (Tzs)	Total value of animals sold (Tzs)	Buyers come from… 1=within the village, 2=near village, 3=district level
2018	Local										
	Crossbred										
2017	Local										
	Crossbred										
2016	Local										
	Crossbred										

31. How long have you been keeping cattle? ……..Years

32. Cattle production

Years	Cattle	No of cows purchased in last 12 months	Price per animal (Tzs)	No of heifers purchased in last 12 months	Price per animal (Tzs)	No of bulls/oxen purchased in last 12 months	Price per animal (Tzs)	No of calves purchased in last 12 months	Price per animal (Tzs)	Total costs of animals purchased in last 12 months (Tzs)
2017/18	Local									
	Crossbred									

33. Cattle prices and sales estimation

33b. For local cattle sold, how many were (Boran: Bulls….., Cows….., Heifer……., Calves…..; and TSZ: Bulls….., Cows….., Heifer……., Calves…..).

34. Sales of cattle products and by products

Type of product/by product in last 12 months	Produced? 1=yes, 2=no	Amount produced	Price per kg (Tzs)	Total value (Tzs)	Amount used at home/given to a friend (kgs)	Remained amount of harvests in storage (kgs)	Buyers come from… 1=within the village, 2=near village, 3=district level
Beef							
Hides							
Manure							

35. Milk yield and sales estimation

Years	Cows	No. of milking cows	Average liters of milk per day (at peak)	Price/liter at peak (Tzs)	Average liters of milk per day (at normal days)	Price/liter at normal days (Tzs)	Lactation period	Liters of milk consumed at home per day	Liters of milk sold per day
2018	Local								
	Crossbred								
2017	Local								
	Crossbred								

* Lactation period: 1 = 3 months, 2 = 4 months, 3 = 6 months, 4 = 8 months, 5 = for a year

36. Where do you sell your milk?..... 1 = neighbors 2 = restaurants 3 = market

37. What are milk transportation costs per year? ..... Tzs

38. Cattle production costs in last 12 months

Item	Paid for? 1=yes, 2=no	If yes, how much (Tzs)
Market charges per cattle sold		
Cattle transportation costs per year		
Forage/hay/silage costs		
Concentrates costs		
Labor costs of herding cattle per year		
Milking and drinking utensils		
Costs of veterinary drugs/services per year		
Dipping/Spraying costs per year		
Animal shed/enclosure construction/repair costs		

39. Off - farm income estimates per year

Type of work (1=seasonal wage, 2=regular wage, 3=salaried public servant, 4=salaried private servant, 5=business income, 6=pension payments)	Income of last month (Tzs)	Income of last 12 months (Tzs)

40. Please circle a code letter from the scale to show how you agree or disagree with each of the following statement (*Strongly Agree = SA, Agree = A, I do not know = NK, Disagree = D, and Strongly Disagree = SD*)

S/No	Statements	SD	D	NK	A	SA
1	Shortage of water and pasture due to drought make pastoralists and agro-pastoralists to destock their larger local cattle herds and keep fewer improved cattle breeds					
2	Awareness on the benefits of improved cattle over local cattle may motivate pastoralists and agro-pastoralists to destock their larger local cattle herds and keep fewer improved cattle breeds					
3	Keeping fewer improved cattle breeds is profitable than keeping larger cattle herd of local breeds					
4	Presence of livestock multiplication units motivate pastoralists and agro-pastoralists to access and keep fewer improved cattle breeds and destock larger local cattle herds					
5	Availability of extension services motivate pastoralists and agro-pastoralists to keep fewer improved cattle breeds than larger local cattle herds					