ECONOMICS OF BEEF CATTLE FATTENING IN THE TRADITIONAL CATTLE SUPPLY CHAIN IN TANZANIA

BY

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ABSTRACT

A study was conducted to examine the economic viability of beef cattle fattening in the traditional cattle supply chain as a means of increasing income to cattle keepers in Tanzania. Analysis of the supply chain, technical efficiency and profitability of beef cattle fattening were carried out; and factors that influenced pastoralist and agro pastoralist's willingness to adopt beef cattle fattening were determined. A structured questionnaire was used to collect data from 401 pastoralists and agro-pastoralists, and 90 cattle fattening operators in eight districts of Shinyanga and Mwanza regions. The districts covered were Kahama, Kishapu, Meatu, Bariadi, and Maswa in Shinyanga Region and Nyamagana, Sengerema and Magu in Mwanza Region. The questionnaire interviews were supplemented with focus group discussions and key informant interviews.

Qualitative and quantitative data were collected and analyzed using descriptive statistics and gross margins to compare different actors along the supply chain. Technical efficiency and profitability for beef cattle fattening enterprises were examined using stochastic frontier production function and budgeting analysis respectively, whilst factors influencing profitability were determined using multiple regression analysis. Keeping other factors constant, profit was expected to be a major incentive for pastoralists and agro-pastoralists to adopt the cattle fattening technology. Factors that influenced pastoralists and agro-pastoralists' willingness to adopt the cattle fattening technology were investigated using Logit regression model.

There were two types of beef cattle supply channels in the study area, one channel where cattle are sold directly to butcher operators within the country and another channel where cattle are fattened in feedlot and sold to exporters of live animals. The key actors in the

beef cattle supply chain are the primary producers (agro pastoralists and pastoralists), traders, butcher operators, middlemen and retailers while the service providers included banks, drug stores, supplementary feed suppliers and government institutions. The spot market relations among actors were the most common practice in the study area. The gross margins for traders who fattened cattle were higher (20.2%) compared to 11.5% for traders who did not fatten their cattle. The challenges along the beef cattle supply chain for producers (pastoralists and agro-pastoralists) were different from those of beef cattle fattening operators whose main problems were; lack of fattening skills (22.6%), lack of credit (20.4%), high cost of fattening (17%), and limited availability of animal feeds (14.2%). While, the problems for beef cattle fattening operators were; high prices of fattening feeds (27.7%), lack of credit (16.6%), difficulty in securing areas for conducting fattening (16.2%), and limited availability of feeds (22.6%). Opportunities for beef cattle fattening included: availability of market outlets for fattened beef cattle (58.9% for Pugu market), availability of feeder cattle (55.1%) and the high level of beef cattle fattening awareness (95.5%) among the agro-pastoralists and pastoralists.

The technical efficiency of cattle fattening ranged between 48% and 98% with an average technical efficiency score of 91%. Education, experience, access to credit, extension services and ethnicity of cattle fattening operators were the main factors that contributed positively to improving the technical efficiency. The maximum net profit was TZS 77 729 200.00 per enterprise and the minimum was a loss of TZS 7 916 500.00 per enterprise with an average of TZS 12 165 871.60 per farmer per annum. The benefit cost ratio of cattle fattening enterprises was 1.35, indicating a return of 35% for every shilling invested in beef cattle fattening. The main determinants of profitability of beef cattle enterprises were; the prices for buying (X_2) and selling (X_6) animals as well as transportation costs from various sources of cattle purchases (X_3) and to the points of selling fattened cattle (X_5).

About 93.5% of the sampled pastoralists and agro pastoralists were willing to fatten their cattle if given an opportunity, while 14.7% had already started to fatten their cattle with about 30 to 100 animals per fattening cycle of three to four months. The main factors influencing adoption of beef cattle fattening were marital status ($p<0.1$), awareness ($p<0.05$) and attitude towards the technology ($p<0.01$).

On the basis of these findings, it is concluded that beef cattle fattening in the traditional cattle supply chain within the study area is economically viable and that pastoralists and agro pastoralists have shown willing to adopt the technology. Thus creationing awareness regarding benefits of cattle fattening, changing the attitudes of pastoralists towards large cattle herds as sign of status, and addressing the challenges faced by cattle fattening operators along the supply chain would promote accelerated adoption and up scaling of cattle fattening in the study area and in Tanzania as a whole.

DECLARATION

I, SOPHIA EZEKIEL NYAKUNGA MLOTE, do hereby declare to the Senate of Sokoine University of Agriculture, that this thesis is my original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

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DEDICATION

This work is specifically dedicated to my beloved parents, the late Ezekiel Chamja Munyibamba Nyakunga and his wife, the late Alatunasa Muyenga Selyode who gave me the chance to live and the laid foundation for my education. "May the almighty God rest their souls in Eternal Peace, Amen.

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ABBREVIATIONS AND SYMBOLS

ADG	Average Daily weight Gain
AGDP	Agricultural Gross Domestic Product
AI	Artificial Insemination
ASDP	Agriculture Sector Development Program
BOT	Bank of Tanzania
COMESA	Common Market for Eastern and Southern Africa
FAO	Food and Agriculture Organizations of the United Nations
GDP	Gross Domestic Product
GPS	Global Positioning System
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MLFD	Ministry of Livestock and Fisheries Development
MLD	Ministry of Livestock Development
NARCO	National Ranching Company
NBS	National Bureau of Statistics
NGDP	National Gross Domestic Product
NLP	National Livestock Policy
NSCA	National Sample Census of Agriculture
NSGRP	National Growth and Reduction of Poverty
SADC	Southern African Development Cooperation
TLMP	Tanzania Livestock Marketing Project
TLU	Tropical Livestock Unit
TSZ	Tanzania Short Horn Zebu
UN	United Nations

URT	United Republic of Tanzania
US	United States of America
VIF	Variance Inflation Factor
WB	Word Bank

CHAPTER ONE

1.0 INTRODUCTION

1.1 Livestock sector in Tanzania

Livestock production in Tanzania is an important agricultural activity that contributes towards achieving development goals under the National Growth and Reduction of Poverty (NSGRP) (Ministry of Livestock Development (MLD), 2006). The livestock sector provides livelihood support to a total of 2 326 025 (39.8%) households out of 5 838 523 agricultural households in the country (United Republic of Tanzania (URT, 2012). Livestock accounts for about 16% of the Agricultural Gross Domestic Product (AGDP) and 3.9% of the National Gross Domestic Product (NGDP) (URT, 2011b).

According to URT (2012), the livestock population in the country stands at 21.3 million cattle, 15.1 million goats and 5.7 million sheep. Other livestock raised include 1.6 million pigs, 35 million local chicken and 23 million improved chicken. About 90% of the livestock population comprises of indigenous cattle. The ownership of livestock differs from region to region. About 94% of the total cattle herd is owned by agro-pastoralists and pastoralists, while 6% are owned by commercial ranches both private and those belonging to public institutions. Mwanza and Shinyanga regions in the lake zone have the largest population of cattle (URT, 2012). According to URT (2012) Shinyanga region had a total of 3.65 million cattle (17 %) while Mwanza had 1.97 million cattle (9%) of the total cattle population in mainland Tanzania. About 44.8% and 36.6% of the households in Shinyanga and Mwanza respectively raise cattle. Other regions with large livestock numbers include; Tabora (2.13 million), Arusha (1.81 million), Mara (1.69 million), Manyara (1.66 million), Dodoma 1.16 million) and Singida (1.59 million).

The production of livestock products such as meat, milk and eggs has been increasing over the past seven years since 2007/08 (Table 1). Total meat production increased by 34.8% from 410 706 000 tones in 2007/08 to 553 455 000 tones in 2012/13. Milk production increased from 1.5 billion liters to 1.9 billion liters, an increase of 28.1%, while eggs production increased from 2.7 billion eggs to 3.7 billion eggs, representing 38.5% increase. During the same period, the estimated per capita annual consumption was 12 kg of meat, 34 liters of milk, and 75 eggs (Ministry of Livestock and Fisheries Development (MLFD), 2013). These consumption levels are much lower than those recommended by FAO at 50 kg of meat, 200 liters of milk and 300 eggs per capita per year (FAO, 2005; MLFD, 2013), which stands at only 24%, 22% and 25%, of the FAO recommended levels for meat, milk and eggs respectively.

Table 1: Production of Livestock Products 2006/07 - 2012/13

	Production Year							
Type of Product	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**% change (2007-2013)**
Meat Production (Tones)								
Beef	180 629	218 976	225 178	243 943	262 606	289 835	299 581	36.8
Lamb/Mutton	80 936	81 173	82 884	86 634	103 709	111 106	115 652	42.5
Pork	31 721	33 307	36 000	38 180	43 647	47 246	50 814	52.6
Chicken	77 280	77 250	78 168	80 916	93 534	84 524	87 408	13.1
Total	**70 566**	**410 706**	**422 230**	**449 673**	**503 496**	**532 711**	**553 455**	**34.8**
Milk Production ('000' liters)								
Traditional Herd	945 524	980 000	012 436	997 261	1 135 422	1 255 938	1 297 775	32.4
Improved Head	475 681	520 000	591 690	652 596	608 800	597 161	623 865	20.0
Total	**1 421 205**	**1 500 000**	**1 604 126**	**1 649 857**	**1 738 683**	**1 853 099**	**1 921 640**	**28.1**
Egg Production ('000')								
Eggs	2 230 900	2 690 000	2 806 350	2 917 875	3 339 566	3 494 584	3 725 200	38.5

Source: MLFD, 2013

Currently, livestock and livestock products produced in the country are largely sold in the domestic markets and only a small amount is exported (Table 2). For example, in the year 2009/10 a total of 857 208 cattle, 682 992 goats and 122 035 sheep were sold, of

which only 2 970 cattle and 302 goats were exported to Middle East and neighboring countries in the region and to the Middle East according to the official records. NB. A lot more livestock trade goes through unofficial route especially across the Kenyan boarder. Some estimates show that about 300 000 animals per annum go out of the country using unofficial routes. Marketing of live animals within the country takes place in primary, secondary, and tertiary livestock markets, where pricing is through negotiation, grading is normally based on visual estimation. Meat and its by-products are mostly marketed by individual business retailers and meat processing companies. Retailing of meat is mostly done through privately owned butcheries located all over the country.

Table 2: Export of Live Animals, Meat and Meat Imports

	Live animal			Meat		Meat Imports
Prod. Year	Cattle	Goats/sheep	Value (000'Tshs)	Tons	Value (000'Tshs)	Tons
2005/06	1 706.00	800.00	675.90	3.50	6.80	1.675
2006/07	2 542.00	1 852.00	1 030.00	92.00	352.00	103.35
2007/08	2 772.00	874.00	1 800.00	195.00	500.00	122.4
2008/09	3 264.00	,834.00	2 100.00	186.50	534.25	70
2009/10	2 970.00	302.00	2 800.00	193.50	580.50	
Total	**13 254.00**	**5 662.00**	**8 405.90**	**670.50**	**1 973.55**	**297.425**

Source: MLFD, (2011)

1.2 The Beef Sub-Sector

The beef sub sector in Tanzania is one of the most important components within the livestock sector, playing an important role as a source of food, income and employment. The sub sector provides income and employment to about 80% of the population (MLD, 2006), comprising of the livestock keeping households as well as traders and other actors in the livestock supply chain. However, the contribution of the beef sub sector to livestock GDP is only 40 % (30% dairy, 30% poultry), which means the contribution of the livestock sector to economic growth is dismally low in relation to other sectors. The entire livestock

sector accounts for only 16% of the agricultural GDP and 3.9 % of the national GDP in 2011 as stated in the previous section.

The beef sub sector is dominated by indigenous cattle which are well known for their low genetic potential in terms of beef production. The indigenous cattle comprises of Tanzania Shorthorn Zebu (TSZ), Boran and Ankole (MLD, 2006). The Tanzania Short horn Zebu (TSZ) and Ankole are the most dominant indigenous breeds, which account for about 94% of the national cattle herd kept traditionally under pastoral (14%) and agro-pastoral (80%) production systems. The remaining 6%, fall under improved dairy and beef cattle management systems. Cattle under the traditional system are raised up to slaughter age entirely on natural pastures, often of poor quality (MLFD, 2009). The animals in most cases have to trek through long distances in search of water and pasture and therefore produce tough and unpalatable meat. The quality of beef from these animals is particularly bad during the dry season when animals face shortage of pasture and water. The animals therefore exhibit an oscillating type of growth, attaining only low slaughter weight at an advanced age of 5 to 7 years, compared to improved breeds which attain slaughter weight at 3 years old (MLFD, 2009).

According to MLFD (2011), among factors that contribute to poor performance of the beef sub sector include; low genetic potential of the existing stock, requiring a longer growth period (5-7 years) to achieve optimum (profitable) sale weight, prevalence of animal diseases leading to high calf mortality rates (>25%), high mortality rates of adult animals (8-10%), low mature weight (200-350kg), low off-take rates (8-10%) per annum, low carcass weight (100-175kg) and inadequate feeding management practices, especially under the traditional system. In the traditional livestock system, inefficiencies in production are also aggravated by seasonal migration of livestock in search for water and

pasture (MLFD, 2009). Modest improvement of these production coefficients, coupled with adding value through beef cattle fattening and processing could significantly increase output and income from the livestock industry. Examples can be drawn from other developing countries such as Botswana and Malawi, which have developed viable commercial beef cattle fattening production systems (Norris et al., 2002; Malope et al., 2007).

1.3 Statement of the Problem and Justification for the Study

Tanzania is rich in terms of cattle numbers estimated at 21.3 million (URT, 2012; MLFD, 2009). The country ranks first in SADC countries and third in Africa in terms of livestock numbers after Ethiopia (43 million) and Sudan (41 million) (URT, 2011a). Despite this large livestock population, the contribution of livestock to the national economy in terms of GDP has been declining from 18% to 4% between 2001 and 2009, and has further declined to 3.7 in 2010 (URT, 2005; 2011a); which is an alarming downward trend. During the same period, the livestock sub-sector grew by only 3.9 % (equivalent to 0.43% per annum) with much of the growth emanating from increase in herd size rather than productivity per livestock unit (URT, 2011a). While the livestock industry plays an important role as a source of food (meat, milk and eggs), income and employment, it is possible to improve the contribution of livestock to the livelihood of farmers and to the national economy as a whole if meat quality and productivity are improved. As already stated, in Tanzania the livestock sector contribute only 3.7% to the GDP compared to Botswana which has only about 2.5 million cattle, but they contribute about 45% of the country's GDP (African Business, 2003). Similarly, Namibia has about 2 million cattle that contribute about 25% to the GDP. Zambia has an estimated 2.6 million cattle contributing about 24% to the GDP (Ndivoi *et al.*, 2007).

While the contribution of cattle to the national economy in Tanzania is minimal, there is unmet demand for beef in the domestic and export markets. However, some of these markets are niche markets that require quality meat in terms of juiciness, leanness, tenderness and marbleing fat. The demand for meat in the domestic markets is influenced by increasing population, urbanization and income levels leading to unmet demand for quality meat in niche markets like supermarkets, tourist hotels and mining sites. The number of tourists for example has tripled from 186 000 in 1993 to 576 000 in 2001 and the number of hotels has doubled from 205 to 469 during the same period; the total earnings from tourism rose from 94 million to 731 million US Dollars (Ashimogo and Greenhalgh, 2007). The demand for quality meat in the export markets like the Middle East and North Africa is also very high estimated at 6 337 776 metric tons per year (Mtenga *et al.*, 2009).

Some of these domestic niche markets that offer premium prices require quality meat which can be produced locally. However, production of quality meat in the country is limited as indicated by imports of quality meat to cover the gap. For example, in 2006/07 and 2007/08 beef imports were 103.4 and 122.4 tons, respectively (Table 2). Given the low quality of meat produced in the traditional beef sub-sector it has been difficult for the traditional beef cattle keepers who own 94% of the livestock in the country, to penetrate into such lucrative markets. Beef from unimproved cattle does not meet the requirements of niche markets in terms of safety, tenderness, leanness, juiciness and marbling fat. The main challenge is therefore how to meet the niche markets' requirements.

The Government has shown interest to improve the traditional cattle herd through various interventions so that the traditional cattle become a major revenue generating resource. This entails changing the traditional livestock production systems among agro pastoralist

and pastoralist so that they own fewer animals but of high value in order to improve productivity and hence the livestock keepers' income, food security and livelihood in general. This would also enable the country to achieve targets set under the NSGRP in relation to attaining food security and poverty reduction (MLD, 2006; MLFD, 2009).

In this regard, the government has formulated a National Livestock Policy (2006) and its corresponding Livestock Sector Development Strategy of 2010 which address and articulate the needs of revitalizing the sub-sector. In relation to this, the Government has formulated a Livestock Development Program of 2011 under which efforts are ongoing to promote private ranching. Some of the public ranches previously owned by the National Ranching Company (NARCO) have been subdivided into units of 2000 – 4000 ha each capable of holding over 120 000 beef cattle. These have been sub-leased to Tanzanian investors for commercial livestock farming. In addition, the Government has established a system for livestock identification, registration and traceability through the supply chain. Efforts are also ongoing to promote and support beef cattle fattening through a feedlot system. However, the response by supply chain actors towards beef cattle fattening has been very low. Nonetheless, a few enterprising individuals from agro-pastoral and pastoral areas especially in Mwanza, Shinyanga, Mara, Dodoma, Morogoro, Arusha, Manyara and Coast regions have devised rudimentary feeding systems for beef fattening to improve the quality of beef animals for sale in niche market within East Africa and the Comoro Island.

Beef cattle fattening under traditional condition may be a positive move towards transforming the traditional livestock production system but, little is known regarding the economic viability (profitability) of these developments as a measure of sustainability (Demircan *et al.*, 2007). Only a few studies have been conducted on beef cattle fattening in Tanzania, mostly focusing on nutritional requirements and weight gains under feedlots

(Mkonyi *et al.*, 2006; Shija *et al.*, 2009; Mwilawa, 2012). Other beef cattle fattening initiatives have been carried out as pilot projects at Mtibwa Sugar Estates, Kongwa ranch, and Manyara ranch. These pilot projects have also assessed the performance of SHZ compared to Boran in terms of quality and quantity of beef under feedlot conditions. The findings have established that the daily weight gain of SHZ was 0.7 to 0.8 kg per day compared to Boran cattle, which gained about 1kg per day (Luziga, 2004, 2006; Mwilawa, 2012). However, weight gain alone is not enough to recommend for replication or scaling up of these production systems because there may be inefficiency in production and the cost of fattening may be higher than the benefits. Although, many studies have been done around the world to assess the profitability of cattle fattening none has been done in Tanzania (Umar et al., 2008; Yidirim, 2006). This study has therefore analyzed the efficiency and profitability of beef cattle fattening in the traditional beef cattle supply chain, taking into consideration the costs of production.

Even if profit levels are positive, it is also not evident if such production systems can be adopted (replicated) by Pastoralists and Agro-pastoralists in order to upgrade their position in the supply chain and hence get a larger share of the net returns accruing to various actors along the chain. In so doing the pastoralists and agro-pastoralists would be participating in developing a growing and sustainable beef sub-sector in Tanzania. In order to improve the performance and the contribution of the traditional cattle production system to livelihood improvement and economic growth, it is therefore important to describe, characterize and examine the economic viability of existing fattening systems as a first step before drawing recommendations, which will contribute towards transforming the traditional beef cattle production system in the country.

1.4 Objectives of the Study

1.4.1 Overall objective

The overall objective of this study was to examine the economic viability of beef cattle fattening in the traditional cattle supply chain as a means of increasing income to cattle keepers and other actors in the beef subsector in Tanzania.

1.4.2 Specific objectives

The specific objectives are to:

(i) Analyze the beef cattle supply chain, so as to identify key actors and their relationships, challenges and opportunities for beef cattle fattening;

(ii) Analyze the technical efficiency and profitability of beef cattle fattening; and

(iii) Determine factors that influence pastoralist and agro pastoralist's willingness to adopt beef cattle fattening technology and the potential for scaling up.

1.5 Research Questions

On the basis of the overall and specific objectives, this study addressed six main questions as listed below:-

(i) Who are the key actors of the beef cattle supply chain in Tanzania

(ii) Are there policies and institutions which can promote beef cattle fattening?

(iii) What are the main challenges and opportunities for cattle fattening in the traditional cattle supply chain?

(iv) Are the beef cattle fattening enterprises practiced in the study area technically efficient and economically viable?

(v) Are pastoralists and agro pastoralists in the study area willing to adopt cattle fattening technology?

(vi) What are the main factors that influence pastoralist and agro pastoralist's willingness to adopt beef cattle fattening technology?

1.6 Theoretical and Conceptual Framework

1.6.1 Theoretical Framework

Farmers in agricultural production systems aim at maximizing production, minimizing costs and hence maximizing profits. While every producer may attempt to optimize, not all of them may succeed in their efforts. Given the same inputs and technology, some farmers will produce more efficiently than others. Neoclassical production economics theory for maximizing profits is often used to provide guidance for making decisions related to optimum resource use (Marshall, 1961). In this study it is assumed that the main objective of the pastoralists and agro pastoralists is to maximize profits within the confinements of their resource endowments and technology embodied in the existing traditional livestock production systems. However, pastoralist and agro pastoralists have multiple objectives such as food security and fulfillment of other obligations in their social environment. In such cases aggregate profit consideration might be secondary but it cannot be entirely ignored as long as resources are scarce in relation to livestock production and livestock keepers' desires and needs. The desire to maximize profit among traditional livestock keepers in the study area is revealed by the reaction among some of them to allocate their resources for fattening their cattle.

On the basis of profit maximization as the overriding objective, neoclassical economic theory can be used to guide decisions for efficient allocation of resources. Economic theory identifies three important efficiency measures (Boris et al., 1997; Effiong and Onyenweaku, 2006). These include: allocative, economic and technical efficiency. Allocative efficiency (AE) reflects the ability of the farm to use the inputs in optimal

proportions given their respective prices and the production technology. Economic efficiency (EE) is defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost for a given level of echnology while technical efficiency (TE) is the measure of the farms success in producing maximum output from a given set of inputs. Alternatively stated this is the ability to operate on the production frontier or isoquant frontier (Farrell, 1957, Effiong and Onyenweaku, 2006). EE is equal to the product of TE and AE. The central problem in neoclassical production theory is to ensure efficiency in allocating resources. It is widely believed that there is substantial variation in economic efficiency and profitability across different farm sizes. These differences in relative performance can be due to differential transaction costs stemming from asymmetric access to assets and information between farms, or differences in spending on environmental practices. If efficiency varies across enterprises in beef cattle fattening, those with relatively high efficiency will be more profitable. The sustainability of enterprises and scaling up in this case is guided by the economic principle which purport that as long as beef cattle fattening operators are getting positive profits, others will be attracted to enter and adopt the technology after comparing the benefits (profits) of the new technology and the uncertain costs of adopting (Uaiene et al., 2009).

1.6.2 Conceptual Framework

This study is based on the premise that for beef fattening to contribute to improving the beef sub-sector in Tanzania, concurrent changes should happen at two levels; first, at the supply chain level and second, at the enterprise level. At the supply chain level, changes should involve; (i) improving the interaction and collaboration among actors in the beef supply chain, (ii) improving policies and institutions in order to enhance opportunities in the emerging beef markets and maintain the market share once secured. Meanwhile, at the enterprise level adoption of beef cattle fattening technologies will mainly depend on how

profitable the cattle fattening enterprises are. According to economic theory, profit should attract entry of new actors. This means, if the existing beef cattle fattening enterprises are profitable, more people should be interested to join. The role of the government and other agencies then should involve deliberate efforts to facilitate more pastoralist and agro-pastoralist to transform their production system such that their animals are finished through fattening, rather than engaging in distress sale of animals at times of drought. For this to happen, pastoralists and agro-pastoralists need to be adequately supported by appropriate services and information systems. Since the sub-sector involves various actors, the framework for improving the traditional beef supply chain into an efficient and well coordinated value chain is given in Figure 1.

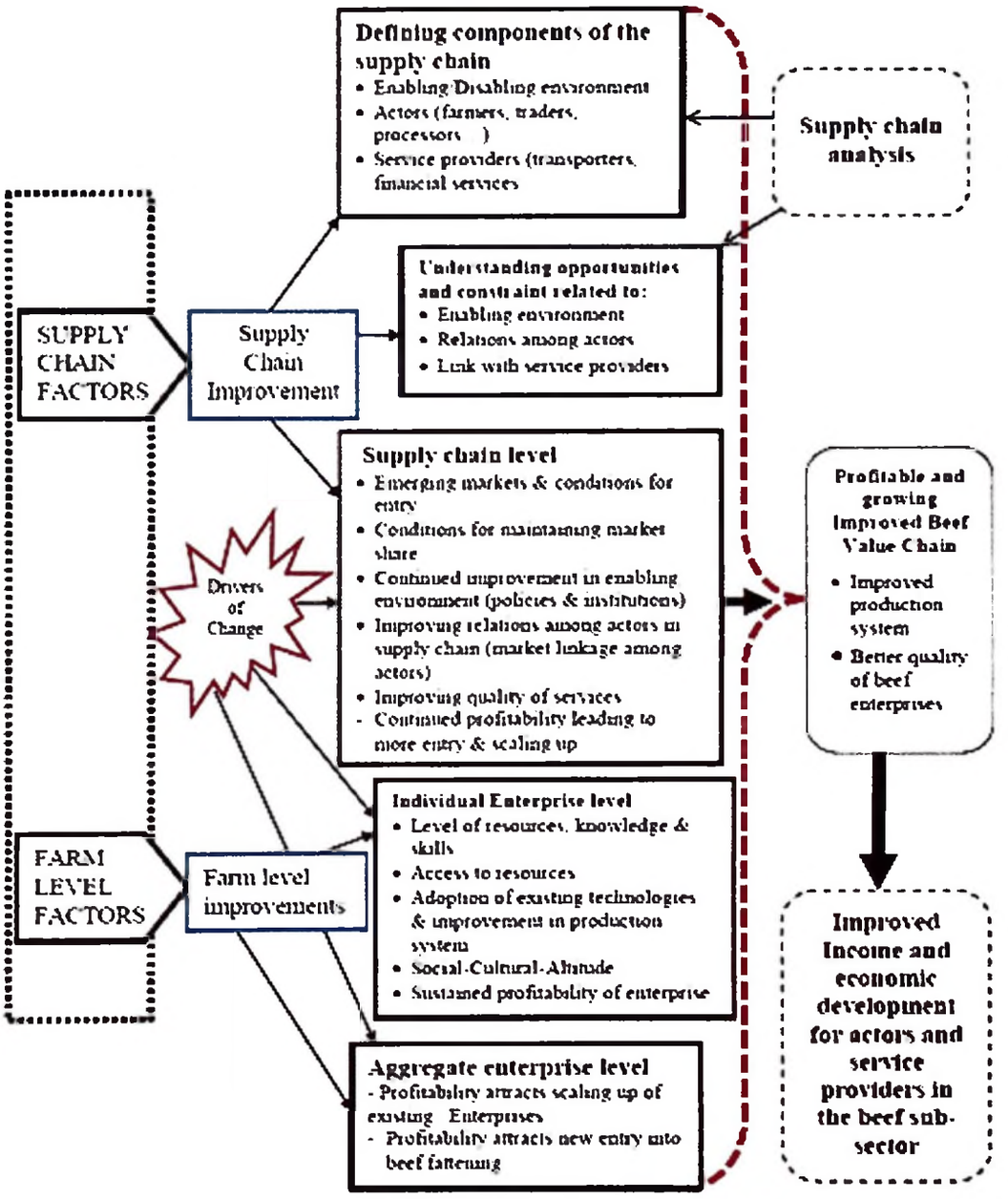

Figure 1: Conceptual Framework for Improving the Traditional Beef Sub-Sector

The framework has three main components: (i) the supply chain is a function of what happens at the aggregate level involving supply chain factors and farm level factors, (ii) improvement in the supply chain is a function of defining the supply chain, understanding the opportunities and constraints related to supply chain drivers of change as well as farm level drivers of change. (iii) If positive economic rent (profit) accrues to the individual

enterprises it attracts entry of new actors and scaling up of existing actors, especially at the fattening level. Whether this supply pull will be reflected at the enterprise level depends on the share of profit accruing to farmers (pastoralists and agro-pastoralists) relative to other actors in the supply chain. If the share of profit is significantly high, adoption of beef fattening enterprises should translate into wider adoption of the technology by agro-pastoralists and pastoralists and hence scaling up at the supply chain level. The conceptual framework presumes that profitable and growing beef value chain, with improved coordination and collaboration among actors will lead to improved production systems, better quality beef and sustainable enterprises. These are necessary conditions for improving income at the household level and for economic development at the aggregate level district, regional and national levels.

1.7 Methodology

To achieve the objectives of this study, various actors in the beef supply chain were interviewed with a focus on beef cattle fattening. Data were collected through key informants, focus group discussion (Appendix 1) and use of structured questionnaire (Appendices 2 and 3 which were administered in Kiswahili but are translated into English in respect to Appendices 4 and 5). The interviews covered 401 Pastoralists and Agro-pastoralists, 90 cattle fattening operators and 10 key informants in eight districts of Shinyanga and Mwanza regions. Respondents came from Kahama, Kishapu, Meatu, Bariadi, and Maswa in Shinyanga Region and Nyamagana, Sengerema and Magu in Mwanza Region. The questionnaires were administered by the principal researcher during the dry season between July and September, 2011 with the assistance of local experienced interviewers who were trained prior to the survey. The data were collected during the dry season because this is when beef cattle fattening is practiced. During the

wet season animals are able to get enough forage from the range lands and are normally in a good condition hence hardly any fattening is done.

The lists of beef cattle fattening operators were obtained from respective Local Government Authorities (LGA) offices in the districts, from which 90 respondents were randomly selected. The list of pastoralist and agro pastoralists were obtained from their respective village registration books, from which 401 respondents were purposively selected. Global Positioning System (GPS) were used to geo-reference all points where the interviews were held.

In order to achieve the first objective of this study, data from all respondents were analyzed using descriptive statistics and gross margin analysis. Descriptive statistics such as frequencies, means and percentage were used to depict the actors and their relationships, distribution of the cattle herds, challenges and opportunities for beef cattle fattening in the traditional beef cattle supply chain. Gross margin analysis was carried out for both fattened and non-fattened cattle in the supply chain. The analysis aimed at determining if the gains from value addition through beef cattle fattening justify the costs associated with cattle fattening. Details of the descriptive statistics used and gross margin calculation are given in Paper No. 1 of this thesis.

To achieve the second objective of this study, analysis of technical efficiency and profitability of beef cattle fattening operators and factors influencing technical efficiency and profitability were conducted using data on the socio-economic variables of the entrepreneurs, quantities of input and their cost, outputs in terms of weight and prices of fattened cattle collected from the 90 cattle fattening operators indicated above. This

analysis aimed at establishing whether beef cattle fattening as currently practiced in the study area is technically efficient and economically profitable.

It was observed during the field survey that beef cattle fattening operators did not weigh their animals before and after fattening. For this reason, a group of 105 animals were selected from Kahama (one of the study districts) for determining the average daily weight gain (ADG). In addition, the weights of 5675 animals (belonging to the 90 respondents) were tracked during the study period covering 12 to 16 weeks (3-4months). All these animals belonged to the Tanzania Short Horn Zebu (TSZ) breed, raised under the same fodder conditions prevailing within the Lake Zone. Most of them were mature bulls, but there were also a few culled cows. These animals were purchased by the respondents from livestock markets in the lake zone. A weight band tape, which is designed to take the live weight of animals such as; cattle, pigs, sheep and goats was used to measure the live weight of the study animals from each respondent. The tape measure was used in the field because cattle weighing instruments are costly and heavy to transport; the tape is a practical field technique, particularly in less developed countries. The animals' heart girth measurements were taken to predict their weights at entry, every two weeks thereafter and at exit.

Based on the data from the 90 cattle fattening operators supplemented with the additional data from the 105 cattle heads, mentioned above, the stochastic frontier production function was used to estimate the technical efficiency of the beef fattening production system. Based on the same data budgeting and multiple regression models were used to analyze the profitability and factors influencing profitability of beef cattle fattening respectively. Details of technical efficiency and profitability analyses are given in Paper II and Paper III of this study respectively.

Finally, to achieve the third objective of the study, factors affecting the Agro-pastoralists and Pastoralists' willingness to adopt the beef cattle fattening technology within the study area. Such willingness was investigated using the data which were collected from the 401 agro-pastoralist and pastoralist by means of a structured questionnaire as stated above. This data included; the respondents' personal characteristics, awareness, attitude towards beef cattle fattening, location and main sources of income and constraints limiting pastoralists and agro pastoralists' to fatten their cattle. These data were analyzed using descriptive statistics and a binary logistic regression model. Details on the descriptive statistics which were used and the logit model specification including its operationalization are given in Paper IV of this thesis.

1.8 Organization of the Thesis

The thesis is organized in four chapters including this introductory chapter which highlights the key issues regarding the livestock sector and previous studies which have been done in relation to beef cattle fattening. This introductory chapter also contains the overall theme of the thesis including the theoretical and conceptual framework. The chapter ends with a description of the methods used to collect and analyse data that is used to achieve the study objectives. In Chapter Two the published papers addressing each of the study objectives are compiled. The Third Chapter contains the synthesis of findings presented in the four papers and other observations in relation to beef cattle fattening in the study area. The fourth chapter draws the overall conclusions of the study on the basis of which recommendations are made for improving the beef sub-sector and beef cattle fattening in particular. The contribution of the study and suggestions for future research are presented at the end of the fourth chapter.

CHAPTER TWO

THESIS OUTPUT

2.1 Introduction

This chapter presents the output of the study in the form of papers. Four papers have been published in international journals as attached herewith. Other outputs of the study are presented on the synthesis of findings in chapter Three.

2.2 Paper I: Value addition of beef cattle fattening in the Lake Zone in Tanzania: Challenges and Opportunities.

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Value addition of beef cattle fattening in the Lake Zone in Tanzania: Challenges and opportunities

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Abstract
A study was conducted in the lake zone in Tanzania to characterize the beef supply chain with a focus on beef cattle fattening. Challenges and opportunities were also identified. Data were collected from various actors and stakeholders in the chain through focus group discussion and use of structured questionnaire which covered 401 Pastoralist and Agro pastoralist, 90 cattle fattening operators and 10 key informants in Shinyanga and Mwanza regions. Eight districts were involved; five districts (Kahama, Kishapu, Meatu, Bariadi, and Maswa) in Shinyanga region and three districts (Nyamagana, Sengerema, Magu) in Mwanza region. Data were analyzed using descriptive and gross margin analysis.

The findings show that the supply chain is characterized by low value addition among the pastoralist and high value addition among the beef cattle fatteners. Opportunities identified included: high market access and prices for fattened cattle compared to animals that are not fattened. However, fattening was constrained by availability and high costs of feeds due to alternative outlets for cotton husks and cotton seed cake. A business model for enhancing the supply chain for beef cattle fattening in the areas is suggested.

Key words: Actors, Agro pastoralist, Pastoralist, Producers, Supply chain, Traders

Introduction

This paper presents an overview of the beef cattle supply chain in Mwanza and Shinyanga regions with a focus in beef cattle fattening. According to the National Sample Census for Agriculture (NSCA) latest figures of 2008/2007, Mwanza and Shinyanga regions in the Lake Zone have the largest population of cattle in Tanzania. Shinyanga region had a total of 3.65 million cattle equivalent to 17 percent of the total cattle population of Tanzania Mainland. Mwanza had 1.97 million cattle equivalent to 9 percent of the total cattle population. About 44.8 and 36.6 percent of households in Shinyanga and Mwanza regions respectively are rearing cattle (NSCA 2007/2008). Other regions with large livestock numbers in the country include Tabora (2.13 million), Arusha (1.81million), Mara (1.69 million), Manyara (1.66 million), Dodoma (1.16 million), and Singida (1.59 million). These regions contribute about 74 percent of the total cattle population, ranking Tanzania on top among Southern African Development Community (SADC) for having the largest cattle herd and third in Africa after Ethiopia and Sudan (Ministry of Livestock Development –MLD 2006, Food and Agriculture Organization-FAO 2010, Himo Tanners and Planters Ltd 2010).

The cattle population in the country and in the study area has been reported to have an increasing trend as indicated by the inter-census population growth rates (NSCA 1984 1994/95 2002/2003 and 2007/2008) as shown in Figure 1. The dominance of the Lake zone as the hub of beef cattle production in the country continues but the Southern highlands and Southern regions have also increased their share of the beef cattle herd as indicated by the following statistics; Lake Zone which include Mara, Kagera, Shinyanga and Mwanza regions contribute about 39%; Central regions (Tabora, Singida and Dodoma) 23.1%; Northern regions (Arusha, Manyara and Kilimanjaro) 18.9 %; Southern highlands regions (Mbeya, Iringa, Rukwa and Kigoma) 11%; Eastern regions (Morogoro, Tanga, Coast and DSM) 7.8 % and the Southern regions (Mtwara, Lindi and Ruvuma) 0.8%. The dairy cattle herd accounts for only 2 percent and are concentrated mainly in the Kilimanjaro, Arusha and Mbeya regions. These regions comprise almost 53% of the Tanzanian dairy cattle. In 2008, the number of beef and dairy cattle producers in Tanzania mainland reached 1.66 million households equivalent to 29.1 percent of the total Tanzania population (NSCA 2007/2008). Figure 1 presents the distribution of cattle by region as reported by various livestock census since 1984.

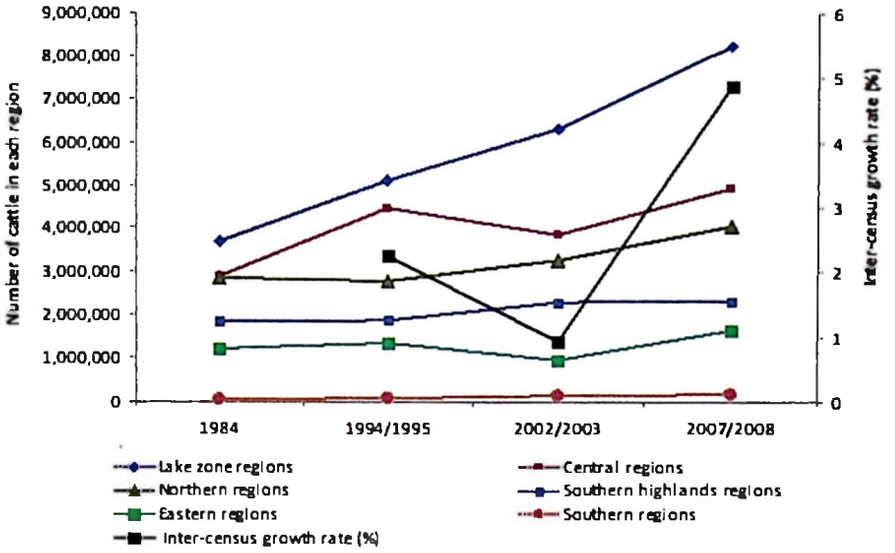

Figure 1: Population Trend of Beef Cattle in Tanzania by Regions

Despite the large number of cattle available in the country, the contribution of the livestock industry contribution to the national economy is low. In 2010, for example the industry contributed only 16% and 3.8% to the Agricultural Gross Domestic Product and the National Gross Domestic Products respectively. The sector grew by only 3.4% compared to 4.4 for the crop sector (United Republic of Tanzania (URT) Economic Survey 2010). This is mainly due to low livestock growth rates, high mortality rates, low production and reproductive rates and poor quality of the final products (MLD 2006, Ministry of Livestock and Fisheries Development- MLFD 2010).

Recently, there has been great emphasis in the country to commercialize beef cattle production for the sector to contribute more effectively to household food security, and income as well as to the nation's economy (MLD 2006). Beef cattle fattening has been earmarked as one among several means to improve beef cattle production through value addition. The word value addition can be defined as the additional value of a commodity over the cost of commodities used to produce it from the previous stage of production (wikipedia.com) or the value added to any product or service as the result of a particular process (webopedia.com). It is also possible for value to be added by cost reduction as a result of increasing productivity. In the case of beef cattle fattening in Shinyanga and Mwanza region, value was added to cattle purchased from pastoralists and agro-pastoralists by increasing productivity and improving the quality of beef cattle through supplementary feeding using concentrates. In this case, animals of lower grades were bought from producers at the primary livestock markets by traders at lower prices and fed cotton seed cakes and cotton husks or maize bran for three to four months before selling again at premium or higher prices to other traders or slaughter houses.

The study aimed at establishing the structure of the beef sub sector in Mwanza and Shinyanga regions of Tanzania where fattening of cattle is becoming more important. Specifically, the objectives of the study were to (i) identify and characterize the existing and potential supply chain strands for beef cattle; (ii) identify primary actors in the supply chain while pointing out their roles and interrelationships; and (iii) identify associated challenges and opportunities for improving the supply chain.

Methodology

The study involved collecting primary and secondary data from various actors and stakeholders in the chain through focused group discussion and use of a structured questionnaire, which covered 401 Pastoralist and Agro pastoralist, 90 cattle fattening entrepreneurs and 10 key informants in Shinyanga and Mwanza regions. The study covered five districts in Shinyanga region namely Kahama, Kishapu, Meatu, Bariadi and Maswa and three districts in Mwanza region namely Nyamagana/Ilemela, Sengerema and Magu as shown in Figure 2 below. The survey involved key beef sub sector stakeholders namely Pastoralists/Agro-pastoralists, Beef cattle fattening operators, traders, processors, butcheries and government officials (key informants) who were purposively selected as shown in figure 3 and 4 below. The preliminary survey was conducted from April to June, 2010 and was followed by the detailed survey which was conducted from July to September, 2011.

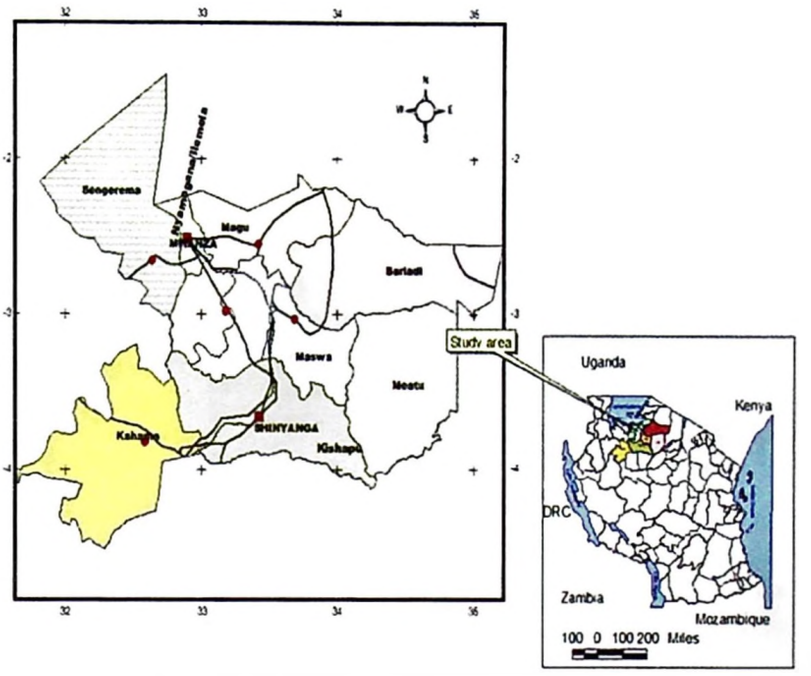

Figure 2: Location of the Study Area

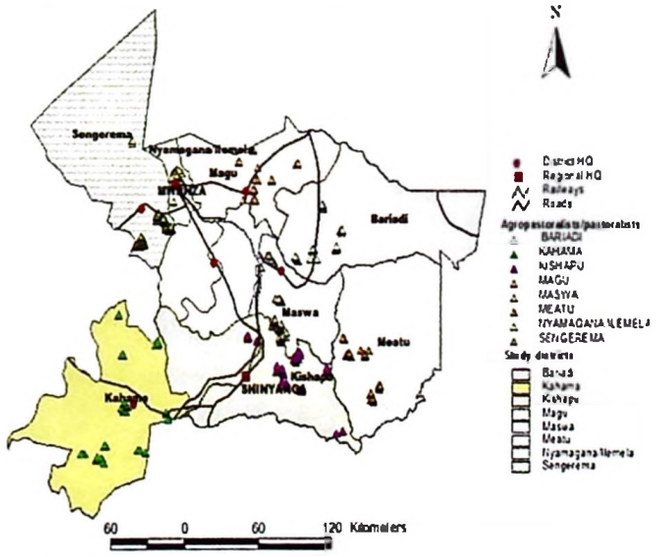

Figure 3: Location of Pastoralists and Agro pastoralists in the study area

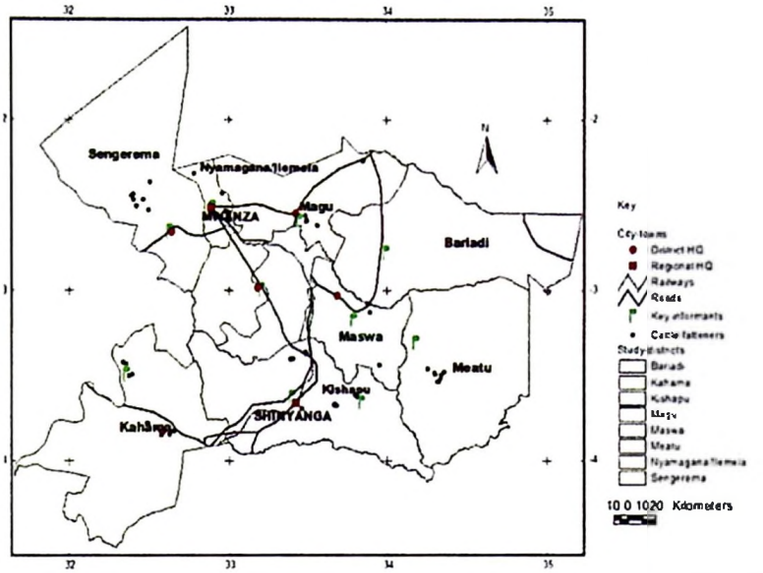

Figure 4: Location of Key informants and beef cattle fattening operators in the study area

Data were analysed using descriptive methods to obtain information on frequencies, means, percentages and Gross Margins (GM) of different actors along the supply chain. The gross margin of an enterprise is the difference between the Total Revenue (TR) and Total Variable Costs (TVC)

Mathematically;

$GMi = TRi - TVCi$..... (1)

Where; GMi = Gross margin at point i (in TShs)

TRi = Total revenue at point i (in TShs)

TVCi = Total Variable costs at point i (in TShs)

i = represent points along the supply chain such as production, un-fattened cattle trading, Beef cattle fattening, cattle slaughtering and meat selling

TR in this case was the summation of the number of cattle sold (N) times their corresponding selling price (P)

$TR=\sum_1^n NxP_s$..... (2)

Where; TR =Total Revenue as defined above

N =Number of cattle sold

P_s =Selling price

In the case of butcher owners, the same equation (2) was applied where N stands for the number of cattle slaughtered and P represents the price per kilogram of meat sold. Equation 2 was also used to calculate the variable costs where N stands for the quantity of inputs used multiplied by the respective price. For comparison purposes, the Gross Margins per head of cattle for Agro-pastoralists/Pastoralist, Traders, Beef cattle fattening operators and Butcher owners were calculated.

The cost for Pastoralist/Agro-pastoralist who sell lean cattle to cattle fattening Traders included-labour, drugs, dipping and trekking costs. Meanwhile the beef cattle traders incur cost in relation to: buying the animals, market fees, permits, transportation, labour and food. In addition they also buy; supplementary feeds water and salt. In the case of Butcher owners they incur cost for buying cattle, market fee, permit fee to move an animal from the market, transportation, holding pens, slaughtering fee, and payment for meat sellers.

Results and Discussion

Livestock marketing in the study area

The study revealed that, there were 14 and 16 operating livestock markets in Shinyanga and Mwanza regions respectively. Out of these, Kishapu and Nyamhongolo were the largest and the only secondary markets, handling about 10,000 cattle per month on average and up to 15,000 cattle during the peak marketing season in September to December. The secondary market in Kishapu operated once per week while Nyamhongolo secondary market operated 6 days per week. These Markets were connected to the Livestock Information Network and Knowledge System (LINKS) where the number of livestock marketed; grades and prices are recorded and reported to the Ministry of Industry and Trade for compilation and information dissemination. Other livestock marketing infrastructure found in the regions included: Cattle Dips, Slaughter Houses, Veterinary Shops and Butcheries as presented in Table 1.

Table 1: Livestock Marketing Infrastructure

Region	Livestock Markets	Butcheries	Slaughter Houses	Veterinary Shops	Operating Cattle Dips
Shinyanga	34	207	19	98	49
Mwanza	16	225	15	146	60

Source: (i) Shinyanga Regional Secretariat Annual report, 2010; (ii) Mwanza Regional Secretariat Annual report, 2010

Livestock marketing channels and trends

There existed two supply channels for terminal domestic beef cattle markets in the study area. The first involved a direct channel where traders bought beef cattle from producers (Pastoralists and Agro pastoralists) at primary markets and sold at a profit to butcher operators. The second involved some value addition where beef cattle fattening operators bought cattle from producers or cattle traders at primary and secondary markets. In either case, the cattle were kept in feedlots for about three months as reported by 93.4% of the respondents and thereafter sold to live animal exporters or to local butcher operators through livestock markets after the animals had gained weight or reconditioned. Livestock processing industries were not well developed in the study area as it is the case for the whole country (MLD 2006, Ministry of Livestock and Fisheries Development-MLFD 2010).

The livestock marketing trend at Kishapu market in Shinyanga region for five years from 2006 to 2010 is positive showing increase in unit price per cattle sold (Figure 5). Grade II and III cattle were the most common categories sold at the markets at an average price of TShs. 323,112 and 174,223 respectively. The increase in unit price for livestock marketing in Mwanza region during the same period was insignificant (Figure 6). Just as is the case with Shinyanga region, grade II and III were the most common categories sold at the markets, with an average nominal price of TShs. 354,384 and 216,901 respectively. The price for both grade II and III was higher in Shinyanga region at Kishapu livestock market by 4.6 and 10.7 percent respectively when compared to the same grades in Mwanza region at Nyamhongolo livestock market. This indicated that market in Kishapu was more competitive than similar markets in Mwanza region.

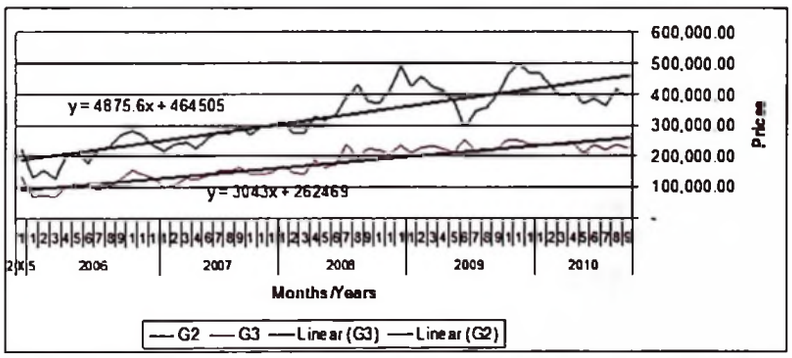

Figure 5: Livestock Marketing Trend at Kishapu Market for grade 2 and 3

Source: Ministry of Industry and Trade, 2010

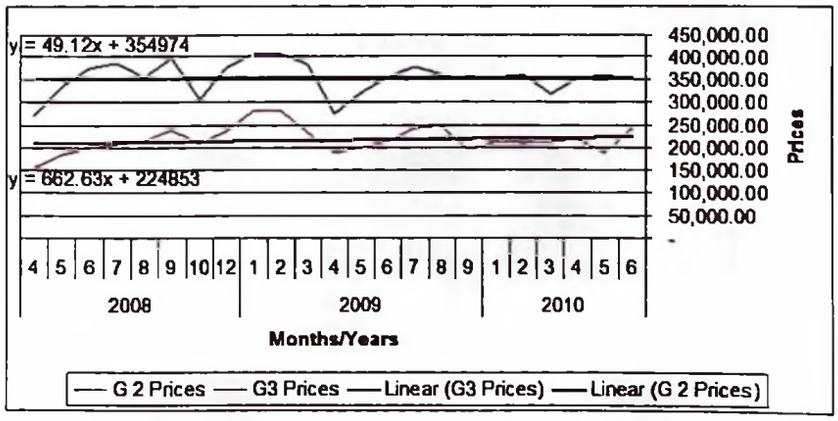

Figure 6: Livestock marketing trend at Nyamhongolo market in Mwanza region for grade 2 and 3

Source: Ministry of Industry and Trade, 2010

Grade I cattle were rarely sold in both regions because this grade was rarely produced due to the poor animal husbandry practices. Moreover, sometimes producers did not sell animals of higher grades as they would prefer to keep such animals as their live banks for storing wealth the data for this study shows that 58.9 percent of the livestock marketed in Mwanza and Shinyanga regions are sold to Pugu secondary market in Dar es Salaam. Table 2 shows the markets where beef cattle are sold.

Table 2: Markets for fattened beef cattle (N=90)

S/N	Name of the market	Number of respondents	Percentage
1	Pugu	53	58.9
2	Mhunze	11	12.2
3	Nyamhongolo	3	3.3
4	Kasamwa	4	4.4
5	Sengerema	3	3.3
6	Shanwa	2	2.2
7	Sale at fattening area	14	15.6
	Total	**90**	**100**

Source: *Survey Data, 2010/2011*

Beef cattle supply chain actors

By definition, beef cattle actors are individuals, businesses or organizations where involved in producing, processing, trading or consuming a particular agricultural product (Royal Tropical Institute (KIT) et al 2006). They include direct actors who are commercially involved in the chain (producers, traders, retailers, and consumers) and indirect actors who provide financial or non financial support services, such as banks and credit agencies, business service providers, government, researchers and extensions agents. The primary actors in the beef cattle supply chain were observed to include beef cattle producers (Pastoralists and Agro pastoralists), Traders that include Beef cattle fattening operators, Middlemen, Butcheries, Retailers and Consumers. All these actors play different roles interacting with each other to supply beef to the final consumers. Interactions among the various beef cattle sub sector actors in the study area are presented in the beef cattle sub sector Map for Shinyanga and Mwanza regions as shown in figure 7 below.

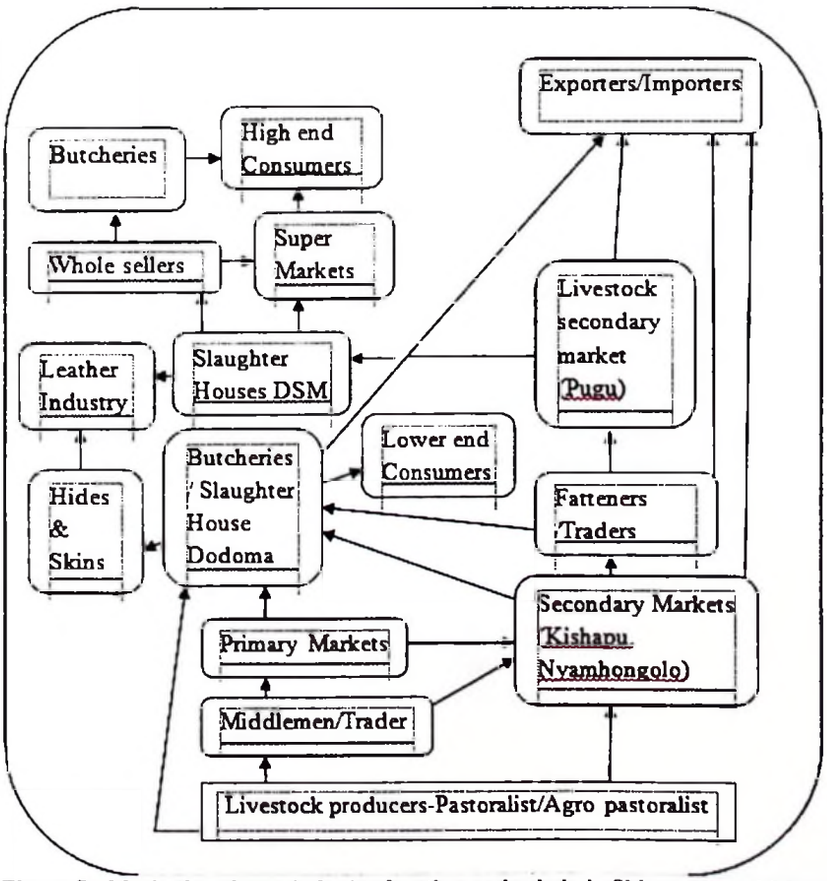

Figure 7: Marketing channels for beef cattle supply chain in Shinyanga and Mwanza

Beef cattle producers (Pastoralists and Agro-pastoralists)
Beef cattle producers included pastoralist and agro pastoralist who kept about 97.3 percent of cattle found in the country (NSCA, 2007/2008). The remaining 2.7 percent are improved dairy (2.4 percent) and beef breeds (0.3 percent) kept by government and private commercial ranches. The beef cattle producers played played the primary function of raising beef cattle up to the point where they were sold and taken to the next level of the supply chain. The producers invested in animal health, nutrition and reproduction. According to the National Sample Census of Agriculture, 2007/2008 reports, there were 261 875 and 145 461 beef cattle producers in Shinyanga and Mwanza regions respectively, mostly agro pastoralist who account for 97.3 percent of all the cattle owners in the nation.

Traders
Beef cattle traders in Shinyanga and Mwanza regions were involved in purchasing cattle from pastoralist and or agro pastoralist through the primary markets (97.6 percent) or directly from cattle producers, with the purpose of reselling in other auctions at higher prices, or selling to butcheries (2.4 percent). Two types of traders were identified in the study area. The first type involved traders who bought healthy and heavy animals from producers and re-sold to other cattle buyers including butcher operators at secondary markets or other niche markets. Second, there were another category of traders, termed fattening entrepreneurs, specifically bought weak animals or semi finished animals from the markets for the a purpose of fattening (adding value) or finishing these cattle for at least three months as reported by 93.4 percent of the respondents before reselling at livestock markets for local consumption or export. Animals for fattening were normally purchased at a lower prices ranging from 279190 to 433096 Tanzanian shillings (TSh) ($1= TShs. 1600) for uncastrated bulls, which were later sold at 553012 to 740000 shillings per piece after fattening.

Butchers and consumers
The category of Butcher operators involved all actors who bought animals from the primary or secondary markets for immediate slaughter. They played an important role in the livestock sub-sector linking producers and consumers through livestock traders. The butcher operators convert animal into an edible form that was acceptable to consumers. There were about 207 and 229 butcheries in the Shinyanga and Mwanza regions respectively.

Retailers and middlemen
Retailers were actors who were involved in buying carcasses from slaughter houses or butcheries and distributed them to supermarkets and other meat shops. In the study area, these actors were not found to be prominent. Another category involved Middlemen who were involved in buying and selling animals at the same location. Normally, they took advantage of time and ignorance as they could buy an animal from one seller and immediately sale to another trader at a profit. As is the case with retailers, middlemen were not found to be prominent in the study area.

Service providers
Service providers included the stockists who supplied drugs and acaricides such as super dips, ginners who own ginneries that produced animal feed ingredients such as cotton seed cake and cotton husks, and government institutions that provided extension services. Extension services were found to be inadequate due to few extension staff. It was evident during field visits for this study that, coordination and collaboration among these actors was not well developed.

Relationships and linkages between and among beef cattle actors
The relationships among actors in the beef cattle supply chain existed between different process steps and within the same process step. The results indicated that spot market relations were the most common. There were no persistent network relationships or contracts practiced among actors or between actors with service providers. Interactions only involved making transactions such as negotiations on price and numbers of animals. Buyers and sellers met and came to an agreement or sometimes they did not reach an agreement. Once the negotiation failed or a deal was closed, the relationship ended, resuming only when there was need to sell or buy another stock of animals. This was described as an arm's length relationships where there are no formal contracts. This kind of relationship confirmed that the beef cattle value chain was underdeveloped. The absence of collaboration among actors minimizes the potential to improve their business and hence increase their income. However, the emerging category of beef cattle fattening entrepreneurs in the study area seemed to be a good starting point for forging a working relationship among actors in the beef supply chain so that it evolves towards a vibrant value chain. A value chain is defined as a linkage between actors who transfer or exchange goods, capital or knowledge through binding relationships (KIT et al 2006), while a supply chain has been defined as a set of linkages between actors where there are no binding or sought-after formal or informal relationship, except when the goods, services and financial agreements are actually transacted (KIT et al 2006, Wim 2004). A value chain is therefore a specific type of supply chain where the actors actively seek to support each other so that they can increase their colletive efficiency and competitiveness, which was not the case in the supply chain as found in the study area. Actors in a value chain invest time, effort and money to build relationships with other actors in order to reach a common goal of satisfying consumer needs in their effort to increase each actor's profit (KIT et al 2006).

Beef cattle value addition in the lake zone

In this study, the results show that mature animals of age ranging between 4 to 10 years were most common in the feedlots. These animals were fed plant by-products for 3 months on average as reported by 93.4% of the respondents, in order to add weight before they were sold. The by-products which were used to feed animals include: cotton husks, cotton seed cake, sunflower cake, rice polish, maize bran and salt all mixed in different rations. In the business of beef cattle fattening, the age of an animal is an important factor as it is highly correlated with the level of profit accruing to the producer. According to the Guide for backyard cattle raising and fattening 2009, the animals' age has a direct bearing on the quality of beef produced. Two to three years-old animals need less feed for every unit of weight gain because they digest more efficiently and consume larger volume of feed in proportion to their body weight. Moreover, younger animals cost less because of lower weight. However, they require longer a period of feeding and higher feed quality to reach the desired finish. Meanwhile, older feeder stock (4 years and above) need less time in the feedlot and will eat a wider variety of feed and roughage than young stock. If nutritious feed is abundant, younger cattle are generally more economical to fatten (Guide to backyard cattle raising and fattening 2009). If only roughage and plant by-products are available, older stock are preferable.

In Shinyanga regions, beef cattle fattening is said to have started much earlier around 1994, but is more recent in Mwanza region where it started in 2007. This practice has led to higher demand of animal feeds such as cotton seed cake and cotton husks. Previously, cotton husks were disposed as a waste and could therefore be obtained free of charge, but now this by producthas become a popular input into the beef fattening business. The prices of these feeds increase every year and sometimes it is not available because it was reported to be exported to neighbouring countries of Kenya and Uganda for a purpose that is not yet known. Table 3 shows price changes for beef cattle fattening feeds for the period of 2010 and 2011 as reported during the survey. Figure 8a show cotton seed cake being offloaded at the fattening area, while figure 8b show animals that are feeding on cotton husks and figure 8c show fattened finished animals ready for sale.

Table 3: Beef cattle feed Price changes.

Feed Type	Year		%change
	2010	2011	
Cotton Seed cake	393.2	575.5	46.4
Cotton Husks	153.6	183.4	19.4
Sunflower seed cake	191.6	243.9	27.3
Rice Polish	47.2	70	48.1
Maize bran	165.7	208.1	25.6
Salt	262.1	348.6	33

Source: Field Survey, 2010/2011

Figure 8. (a) Offloading feeds at the fattening site in Kahama District (b) Tarime cattle feeding on cotton seed husks/cake in Magu District (c) Fattened beef cattle ready for sale in Kishapu District

Beef cattle actor's gross margins

Pastoralist and Agro pastoralist

Pastoralists and agro pastoralist usually keep livestock for several years before selling them; they only sell when the need or cash arises. It was reported that cattle are kept for 5 to 7 years and sometimes more before they are sold. Their costs of keeping livestock include; labour, medication, dipping services, and trekking costs to the selling point. Table 4 presents the gross margins for Pastoralist and agro-pastoralist. These have been computed per animal based on average data for 401 respondents who participated in the study area.

Table 4: Gross margin analysis for Pastoralist and Agro-pastoralist

Costs	Tshs/Head per year	Tshs/Head for 6 years	Proportion of total Costs (%)
Cost of raising one animal for 6 years			
Labour	4000	24000	20.8
Drugs/Injections	10000	60000	52.1
Dipping/Spraying	1200	7200	6.3
Trekking	4000	24000	20.8
Total Costs(6 years)	19200	115200	100
Revenue from sale of one animal after 6 years at 300 kg live weight			
Cattle		400000	
Gross Margin		284800	
Gross Margins as % of sale		71%	
Cost of raising one animal for 3 years			
	Tshs/Head per year	**Tshs/Head for 6 years**	**Proportion of total Costs (%)**
Labour	4000	12000	20.8
Drugs/Injections	10000	30000	52.1
Dipping/Spraying	1200	3600	6.3
Trekking	4000	12000	20.8
Total Costs (3 years)	19200	57600	
Revenue from sale of one animal after 3 years at 200 kg live weight			
Cattle		300000	
Gross Margins(200kg)		242400	
Gross Margins% of sales		81%	

Source: Field survey, 2010/2011

Analysis in Table 4 shows that the sale price of cattle at 300 kg live weight gives a margin of TShs 284800 equivalent to 71 percent of the value of sales, while the sale of cattle at 200 kg live weight gives a gross margin of TShs. 242400 which is 81% of the sales value, relatively higher. These results indicated that returns are higher if cattle are kept for shorter periods. The Cost was lower (TShs 57600) compared to the total cost for six years (TShs. 115200). Drugs and medications were the highest cost item, accounting for about 52.1% of the total cost. This was followed by labour (20.8%) and trekking cost (20.8%). Dipping or spraying to control parasites was the least cost accounting for only 6.3% of the total cost.

The survey results show that the pastoralist and agro pastoralists do not add value to their animals before selling. They normally sale mature animals of 6 years old and above. This result support findings by Mapiye et al., 2007 who found that there were limited or no efforts to add value to the existing Nguni cattle products by farmers in South Africa. Sarma and Ahmed (2011) in their findings also found that three years old cattle were used for fattening in Rajbari district in Bangladesh instead of mature animals. This means, farmers in the study area need to be sensitized to sell animals for fattening at young age, while traders are also adviced to buy the same.

Beef cattle traders

Livestock trading provides liquidity to pastoralists as well as serving as livestock outlets. Livestock traders incur several costs in the process. These include market fees, trekking costs (herder's wages, food, and transport), livestock movement permits, feeds, treatment and transport to secondary markets. Table 5 shows the costs, revenue and the margin for cattle trading for both fattened and non fattened beef cattle.

Table 5: Gross margin analysis for traders of non-fattened cattle and fattened beef Cattle

Costs	Non Fattened Cattle		Fattened Cattle	
	Tshs/Head	**% of total cost**	**Tshs/Head**	**% of total cost**
Cost of buying and transporting one cattle				
Cattle 300kg (purchase price)	400000	90.4	400000	71.6
Market fee	3000	0.68	3000	0.54
Movement permit (buying)	1000	0.23	1000	0.18
Transportation (Buying)	3000	0.68	3000	0.54
Feeds	0	0	100000	17.9
Treatment	0	0	7600	1.36
Headers (labour)	2000	0.45	7500	1.34
Food	2000	0.45	5000	0.9
Movement permit (selling)	1500	0.34	1500	0.27
Transportation (Selling) to Pugu	30000	6.78	30000	5.37
Total Costs	**442500**	**100**	**558600**	**100**
Revenue from sale of one cattle				
Cattle	500000		700000	
Gross Margin(300kg)	57500		141400	
Gross Margins % of sales	**11.5**		**20.2**	

Source: Survey data, 2010/11

It was evident that cattle traders who did not engage in fattening had gross margins of TShs. 57500, which is equivalent to 11.5 percent of the total value of sale. The cost of purchasing cattle was the most significant (90.4%) followed by transportation cost at about 6.78 % of the total cost, the remaining cost were insignificant being less than one percent. When traders engaged in adding value through fattening they earned a margin of Tshs. 141,400 per head of cattle, which is 20.2 percent of the sale value almost twice as much as the gross margin without fattening. As was the case with traders of non-fattened cattle, the purchasing price of cattle from secondary markets took up the highest share of the total cost (71.6%). Supplementary feeds were also significant being 17.9 percent of the total cost.

Butcher owners

As was the case for Traders, the main cost for butcher operators came from purchase of beef cattle which represented about 94.3 percent of the total cost for the sample followed by Labour or wage for butcher operators (1.9 percent). The rest of the cost items were insignificant being less than one percent each as shown in Table 6.

Table 6: Gross margin analysis for butcher owners

Costs	Tshs/Head	Percent of total cost
Cost of purchasing and handling one cattle		
Cattle 300kg (purchase price)	400000	94.3
Market fee	3000	0.71
Movement permit	1000	0.24
Transportation (buying)	3000	0.71
Holding pen fee	2000	0.47
Butchers fee/slaughtering fee	4000	0.94
Meat transportation fee	3000	0.71
Meat sellers (labour or wage??)	8000	1.89
Total Costs	**424000**	100
Revenue from one cattle		
Carcass 150 kg @ 4000	600000	
Hide	4000	
Head	6000	
Offals and legs	12000	
Total Revenue	**622000**	
Gross Margin(300kg)	**198000**	
Gross Margins % of sales	**31.8**	

Source: *Survey data, 2010/11*

Comparison of beef cattle fattening operator's margins (20.2%) with those obtained by pastoralist and agro pastoralist (71%) , reveals that the beef cattle fattening operators earned higher margins due to their production cycle as they could run 3 fattening cycles in a year of three months each, while pastoralist could only sell an animal after six or more years.

Challenges and opportunities along the beef cattle supply chain

The performance and effectiveness of the beef supply chain depend on various factors that affected the supply chain actors through different channels. These factors may impose constraints or establish opportunities which have bearings on the performance of the livestock supply chain. The survey results as reported by beef cattle fattening operators indicated that high prices of fattening feeds was the leading challenge (27.7%) followed by availability of credits to expand fattening enterprises (16.6%), area for conducting fattening (16.2%), and availability of feed stuff (22.6%). The results in the present study support findings by Alemayehu (2011), Petrus et al., (2011) and Moreki et al., (2011) who found high prices and availability of feeds to be the leading challenge faced beef cattle fattening enterprises. Although, Umar et al., (2008) reported that the economic viability of cattle fattening enterprises was not in doubt because raw materials needed for fattening could be sourced at ease, but the availability of credit was the challenge facing smallholder producers when fattening. On the other hand the results reported by agro-pastoralists and pastoralist indicated that lack of fattening skills or low level of education to start fattening business was the leading challenge (22.6%), followed by other challenges as reported by beef cattle fatteners such as availability of credit (20.4%), high cost of fattening (17%), availability of feeds (14.2%) and facilitate to acquire area for fattening (12.4%). Other challenges were insignificant, being less than 5% as shown in Table 7.

Table 7: Challenges to beef cattle fattening

Beef cattle fattening operators (N=90)			Agro pastoralist/pastoralist (N=401)	
S/N	Challenge	percentage	Challenge	Percentage
1	High prices of feed staff	27.7	Have no Fattening skills	22.6
2	Credit provision	16.6	Credit provision	20.4
3	Fattening area	16.2	High fattening costs	17
4	Availability of feed staff	22.6	Availability of feed staff	14.2
5	Availability of water for feeder cattle	4.7	Fattening area	12.4
6	Transportation of beef cattle (means and costs)	3.8	Long distance from sources of feed staff	3.1
7	Reliable markets for fattened beef cattle	3.4	High feeds transportation costs	2.8
8	High costs of treatment	2.1	Not aware about fattening	2.8
9	Animal diseases during fattening	2.1	High treatment costs	1.6
10	Availability of feeder cattle	0.4	Shortage of extension officers	0.8
11	Availability of casual labourers	0.4	Animal diseases	0.8
12			Tedious activity	0.8
13			Lack of FMD vaccination	0.5
14			Unreliable market	0.2

Source: *Survey data, 2010/11*

Opportunities for beef cattle fattening included; availability of market outlets for fattened beef cattle as indicated by demand and high gross margins (20.2%), availability of feeder cattle for fattening as shown by 55.1% of the respondents who preferred to sell mature animals (Table 8), and the agro-pastoralist and pastoralist awareness about beef cattle fattening (95.5%) as an opportunity to expand anf transform beef cattle fattening enterprises in the study area and later in the entire country for economic growth. Result in Table 9 indicates that 82.5% of the agro pastoralist and pastoralist respondents were willing to start fattening but only 14.5% had already started beef cattle fattening business. Other challenges and opportunities observed during the survey impacting on the livestock supply chain related to inputs, production, attitudes, processing, marketing and finances are summarised in Table 10.

Table 8: Animals preferred for selling by agro-pastoralists and pastoralists (N=401)

District name	animal type						Frequency
	Young animals (1-2 years)	Immature animals (2-3 years)	Mature and Old animals (4 to 7 years and above)	Unused drought animals	Barren/ infertile animals	Sick or emaciated animals	
Kahama	4	6	26	24	23	6	89
Kishapu	0	4	18	26	14	7	69
Meatu	0	12	28	37	33	8	118
Bariadi	4	15	29	26	14	4	92
Nyamagana/Ilemela	1	11	23	7	12	4	58
Magu	4	13	32	12	8	3	72
Sengerema	0	2	39	24	15	4	84
Maswa	3	16	26	26	11	2	84
Total	16	79	221	182	130	38	666
% of Total Respondents	4	19.7	55.1	45.4	32.4	9.5	

Source: Survey Data, 2010/11

Table 9: Opportunities for beef cattle fattening (N=401)

District	Aware about Fattening	Aware and would like to fatten	Aware and started fattening
Kahama	51	41	9
Kishapu	47	37	11
Meatu	50	38	11
Bariadi	41	40	3
Nyamagana/ Ilemela	47	44	4
Magu	50	46	4
Sengerema	48	47	3
Maswa	49	38	14
Total	**383**	**331**	**59**
% of Total	**95.5**	**82.5**	**14.7**

Conclusion

- The beef cattle supply chain in the study area was under-developed and it was characterized by low value addition among the pastoralists and high value addition among the beef cattle fatteners.
- Considering the production cycle, the gross margins for beef cattle fattening operators were higher than for the agro-pastoralist and pastoralist.
- There were challenges impacting the beef cattle supply chain in the study area, which included high prices of fattening feeds, limited availability of credit to expand fattening enterprises, absence of designated area for conducting fattening, unreliable supply of feed stuff, lacking improved fattening skills/education, poor linkages and low collaboration among and between the actors in the chain. Despite all these shortcomings, there are also opportunities to expand and improve beef cattle supply chain and foster economic growth both at the local and national level. These include; provision of market for fattened beef cattle, improving the availability of feeder cattle, improving the agro-pastoralist and pastoralist awareness on beef cattle fattening and their willingness to participate in the chain. These can be used to expand and improve the precursor beef cattle fattening enterprises, pioneered by a few enterprising innovative traders, into a vibrant value chain that makes meaningful contribution to improving cash income of many households who depend on livestock keeping for their livelihoods.

Recommendations

Based on the results discussed above, a number of recommendations for improving the beef cattle supply chain are made as follows;

- Improve farmers' skills through training so that they are able to produce higher volumes and more consistent quality of beef that is better suited to the market requirements. Becoming a beef cattle specialist is a necessary first step before any other form of chain development like investing in processing.
- Upgrade the beef cattle supply chain to a vibrant value chain by supporting the evolution of collaboration and binding linkages among actors. Beef cattle fattening provides an opportunity for doing this if the government or other development agencies such as Non-Government Organizations (NGOs) collaborates to facilitate and guide the transformation. Production of feeds should be emphasized as a specialised activity. In addition, actors should be well coordinated by improving market relations among them. A business model for an improved beef cattle supply chain for fattened beef is suggested in Figure 9.
- Improve the enabling environment in term of policies and institutions. Policies and regulations related to beef cattle fattening should be improved and implemented. Extension services should be improved especially on the number of staff to cover a wider range of villages in the country.

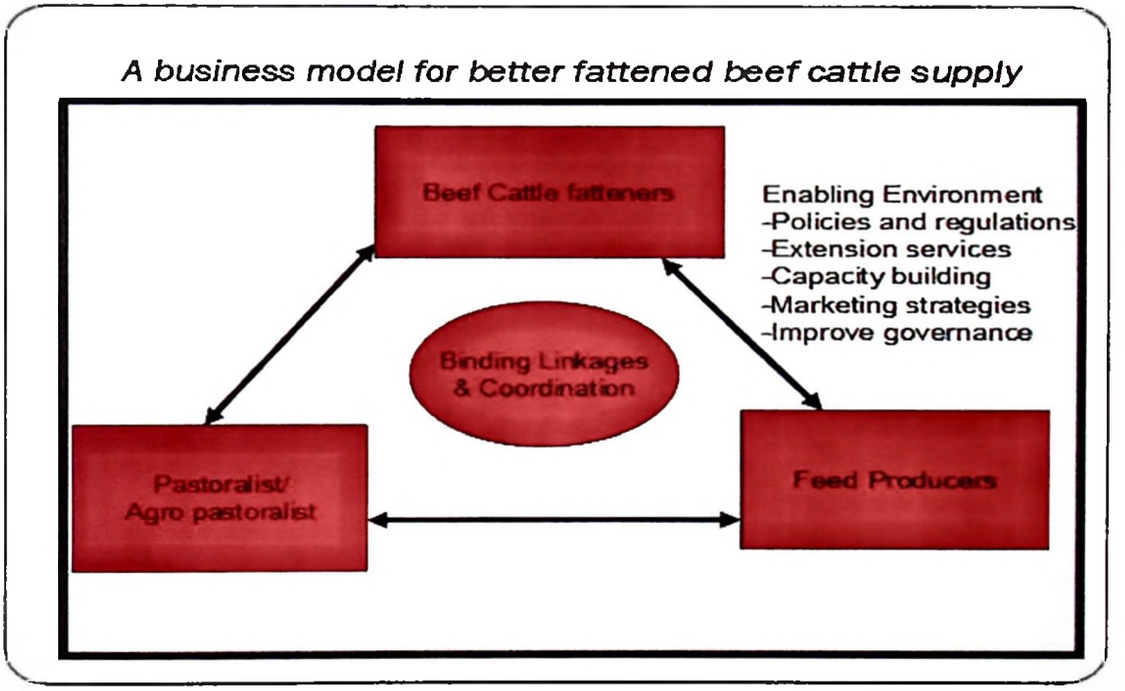

Figure 9: Suggested business model for improved fattened beef cattle

Table 10: Challenges and opportunities for beef cattle value addition

	INPUTS	PRODUCTION	ATTITUDES	MARKETING	PROCESSING	FINANCES
CHALLENGES	Few ginneries High costs of inputs Difficulties in availability of veterinary services Poor pasture Lack of specialization in feed production	Shortage of land Low productivity resulting into low weights of livestock Low productivity of indigenous animals Livestock diseases	Reluctance of livestock producers to invest into the sub sector Attitude of livestock producers to keep animals for prestige and store of value instead of business (keep for 5-6 years before sale)	Distorted livestock markets in terms of prices (buying) Poor organization of sellers High tax rates Poor market infrastructure	Lack of capital Poor quality of animals Poor processing infrastructure Unavailability of processing plants	Inadequate sources for credits Unwillingness of some of creditors e.g CRDB to facilitate livestock producers due to uncertainties of the livestock business
OPPORTUNITIES	Urban/ Town High demand for inputs More private entrepreneur to take advantage of high demand Establish feed processing industries	Potential for beef cattle fattening Potential for crossbreeding, AI Educating pastoralist and Agro pastoralist on productive livestock keeping methods	Opportunity to educate the society on the role of livestock as a resource that can be invested	• Formal organization of livestock sellers to combat distortion of market prices	Urban/ Town Opportunity to establish processing activities or plants in the regions Government policy to open doors for investors including investment in processing	• Opportunity to educate farmers on different sources of credits

Source: Survey data, 2010/11

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2.3 Paper II: Estimating technical efficiency of small scale beef cattle fattening in the lake zone in Tanzania

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Full Length Research Paper

Estimating technical efficiency of small scale beef cattle fattening in the lake zone in Tanzania

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This study examines the technical efficiency of small-scale beef cattle fattening in eight districts of Mwanza and Shinyanga regions, the lake zone in Tanzania. Data were collected using a structured questionnaire which was administered to 90 randomly selected cattle fatteners from the eight districts. Data were analyzed using descriptive methods and stochastic frontier production function approach. The estimated stochastic frontier production function showed that the herd size was the critical variable that affected weight gain in beef cattle fattening and hence beef output. The efficiency analysis results show that the estimated farm level technical efficiency ranged between 48 to 98% with a mean of 91%, indicating that the majority of the beef cattle fattening operators in the study area are efficient though not at 100%. The socio-economic determinants of the respondents' technical efficiency were age, education, experience, extension services and ethnicity. These findings can be used by the Ministry of Livestock and Fisheries Development extension agents to promote beef cattle fattening in areas where beef cattle fattening is not practiced in the country.

Key words: Average daily weight gain (ADG), cattle fattening operators, enterprises, technical efficiency, Tanzania shorthorn zebu (TSZ).

INTRODUCTION

The beef sub sector in Tanzania is dominated by indigenous cattle breeds which account for about 94 percent of the national cattle herd kept traditionally under pastoral and agro-pastoral production systems (Ministry of Livestock Development (MLD), 2006). The remaining 6%, fall under improved dairy and beef cattle management systems. Indigenous cattle are made of Tanzania shorthorn zebu (TSZ) and boran and ankole [Ministry of Livestock and Fisheries Development (MLFD), 2011]. The Tanzania short horn zebu (TSZ) and ankole are the dominant indigenous breeds in the country.

These types are well known for their low genetic potential in terms of beef production (MLD, 2006). As a result, the contribution of livestock to the national economy as well as to the household's well-being is low. In 2010, for example the livestock sector contributed only 16 and 3.8% to the agricultural gross domestic product (AGDP) and national gross domestic products (NGDP), respectively and the sector grew by only 3.4% compared to 4.4% for the crop sector (United Republic of Tanzania-URT, 2011). There are two major factors contributing to this situation. First, low average meat production per head especially in the traditional beef production system

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where average cattle productivity is estimated to be 107 kg per head compared to the average of 166 kg per head for other developing countries and 198 kg per head for the world (FAOSTAT, 2005).

Second, the low rate of adoption of improved livestock production technologies such as use of artificial insemination to improve the size of animals and limited use of fattening technologies is another contributing factor (URT, 2011). Low productivity of beef cattle in addition with other factors such as low purchasing power for the most of the population in the country has prevented Tanzania from meeting the World Health Organization (WHO) recommendation of a minimum per capital consumption of meat of 50 kg per year. The per capita consumption of meat in Tanzania is estimated to be 12 kg, compared to the world average of 46.6 kg/year (FAOSTAT, 2005; MLFD, 2012).

In order to improve the contribution of livestock to the national economy and well-being at the household level, the government has formulated the Livestock policy and strategy geared towards improving livestock productivity and commercialization of the livestock in the traditional sector (MLD, 2006, 2010, 2011). In the course of implementing the strategy, efforts have been made to encourage nomadic pastoralists with large cattle herds to reduce their herds and settle in areas where they are allocated land for cattle grazing. Besides encouraging pastoralists to settle, beef cattle fattening has been earmarked as one of the means to improve beef cattle productivity. Beef cattle fattening is a recent undertaking in the country, but it is increasingly gaining importance in some traditional livestock keeping regions of Tanzania. According to MLFD (2012), the number of fattened animals in the country is estimated to be 132,229 heads of cattle. Out of these, the lake zone (Mwanza, Shinyanga and Kagera regions) which is the study area account for 46.6%. Beef cattle fattening has the potential to improve the Tanzanian economy, if well harnessed. However, this depends, to a large extent, on the efficiency of the production system, hence livestock productivity. Efficiency is concerned with relative performance of the processes used in transforming given input into output (Abu and Asember, 2011; Otieno et al., 2012). Efficiency measurement has received significant attention from researchers in different fields of study (Abu and Asember, 2011; Facayode et al., 2011; Dawing et al., 2011). Measuring efficiency is vital because it can guide resource utilization and may lead to considerable resource savings, which have important implication for both policy formulation and farm management (Bravo-Ureta and Rieger, 1991). However, to date there is no study carried out to investigate the technical efficiency of beef cattle fattening enterprises undertaken in the country.

This study investigates the technical efficiency of beef cattle fattening enterprises practiced in Shinyanga and Mwanza regions of Tanzania. The specific objectives of the study are to: (i) estimate the technical efficiency of beef cattle fattening in the study area and (ii) examine the relationship between technical efficiency and socio-characteristics of cattle fattening operators. Subsequent parts of the paper are organized into five main sections which include: the theoretical framework, methodological section, results and discussion, conclusion and recommendations.

Theoretical framework

Economic theory identifies three important efficiency measures (Boris et al., 1997; Effiong and Onyenweaku, 2006). These include; the allocative, economic and technical efficiency. The allocative efficiency (AE) reflects the ability of the farm to use the inputs in optimum proportions given their respective prices and the production technology. Economic efficiency (EE) is defined as the capacity of a firm to produce a predetermined quantity of output at minimum cost for a given level of technology. Technical efficiency (TE) is the measure of the farms success in producing maximum output from a given set of inputs. Alternatively, it is the ability to operate on the production frontier or the isoquant frontier (Effiong and Onyenweaku, 2006). This study examines the TE for beef cattle fattening operators in the study area.

METHODOLOGY

Sampling and data collection

Data for this study were collected from beef cattle fattening enterprises in Mwanza and Shinyanga regions in the lake zone in Tanzania. Geographically, Mwanza and Shinyanga regions lie in the Northern part of the country.

The sampling frame included all beef cattle operators who are engaged in beef cattle fattening in selected districts of Magu, Nyamagana and Sengerema in Mwanza region and Kahama, Kishapu, Meatu, Bariadi and Maswa districts in Shinyanga region as shown in Figure 1. The list of beef cattle fattening entrepreneurs was collected from the respective local government authority offices in the districts, from which 90 respondents were randomly selected. Global positioning system (GPS) devices were used to geo-reference all points where the interview were held.

Data were collected through face to face interviews conducted by the principal researcher during the dry season between July and September, 2011, with the assistance of local experienced interviewers who were adequately trained prior to the surveys. The data were collected during dry season because this is when fattening is practiced. During the wet season animals are able to get enough forage from the rangelands and are normally in good condition hence hardly any fattening was done. Data gathered include information on socio-economic variables of the entrepreneurs such as age, education, household size, location, experience, access to credit and extension services. Information was also collected on the inputs as well as output in terms of weight gain for fattened beef cattle. The inputs data collected included: feeds used, amount of minerals used, and treatment/drugs used while output data collected was the weight of beef cattle after the fattening period.

It was observed during the field survey that beef cattle fattening operators did not weigh their animals before and after fattening.

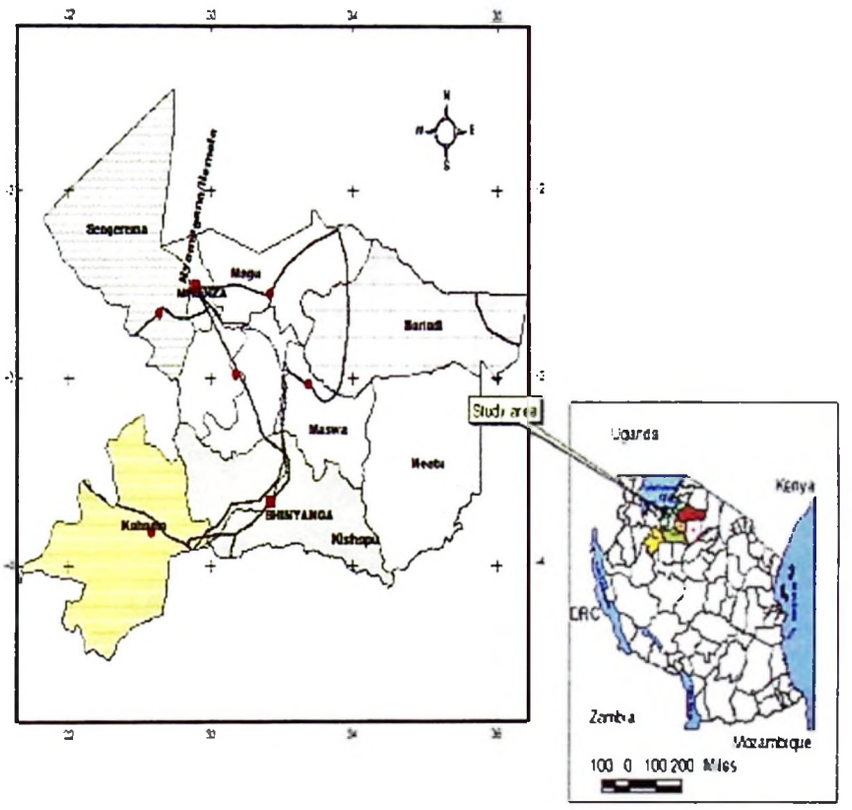

Figure 1. Location of the study area.

Also, they did not keep records of their business. In this regard, a control group of 105 animals were selected from Kahama district and used to determine the Average Daily Gain (ADG) along with 5675 animals (belonging to the respondents) whose weights were tracked during the study period covering 12 to 16 weeks (3 to 4 months). The animals under fattening were of the same breed that is Tanzanian short horn zebu (TSHZ) and same fodder conditions originating within the lake zone. Most of them were mature bulls and few culled cows purchased by the respondents from the livestock markets in the lake zone. A weight band tape, which is designed to take the live weight of animals such as; cattle, pigs, sheep and goats was used to measure the live weight of the study animals from each respondent (Figure 2a and b). The tape measure was used in the field because cattle weighing instruments are costly and heavy to transport and it is a practical field techniques, particularly in less developed countries. The animals' heart girth measurements were taken to predict animal's weights at entry, every two weeks thereafter and at exit.

Analytical framework

Technical efficiency can be estimated using computer software such as LIMDEP econometrics packages (Green, 1993) or the Frontier 4.1 program (Coelli, 1996) to find the maximum likelihood estimates for the parameters of the stochastic frontier production function. The stochastic frontier production function model is popular because of its flexibility and ability to closely marry economic concepts with modeling the reality (Dawang et al., 2011). Battese and Corra, 1997 applied the technique to the pastoral zone of the Eastern Australia.

Recently, many studies have been done in Africa using the technique which include; Facayode et al. (2011), for Technical efficiency analysis on small scale rabbit production in South to West Nigeria, Dawang et al., 2011 used the technique to estimate the profitability and technical efficiency of artisanal fishermen also in Nigeria, while Oleke and Isinika (2008) used the technique to assess the technical efficiency of commercial egg production in Tanzania.

Stochastic frontier production function analysis (SFA)

Farmers in agricultural production aim at maximizing production, minimizing costs and maximizing profits. However, though every producer may attempt to optimize, not all of them may succeed in their efforts. Given the same inputs and technology, some farmers will produce more efficient than others. Econometrics estimation techniques allow for the fact that deviations of observed choices from optimal ones are due to either failure to optimize (inefficient) or due to random shocks.

The SFA produces efficiency estimates or scores of individual producers, thus identifying those who need interventions and corrective measures. The variations of efficiency scores can be

Figure 2. (a) Weight band tape. (b) Estimating live weight using weight band tape.

related to producer's characteristics like age, size, ownership, location, education etc. Thus one can identify source of inefficiency. The SFA also provides a powerful tool for examining effects of interventions. A stochastic production frontier model using the FRONTIER 4.1 statistical software developed by Coelli (1996) was used to estimate the technical efficiency of beef cattle fattening in the study area. This analysis has the advantage of separating the impact of weather and other factors that contribute to variations in technical efficiency.

A frontier model with output-oriented technical efficiency according to Battese and Coelli (1995) is specified in Equation 1.

$$Y_i = X_i\beta + (\varepsilon = v_i - \mu_i) \quad (1)$$

Where; Y_{ij} = is the (logarithm of) output in terms of weight gain obtained by the i-th respondents from the j^{th} animal (for i = 1, 2,3 N; and j = 1,2,3, ...m), X_{ik} = is the corresponding matrix of K inputs, β = is a kx1 vector of unknown parameter to be estimated, ε_i is the disturbance term comprised of two independent components, V_i and U_i, V_i = are random variables which are assumed to be i.i.d. N $(0, \delta^2_v)$, and independent of the U_i's and U_{is} = are non negative random variables which are assumed to account for technical inefficiency in production and are assumed to be independently distributed as truncations at zero of the N (m_i, δ^2_u).

The maximum likelihood estimation of Equation 1 provides the estimators for β_i and variance estimators and other relationships denoted as;

$$\delta^2 = \delta_v^2 + \delta_\mu^2 \quad (2)$$

$$\gamma = \delta_v^2 / \delta^2 \quad (3)$$

$$\lambda = \delta_v^2 / \delta_\mu^2 \quad (4)$$

Where, δ^2, δ^2_v, δ^2_u are the overall variance of the model, variance of the random error, and variance of the technical inefficiencies respectively. According to Battese and Corra (1997), gamma (γ) is the total output made on the frontier function which is attributed to technical efficiency. The parameter gamma (γ) has a value between zero and one. Hence (1- γ) measures the technical inefficiency of the farms. The parameter lambda (λ) is expected to be greater than one. This condition according to Facayode et al. (2011) indicates a good fit for the model and correctly specified error term (V_i and U_i). From Equation 1, the polynomial of degree 2 technical efficiency equation for beef cattle fattening in the study area was specified as follows;

$$\begin{aligned} \ln Y = {} & \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 \ln X_6 + \beta_6 \ln X_5 \ln X_4 \\ & + \beta_7 \ln X_5 \ln X_3 + \beta_8 \ln X_5 \ln X_6 + \beta_9 \ln X_5 \ln X_4 + \beta_{10} \ln X_5 \ln X_6 \\ & + \tfrac{1}{2}(\beta_{11} \ln X_1 + \beta_{12} \ln X_2 + \beta_{13} \ln X_3 + \beta_{14} \ln X_4)^2 + \beta_5 X_5 + \beta_6 X_6 \\ & + (v_i - \mu_i) \end{aligned} \quad (5)$$

Where; ln = denotes the natural logarithm (base e), Y_i = is the total weight gain over the study period for the j^{th} animal of the i^{th} respondent for i = 1, 2, 3...n and for j = 1, 2, 3...k, X_1 = Herd size in numbers denoted as HERDSIZE, X_2 = Supplementary feeds in kg denoted as FEED, X_3 = Treatment index denoted as TREAT, X_4 = Minerals index denoted as MINERAL, X_5 = Location of farmers denoted as LOC (Dummy), X_6 = Fattening potential according to farmers perception denoted as FATPOT (Dummy) and β_0 = A vector of parameters to be estimated

Technical inefficiency model

According to Battese and Coelli (1995) in the efficiency model, the one sided error term is specified as;

$$\mu_i = \delta_0 + \sum \delta_m Z_m + \omega_i \quad (6)$$

Where; Zs are social economic variables used to explain efficiency differences among beef cattle fatteners, where the parameters δ_m are unknown, to be estimated and ω_i are iid random variable with zero mean and variance defined by the truncation of the normal distribution. The specific Z variables in the above model can be specified as follows:

$$U_i = \delta_0 + \sum\sum \delta_i Z_{ij} \quad (7)$$

Where: U_i = the technical inefficiency of the i^{th} respondent for i = 1, 2, 3, ..., N; Z_j = the j^{th} socio-economic variable for the i^{th} respondent for i = 1, 2, 3, ..., N and j = 1, 2, 3, ..., k δ_0 = the intercept, and δ_i = the coefficient for the K^{th} variable.

Table 1. Average daily weight gain per animal.

Variable	Mean	Min	Max	Std	Mode
Duration of fattening (days)	92	60	240	21.9	90
Average weight gain per animal over the study period (Kg)	58.6	37.7	151.1	13.6	56.6
Average daily weight gain per animal (Kg)	0.646	0.236	1.259	0.116	0.630

Source: Field survey data, 2011/2012.

The socio-economic variables represented in this study include; 1 = age, 2 = educational level in years, 3 = experiance, 4 = housing type, 5 = Ethnic group, 6 = access to credit and 7 = extension services. The technical inefficiency in Equation 7 can be estimated if the technical inefficiency effects, U_i are stochastic and have particular distributional properties (Battese and Corra, 1997). Under the null hypothesis gamma (γ) = 0, the stochastic model reduces to a traditional average response function, thus no technical inefficiency effects exist. The null hypothesis was tested using log likelihood ratio test as follows;

$$\lambda = -2\ln\{L(H_0)\} - \ln\{L(H_1)\}. \quad (8)$$

Where; $L(H_0)$ and $L(H_1)$ are values of likelihood function under the null hypothesis and the alternative (H_1) hypothesis, respectively.

RESULTS AND DISCUSSION

Determination of average daily weight gain (ADG)

The ADG was calculated by subtracting the initial weight from the final weight and dividing by the number of fattening days. The computed ADG is as shown in Table 1.

The ADG per animal was 0.646 kg and the mean fattening duration was 92 days. This finding compares well with similar finding by Mwilawa (2012) which revealed that ADG for Boran beef cattle kept under station conditions in Tanzania was 0.889 kg which implies that traditional beef cattle respond to fattening.

Results of technical efficiency analysis

Descriptive statistics of variables used for the production function frontier estimation are presented in Table 3. The mean total animal weight gain per farmer (obtained by multiplying the average daily weight gain per animal (0.646 kg/day) with the number of animals per enterprise and the duration of fattening) was 3607.75 kg with a standard deviation of 4292.2 kg. The large value of standard deviation implies that the beef cattle fattening operators were raising different numbers of animals with a minimum of 4 animals and a maximum of 330 animals.

The mean quantity of supplementary feed used per farmer was 1053.8 kg with a minimum of 0 and maximum of 7800 kg. There was variability in feed usage by cattle fatteners measured by the minimum and maximum amounts, which was confirmed by the large value of the standard deviation. This may be due to differences in feed ranging from exclusive standing hay to different additional quantities of supplementary feeds. Feed scarcity and the high cost of feeds as it was observed during the survey, making it difficult for most operators to provide adequate feed for speedy weight gain of the animals. This implies that improvement in feed availability in the study area may lead to improvements in animals' weight gain and reduce the duration of beef cattle fattening.

The mean mineral index (calculated as a ratio of feeds) was 0.004 while the mean for the treatment index was 0.32. The location of the respondent (urban = 1 or peri-urban = 0) was included in the model as dummy variable. The fattening potential according to farmers perception of the animals (un-castrated bulls = 1 or castrated bulls and cows = 0) was also included as a dummy variable to test farmers' preferences to fatten un-castrated beef cattle bulls over castrated bulls and cows as observed during the survey. A summary of all the descriptive statistics is presented in Table 2.

Most of the entrepreneurs who were engaged in beef cattle fattening were middle aged being 39.5 years on average age with a standard deviation of 9.2 years. This shows that most farmers were middle aged people. The average year of schooling was 6.8 years with a minimum of 0, a maximum of 16 and a standard deviation of 3 years, hence most of the farmers attended at least primary school. The average experience in beef fattening was 5.4 years with a standard deviation of 4.6 years implying that most of the farmers are relatively new in the beef fattening enterprises, but the most experienced operator had been 26 years in the business. Other variables such as the average housing type, credit provision, extension services and ethnic group were included in the model as dummy values.

Results of stochastic frontier production analysis

Equation 8 was used to test the assumption of the trans-log model specification for the beef cattle fattening. The maximum likelihood estimates of the stochastic frontier production function are presented in Table 3. The findings show that, the value of lambda (λ) was greater than one (17.36) implying goodness fit for the estimated model and also correct specification of the error term

Table 2. Descriptive statistics of variables used in the stochastic frontier analysis.

Variable	Notation	Mean	SD	Min	Max
Total animal weight gain per farmer (kg) for the study period	WGAIN	3607.8	4292	151.1	18699
Number of animals per farmer (N)	HERDSIZE	63.6	76	4	330
Feeds usage (kg)	FEED	1053.8	1214	0	7800
Treatment (Index)	TREAT	0.32	1.8	0	16.7
Mineral Intake (Index)	MINERAL	0.004	0.006	0	0.343
Location	LOC	0.45	0.5	0	1
Fattening Potential	FATPOT	0.4	0.5	0	1
Age (years)	AGE	39.5	9.2	24	69
Education (years)	EDUYRS	6.8	3	0	16
Experience (years)	EXP	5.4	4.6	1	26
Housing type	HOUSE	0.8	0.4	0	1
Credit provision	CREDIT	0.06	0.2	0	1
Extension services	EXT	0.6	0.5	0	1
Ethnic group	ETHNIC	0.8	0.4	0	1

Table 3. Maximum Likelihood estimates of trans-log production function.

Variable	Par.	Expected sign	Coeff.	SE	t-ratio
Constant	β_0		4.874	0.13	37.451
LNHERDSIZE	β_1	-	6.036*	3.232	1.868
LNFEED	β_2	+	1.031	1.214	0.85
LNMINERAL	β_3	-	3.276*	1.895	-1.729
LNTREAT	β_4	+/-	1.758*	1.06	-1.659
LNHERDSIZE^2	β_5	+/-	2.581*	1.617	-1.596
LNFEED^2	β_6	-	-0.613	0.608	-1.009
LNMINERAL^2	β_7	+	1.637*	0.949	1.724
LNTREAT^2	β_8	+	0.915*	0.535	1.71
LN HERDSIZE X FEED	β_9	+	0.093**	0.041	2.284
LN HERDSIZE X MINERAL	β_{10}	+	0.005	0.049	0.097
LN HERDSIZE X TREAT	β_{11}	-	-0.043	0.046	-0.942
LN FEED X MINERAL	β_{12}	+/-	0.025	0.033	0.749
LN FEED X TREAT	β_{13}	+/-	-0.006	0.037	-0.168
LN MINERAL X TREAT	β_{14}	+/-	-0.03	0.053	-0.565
LOCATION	β_{15}	+/-	0.016	0.043	0.344
FATPOT	β_{16}	+/-	0.033	0.038	0.867
Variance parameter					
Sigma-squared	σ^2		0.082***	0.026	3.154
Gamma	Υ		0.853***	0.066	13.02
log likelihood (LLF)			46.18		
Lambda	λ		17.36		
Inefficiency effect					
AGE	δ_1	-	-0.044**	0.021	-2.1
AGE^2	δ_2	+/-	0*	0	1.97
EDUC	δ_3	-	0.314***	0.09	3.485
EDUC^2	δ_4	-	-0.02***	0.006	-3.542
EXP	δ_5	-	-0.073*	0.04	-1.814
EXP^2	δ_6	+/-	0.004*	0.002	1.83

Table 3. Contd.

HOUSING	δ_7	+/-	0.085	0.155	0.549
CREDIT	δ_8	-	-0.104	0.14	-0.746
EXTENSION	δ_9	-	-0.366**	0.153	-2.387
ETHNIC	δ_{10}	-	0.531***	0.173	-3.068

Level of Significance; *** α = 0.01; ** α = 0.05; * α = 0.1

distribution. This was also evident from the estimated Gamma (Y) value of 0.853 which measures the level of inefficiency of the production system, this was significant at α = 0.05 and was above the 50 percent of a unity. These results imply that within the study area, about 85.3% of the variation in beef cattle fattening is explained by inefficiency, whereas the remaining 14.7% (that is 1-Y = 0.147) is due to measurement error and specifications bias as well as other factors that are not incorporated in the stochastic frontier and inefficiency effects models. This further confirms that the technical inefficiency effects are significant in the estimated model. The variance parameter (σ^2) was also positive (0.082) and significantly greater than zero at α = 0.05.

The inefficiency model estimates

The inefficiency analysis of the stochastic frontier indicated the coefficients for age, education^2, experience; extension contact and ethnic group were all negative and significantly different from zero, suggesting that increasing these variables will increase technical efficiency. However, ageing (age^2) does not contribute to technical efficiency such that the coefficient for this variable is zero. The estimated coefficient on education is positive and significantly greater than zero indicating increase in production inefficiency. However, as the education level increases (Education^2) the effect on technical efficiency is negative and statistically significant indicating reduction in production inefficiency. In other words, education (years of schooling) had a positive correlation with technical efficiency. These results are consistent with Ogunniyi (2011) and Dawing et al. (2011) who established that for every extra year of schooling that a farmer/fisher got, there was an increase in the chance or probability of being technically efficient.

The estimated coefficient on experience is negative and statistically significantly different from zero, contributing to decrease in technical inefficiency by 7.3% for every year of increase in experience. Credit access showed a negative relationship with technical inefficiency as expected though it was not significant implying that only few farmers had access to credit. Having access to credit reduced the level of inefficiency of respondents by 1.04%. This means policies that will make micro-credit from government and non-governmental agencies accessible to these farmers will go a long way to address their resource use inefficiency problems. The coefficient for extension service contact was negative and significantly different from zero indicating that if a respondent had contact with extension services they were likely to experience increase in technical efficiency equivalent to about 3.66% average daily weight gain of the fattening animals. The Ethnic group was negative and significant (α < 0.05) indicating that Sukuma group (denoted as 1) were more involved in beef cattle fattening compared to other ethnic groups (denoted by zero).

Technical efficiency score analysis

The frequency distributions of technical efficiency (TE) scores are presented in Table 4. The findings show the beef fattening enterprises achieved on average 91% level of efficiency, ranging from 48 to 98% with a wide range of efficiency variation among the operators (Appendix 1). About 81.6% of beef cattle fattening operators operate at 91% TE or more while 13.8% were able to achieve 81% up to 90% TE levels. The results also suggest that about 98.7% of the respondents were able to achieve above 50% of the technical efficiency. Only 1.1% of the enterprises operated at 50% or less (Appendix 1). These results suggest that the majority of the respondents operate efficiently though not at 100%, there is still room for improving technical efficiency of few beef cattle fattening enterprises in the study area.

CONCLUSION AND RECOMMENDATIONS

This study applied the stochastic frontier model to estimate technical efficiency of beef cattle fattening. Results give efficiency scores that range from 48 to 98%, suggesting that there is room for improving the low performing cattle fattening enterprises. Further, it was found that education, experience, access to credit, extension services and ethnicity of cattle fattening operator contribute negatively to inefficiency that is, positively to efficiency improvement in cattle fattening. On the other hand, location and housing type did not have a positive influence on efficiency in cattle fattening, probably indicating that these variables did not render any technological differences among the cattle fattening entrepreneurs in the study area. All these findings have important implications on improving beef fattening

Table 4. Technical Efficiency scores for the sampled beef cattle operators.

Technical efficiency level (%)	No. of farmers	Percentage
<50	1	1.1
51-60	1	1.1
61-70	1	1.1
71-80	1	1.1
81-90	12	13.8
>91	71	81.6
Total	87	100
Mean	0.91	
Standard Deviation	0.08	
Minimum	0.48	
Maximum	0.98	

efficiency in Tanzania. The positive relationship of education and extension on technical efficiency imply providing appropriate knowledge and skills would facilitate better use of the available cattle fattening technologies by the operators who are currently operating inefficiently. Necessary interventions would include improving fattening operators' knowledge on feeding and disease control methods.

The negative relationship between access to credit and inefficiency implies that policies that will improve access to credit from government and non government agencies would increase the cattle fattening operators' ability to acquire better technologies (better cattle breeds and feeds through acquisition of mini to medium ranches where pastures could be improved and herd size expanded) with the potential of increasing productivity for domestic and export market. The efforts by the government to establish an agricultural bank is likely going to improve access to credit by farmers in Tanzania including cattle fattening operators if the bank conditions for credit will be favorable. These findings can be used by the Ministry of Livestock and Fisheries Development extension agents to promote beef cattle fattening in areas where beef cattle fattening is not practiced in the country.

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Appendix 1. beef cattle fattening operators individual efficiency score

Beef Cattle fattening operators No.	Efficiency score	Percentage
1	0.96214561	96.21
2	0.94622229	94.62
3	0.90990675	90.99
4	0.90836731	90.84
5	0.91718459	91.72
6	0.94651977	94.65
7	0.92162874	92.16
8	0.91154839	91.15
9	0.92729179	92.73
10	0.94453186	94.45
11	0.9178525	91.79
12	0.95143245	95.14
13	0.95393396	95.39
14	0.95476767	95.48
15	0.91568868	91.57
16	0.90804903	90.8
17	0.93534417	93.53
18	0.9089111	90.89
19	0.97801878	97.8
20	0.93575987	93.58
21	0.9321321	93.21
22	0.91532701	91.53
23	0.9009158	90.09
24	0.90640892	90.64
25	0.93834282	93.83
26	0.95582983	95.58
27	0.94903479	94.9
28	0.92827808	92.83
29	0.84726318	84.73
30	0.97484628	97.48
31	0.96947349	96.95
32	0.90510863	90.51
33	0.93306386	93.31
34	0.63422246	63.42
35	0.96445711	96.45
36	0.91327269	91.33
37	0.83504685	83.5
38	0.95367473	95.37
39	0.91304118	91.3
40	0.9195629	91.96
41	0.96544705	96.54
42	0.92534497	92.53
43	0.96375558	96.38
44	0.92175427	92.18
45	0.95109311	95.11
46	0.93799274	93.8
47	0.96986503	96.99
48	0.89269371	89.27
49	0.90672046	90.67
50	0.94312792	94.31

Appendix 1

52	0.91480716	91.48
53	0.87264073	87.26
54	0.9002228	90.02
55	0.96420636	96.42
56	0.94762449	94.76
57	0.96078686	96.08
58	0.95389044	95.39
59	0.9462963	94.63
60	0.91920711	91.92
61	0.93534727	93.53
62	0.94473073	94.47
63	0.92517926	92.52
64	0.9157181	91.57
65	0.89907558	89.91
66	0.95832715	95.83
67	0.90969569	90.97
68	0.90579944	90.58
69	0.92821406	92.82
70	0.85060658	85.06
71	0.95608835	95.61
72	0.94071958	94.07
73	0.88981	88.98
74	0.94438271	94.44
75	0.86631765	86.63
76	0.91320091	91.32
77	0.97630442	97.63
78	0.52971188	52.97
79	0.963581	96.36
80	0.47609183	47.61**
81	0.93853943	93.85
82	0.93368394	93.37
83	0.74611235	74.61
84	0.92489804	92.49
85	0.91071263	91.07
86	0.9428072	94.28
87	0.82394518	82.39

**Below 50%.

2.4 Paper III: Profitability analysis of small scale beef cattle fattening in the Lake Zone in Tanzania.

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Full Length Research Paper

Profitability analysis of small scale beef cattle fattening in the Lake Zone in Tanzania

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This study examined the profitability of small-scale beef cattle fattening enterprises and its determinants in Mwanza and Shinyanga regions in the Lake Zone of Tanzania. Data were collected using a structured questionnaire administered to a random sample of 90 beef cattle fattening operators. The data were analyzed using descriptive statistics, farm budgets and Multiple Regression Model. The obtained results showed that beef cattle business is dominated by male (98.9%) within the productive age (below 60 years), of which 93.3% of the respondents were married with less than 5 years of experience (66.7%) in beef cattle business. The majority of the respondents (77.8%) had primary school education. The farm budget analysis showed that beef cattle fattening in the study area is a profitable venture that for every shilling invested in beef cattle fattening, there was a return of 35% and Tshs. 3,201.12 per kg of weight gain. The average net farm income per farmer was Tshs. 12,165,871.60 equivalent to USD 7,699.90 per year or USD 21.10 per day. The return per shilling invested is higher than the current bank lending rates (16 - 20%) in the country, indicating that beef cattle fattening operators in the study area are credit worthy. The multiple regression models revealed that the prices for buying and selling the animals as well as transportation cost are the major determinants of profitability for beef cattle fattening enterprises in the study area.

Key words: Beef cattle fattening, farm budget, profitability, small scale, Lake Zone, Tanzania, net farm income.

INTRODUCTION

Tanzania's livestock resource consists of 22.8 million cattle, 15.6 million goats, 7.0 million sheep, 2.01 million pigs, 24.5 million improved poultry and 35.5 million indigenous poultry (Ministry of Livestock and Fisheries Development - MLFD, 2012). Cattle are the dominant type accounting for about 75% of total livestock production in the country. Most of the cattle are raised for beef cattle by pastoralists and agro-pastoralists in arid and semi-arid areas of the country. Despite the large number of cattle available in the country, the contribution of the livestock sector to the national economy is low. In 2010, for example the industry contributed only 16 and 3.8% to the Agricultural Gross Domestic Product and National Gross Domestic Product respectively and the sector grew by 3.4% (United Republic of Tanzania (URT) Economic Survey, 2010). This is mainly due to low livestock growth rates, high mortality rates, low production and reproductive rates, low off-take rates and poor quality of the final products from the industry (Ministry of Livestock Development-MLD, 2006).

In the recent past, there have been efforts to promote beef cattle fattening in the country in order to increase beef cattle productivity with the aim of enhancing the beef sector's contribution to household food security, and income as well as to the national economy (MLD, 2006). Beef cattle fattening has particularly gained prominence

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as an important enterprise in the Lake Zone regions (Lake zone consists of Mwanza, Shinyanga, Mara and Kagera regions (Ministry of Agriculture, Food and Cooperatives, 1956)) of Tanzania, which account for about 39% of the beef cattle in the country (National Sample Census of Agriculture-NSCA, 2007/2008). The cattle fattening operators in the Lake Zone are entrepreneurs who buy lean beef cattle from nomadic pastoralists and agro-pastoralists and then feed the cattle until they gain weight up to a marketable level. The basal diet for fattening mostly comprises pasture feeding from selected standing hay with supplementation using farm by-products which include: cotton seed cake, cotton husks, sunflower seed cake and minerals locally known as *Nyalanja*. In addition to feeding, the animals were treated for diseases and pests if necessary. The animals were then sold after 3 to 4 months of feeding, depending on the rate of weight gain (Mlote et al., 2012). Most importantly, cattle fattening helps to meet the rising demand for high-protein foods in the country and plays a great role in: (i) ensuring food security, (ii) providing households with employment, income, investment opportunity and a store of value, and (iii) providing draught power and manure for sustainable agriculture and fulfilling cultural roles.

Beef cattle fattening is a new technology in the country but has potential to improve the livestock sector and the Tanzanian economy, if well harnessed. However, this will depend on the extent to which existing fattening enterprises attract new entrants to the subsector based on their profitability. In a competitive industry, high profit levels reflect high productivity and efficient use of resources. According to Soto (2006), profitability is, in general, the efficiency of a company or industry or farm at generating earnings. Many studies have been done to assess the profitability of cattle fattening farms elsewhere in the world (Yildirim, 2006; Even, 2006; Sahin et al., 2008) but, none has been done to investigate the profitability of beef cattle fattening in Tanzania. Only a few studies have been conducted on beef cattle fattening in Tanzania at research stations to determine the nutritional requirements and weight gains for local breeds (Mwilawa, 2012). Also, there have been pilot studies at Mtibwa Sugar Estates in Morogoro region, Kongwa ranch in Dodoma region, and Manyara ranch in Arusha region to assess the performance of Short Horn Zebu (SHZ) in comparison with Boran cattle in terms of nutritional requirement and weight gain under feedlot conditions. The daily weight gain of SHZ was reported to be between 0.7 and 0.8 kg per day, compared to 0.8 and 0.9 kg per day for Boran (Luziga, 2004, 2006). There are no documented studies that assessed the profitability of beef cattle fattening enterprises in Tanzania. This study is therefore an attempt to examine the profitability associated with beef cattle fattening enterprises in Shinyanga and Mwanza regions, which pioneered cattle fattening in Tanzania.

The specific objectives of this study are to: (i) Assess the socio-economic characteristics of beef cattle fattening operators in the study area, (ii) determine profitability of beef cattle fattening enterprises, and (iii) assess factors that affect profitability of beef cattle fattening enterprises.

METHODOLOGY

Data for this study were collected from beef cattle fattening enterprises in Mwanza and Shinyanga regions in the Lake zone in Tanzania. Geographically, Mwanza region lies between latitudes 1°30'3" South of Equator and 31°45'34" East of Greenwich, while Shinyanga region is located at 03°39'43" South and 33°25'23" East. The sampling frame included all beef cattle operators who are engaged in beef cattle fattening in selected districts of Magu, Nyamagana and Sengerema in Mwanza region and Kahama, Kishapu, Meatu, Bariadi and Maswa districts in Shinyanga region as shown in Figure 1. The list of beef cattle fattening enterprises was obtained from the respective Local Government Authority Offices (LGA) in the districts, from which 90 respondents were randomly selected. Global Positioning System (GPS) devices were used to geo-reference all points where the interviews were held.

A structured questionnaire was used to collect data through face to face interviews conducted by the principal researcher during the dry season between July and September, 2011, with the assistance of local experienced interviewers who were adequately trained prior to the surveys. The data were collected during the dry season because during the wet season, animals get enough forage from the pastures in the range and are normally in a good condition hence hardly any fattening was done. Data were gathered on socio- economic variables of the entrepreneurs such as gender, age, marriage, education, household size, location, experience, extension services, livelihood assets and source of capital. Information was also collected on the inputs as well as the output in terms of weight gain of the fattened beef cattle. These data include the number of animals under fattening, the type and quantity of inputs used and the associated costs, the weight of cattle before and after fattening, the cost of cattle before fattening (buying price) and selling price after fattening, cost of feeds, minerals, drugs, labor, marketing fees and transportation cost, cost of constructing holding pens, storage facilities, equipment, feeders, the cost of digging shallow wells or boreholes for water supply, as well as other costs as reported by the respondent.

It was observed during the field survey that beef cattle fattening operators did not weigh their animals before and after fattening. Also, they did not keep records of their business. In this regard, a group of 105 animals were selected from Kahama district. These were used to determine the average daily gain (ADG) along with 5675 animals (belonging to the respondents) whose weights

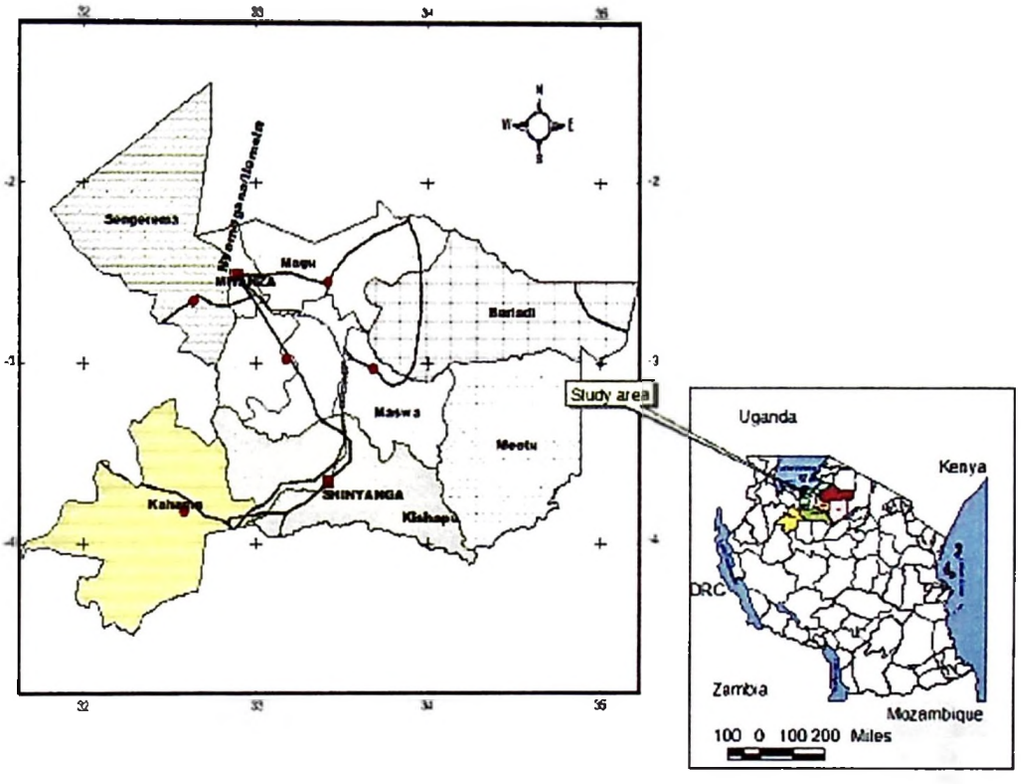

Figure 1. Location of the study area.

were tracked during the study period covering 12 to 16 weeks (3-4 Months). A weight band tape, which is designed to take the live weight of animals such as: cattle, pigs, sheep and goats was used to measure the live weight of the study animals from each respondent. The accuracy of the tape is about 99% compared to a weighing scale (Stajnko et al., 2010). The animals were weighed at entry, every two weeks thereafter and at exit when they are ready for the market.

DATA ANALYSIS

Descriptive data were computed using SPSS Version 16.0 to calculate means, frequency distribution and percentages for describing socio-economic characteristics of the respondents. The profitability of beef cattle fattening enterprises was determined by employing farm budget analysis. Net Farm Income (NFI) was calculated by subtracting the production costs from the gross production value (Okoruwa, 2005; Yidirim, 2006; Malope et al., 2007; Dawang et al., 2011). Computing the net income enables one to determine the profit level of a firm when the fixed cost can be calculated (Umar et al., 2008). For this study, fixed cost included the cost of constructing the holding pens, storage facilities, feeders, drinkers, dehorning scissors and the cost of equipment used for supplying water to the fattening area. Mathematically, the NFI of an enterprise is given as follows:

$$NFI = \sum P_i Y_i - \sum P_x X_j - \sum Z_k \quad (1)$$

Where:
NFI = Net Farm Income for the beef cattle fattening enterprise (Tshs),
Y_i = The i^{th} fattened animal, for i = 1, 2, ..., n
P_i = Unit price of the i^{th} fattened beef cattle (Tshs)
X_j = The j^{th} variable inputs used in cattle fattening (for j = 1, 2, 3....., m)

P_{xj} = Unit cost of the j^{th} variable inputs (Tshs)
Z_k = The cost of the k^{th} fixed inputs (Tshs) (for k = 1, 2, 3...., k)
$\sum$ = The summation sign.

The Benefit Cost Ratio is given as

$$TR/TC \quad (2)$$

The depreciation cost of various fixed inputs, with the exception of the cost of purchasing live animals for fattening which in this case was treated as a variable cost, was computed using the straight line depreciation method (Equation 3). Zero scrap value was assumed for all equipment after five years of use:

$$\text{Annual depreciation} = \frac{\text{Current value of fixed inputs}}{\text{Expected useful life span of input}} \quad (3)$$

The multiple regression method was used to estimate the direction and magnitude of the relation between the profit per animal and variables that are hypothesized to have an effect on profit. These include the herd size, beef cattle purchase price as a proxy for quality of beef cattle before fattening, price of feeds per kilogram as a proxy for quality of supplementary feeds, transport cost before and after fattening as a proxy for distance from or to the market, age of an animal, sex of an animal, labor cost per animal, duration of fattening and the selling price of fattened beef cattle as a proxy for the quality of an animal after fattening. The regression model for the relationship between these variables and profit was estimated using a profit function as defined in Equation (4):

$$\prod_{ij} = f(X_i) \quad (4)$$

Where:
$\prod_{ij}$ is the profit level of the i^{th} respondent in j^{th} region;
f is a function term;
X_i denotes the variables considered to affect profit of the i^{th} respondent in j^{th} region.

Using log-linear transformation, the profit function was estimated as shown in Equation (5)

$$y_i = \beta_o + \beta_i X_i + \varepsilon_i \text{; for i = 1,2,3,.....n and j = 1 and 2} \quad (5)$$

Where:
y_i = Profit for i^{th} respondent in j^{th} region,
β_o = Constant term (y-intercept),
β_i = Coefficients for independent variables,
X_i = Independent variables,
ε_i = Error term (disturbance term), representing all factors that affect variation of the dependent variable but are not captured by the independent variables.

From Equation 5, the regression equation for beef cattle fattening was estimated as in Equation 6.

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} \quad (6)$$

Where:
y = Net profit per animal (Tsh.),
X_1 = herd size (Numbers),
X_2 = live beef cattle purchase price (Tshs/Animal),
X_3 = live beef cattle transportation costs during purchase (Tshs/Animal),
X_4 = price of feeds (Tshs/kg),
X_5 = live beef cattle transportation costs during selling (Tshs/Animal),
X_6 = live beef cattle selling price for fattened animals (Tshs/Animal),
X_7 = age of an animal (years),
X_8 = sex of an animal (1=male; 0=otherwise),
X_9 = duration of beef cattle fattening (days),
X_{10} = labor cost (Tshs/Animal).

Regression analysis

Regression analysis of Equation 6 was done using STATA statistics/data analysis version 10.1. As a first attempt during the model building process, various types of relationships (for example, linear and quadratic) between the dependent variable (y) and each independent variable (X_i) were examined on scattered graphs. The reliability and stability of the regression model was then tested against violation of Ordinary Least Square (OLS) estimation assumptions, that is, abnormality, distributed independent variable, autocorrelation, heteroscedasticity and multicollinearity.

RESULTS AND DISCUSSION

Social-economic characteristics of the beef cattle fattening operators

The socio economic characteristics of the beef cattle fattening operators are presented in Table 1. The age distribution for the majority of the respondents showed a range between 20 and 60 years old with only 4.5% of the respondents being 61 years or older. This indicates that beef cattle fattening enterprises were operated by people within the productive age. Only 1.1% of the respondents had tertiary education compared to 78.8 and 12.2% that had either primary or secondary education respectively. About 6.7% had no formal education at all, while 2.2% had adult education. These results indicate that few highly educated people were engaged in the beef cattle fattening enterprises, the majority of the entrepreneurs being primary school graduates. A high proportion of the respondents (66.7%) had equal or less than 5 years of

Table 1. Demographic characteristics of the beef cattle fattening operators (N=90).

Demographic characteristics	Frequency	Percentage
Gender		
Male	89	98.9
Female	1	1.1
Age		
<40	48	53.3
41-60	38	42.2
>61	4	4.5
Education		
No formal Education	6	6.7
Adult Education	2	2.2
Primary Education	70	77.8
Secondary Education	11	12.2
College Education	1	1.1
Experience		
<5	60	66.7
6 to15	28	31.1
>16	2	2.2
Marriage		
Married	84	93.3
Single	6	6.7
Household size		
<5	71	78.9
6 to 10	14	15.5
>11	5	5.6
Ethnic affiliation		
Sukuma	76	84.4
Zinza	7	7.8
Others (Chaga, Kurya, Nyambo, etc.)	7	7.8
Location		
Town	23	25.6
Per-urban	19	21.1
Rural	48	53.3

Source: Field survey (2011/2012).

experience in the beef cattle fattening business, while 31.1% had experience of between 6 and 15 years of experience, and only 2.2% of the respondents had 16 years of experience or above. This implies that beef cattle fattening enterprises is relatively new in the study area and hence the need for improving managerial capabilities for higher productivity.

About 93.3% of the beef cattle fattening operators were married with household size of equal to or less than 5 people (78.9%).

Most of the beef cattle fattening operators were located in the rural areas (53.3%), while 25.6 and 21.1% were located in urban and peri-urban respectively, often operating along the road side. The Sukuma tribe

Table 2. Source of capital and livelihood assets of beef cattle fattening operators (N=90).

Variable	Frequency	Percentage
Source of capital		
Personal savings	79	87.8
Family	6	6.7
Others	5	5.5
Livelihood assets		
House ownership	84	93.3
Lamp	59	68.6
Radio	79	91.9
Television	39	45.3
Mobile phone	83	96.5
Bicycle	70	81.4
Motor cycle	41	47.7
Small vehicle	17	19.8
Big Truck	8	9.3
Refrigerator	19	22.1

Source: Field survey (2011/2012).

Table 3. Source of labor and duration of fattening.

Variable	Frequency	Percentage
Source of labor		
Family labor	11	12.2
Hired labor	1	1.1
Both (Hired and Family) labor	78	86.7
Duration of fattening		
2 to 3	84	93.4
4 to 5	4	4.4
6 to 8	2	2.2

Source: Field Survey (2011/2012).

dominated (84.4%) the fattening operators, followed by the Zinza (7.8%) and others (7.8%).

Source of capital and ownership of assets

The results in Table 2 indicates that 87.7% of the operators sourced capital for beef cattle fattening from their personal savings while 6.7% inherited from their families and 5.5% solicited finances from other sources which they could not disclose. Analysis of their livelihood assets showed that about 93.3% of the respondents owned at least one house and were well connected with communication and transportation facilities. About 91.9% of the respondents owned radios, 45.30% owned television sets, and 96.5% owned mobile phones. Ownership of these assets is a good sign for transferring technological information for improvement and up-scaling. About 22% of the respondents owned refrigerators and 68.6% owned house lamps. The ownership of transportation facilities was also common where 81.4% owned bicycle, 47.7% owned motor cycles, 19.8% owned small vehicles and 9.3% owned big trucks which assisted them in transporting animals to the fattening places as well as to the selling points.

Cattle fattening management practices

The basic goal of the cattle owners was to add value to their cattle by fattening before selling them in order to fetch higher prices and hence profit (Mlote et al., 2012). The fattening operators purchased animals mostly from markets where pastoralists and agro-pastoralists sold their cattle. Some of the markets from where the beef cattle fattening operators purchased cattle include: Igoma, Meatu, Bariadi, Kishapu, Ipuli, Sengerema, Biharamulo, Igunga, Misenyi and sometimes from within or nearby villages. The price of cattle differed according to sex, body conformation and age of animals. Buyers did not pay much attention to the actual weight.

Most of the operators carried out cattle fattening operation under semi-intensive system. The fattening process involved purchase and feeding of animals. During the stocking period, farm by-products such as cotton seed cake, cotton husks, sunflower seed cake and minerals locally known as Nyalanja (local salts) were fed to animals. Supplementary feeds are usually more nutritive and are fed to the animals to boost the fattening process (Okuruwa et al., 2005). This is meant to hasten the attainment of a standard beef cattle slaughter weight and conformation. Water and Multi-Vitamin injections were additions also given to the animals. Treatment of animals was done by the beef cattle fattening operators particularly for de-worming and treatment of ecto and endo parasites.

Results in Table 3 show the source of labor and the length of fattening period for beef cattle fattening enterprises. According to these results, the operators relied on both hired and family labor (86.7) with 12.2% using family labor alone and only 1.1% using hired labor. No formal training was provided to hired labor before they were allowed to manage the animals, which may have affected the potential for increased productivity in the business. Other inputs used included feeding equipment, holding pens and feed storage. Most operators (93.4%) fattened the animals for 2 to 3 months or 92 days on average (Table 4). Another 4.4% of the operators fattened for 4 to 5 months and the remaining 2.2% of the operators fattened for longer periods of 6 to 8 months, especially in Sengerema district where animals were fattened using standing hay along Lake Victoria. Most of the operators preferred to fatten bulls (97.8%) compared to cows (1.1%) and heifers (1.1%) because the bulls gained weight faster. Sales of fattened animals were

Table 4. Average daily weight gain per animal (N=105).

Variable	Mean	Min	Max.	Std	Mode
Duration of fattening (days)	92	60	240	21.9	90
Average weight gain per animal over the study period (Kg)	58.6	37.7	151.1	13.6	56.6
Average daily weight gain per animal (Kg)	0.646	0.236	1.259	0.116	0.630

Source: Field Survey (2011/2012).

often carried out by the operators themselves and selling prices were determined by sex, size, and physical condition of the animal. The bargaining power of the purchaser was also important. About 58.7% of the fattened beef cattle were sold to Pugu secondary market in Dar es Salaam (Mlote et al., 2012), about 1200 km away from fattening places, while the remaining 41.3% were sold to the nearby markets.

Table 4 shows weight gain for the beef cattle fattening business. The average daily gain per animal was found to be 0.646 kg per day or 58.6 kg per animal over the study period of 3.5 months. This compares well with similar findings by Mwilawa (2012) which showed that ADG for Boran beef cattle kept under station conditions in Tanzania was 0.889 kg per day, implying that traditional beef cattle respond to fattening.

Profitability analysis

Farm budget analysis was carried out to assess the profitability of beef cattle fattening enterprises as presented in Table 5. The results reveal that animal purchases for fattening had the highest operating expenses accounting for about 73% of the total variable costs of production. This was followed by feed cost (17.5%) and transportation costs during selling (5.3%). Other costs were below 5% each which included treatment (1.4%), labor costs (1.3%), and transportation costs during purchase of animals for fattening (0.5%), market fees (0.5%), minerals costs (0.3%), permit fees during selling (0.3%) and permit fees during buying (0.2%). Holding pens and or feed storage facilities construction accounted for 76.5% of the fixed costs, while equipment had the least cost of 0.5%. Other fixed costs were feeders' cost (11.3%), drilling of water points (10.2%) and purchase of trolleys (1.5%). During the survey, it was observed that only a few respondents had constructed feed storage facilities and dug water wells for their animals. It was further observed that many of the beef cattle fattening operators did not own land for their fattening enterprises. Consequently, some of the operators conducted their business along the road sides for easy access to the main road as well as water from dams which were created during road construction.

The average gross margin per farmer was Tshs. 12,282,878.27 per year while the net profit was estimated at Tshs.12, 165,871.60. The benefit cost ratio of the entire enterprise was 1.35 thus indicating an additional return of 35 shillings for every one shilling spent on production. The average return on every shilling invested in the beef cattle fattening business (35%) is higher than the prevailing nominal bank lending rate currently standing at 16-20% (Bank of Tanzania-BOT, 2007; World Bank-WB, 2012), implying that beef cattle fattening operators are credit worthy. This finding is higher than the findings made by Mdoe and Wiggins (1997) who reported a 20% return for dairy farming in Kilimanjaro region in Tanzania and the finding of Okuruwa et al. (2005) who found a 28% return on beef cattle fattening in Nigeria. In addition, the positive value of the net profit indicates that cattle fattening business is a profitable venture.

Table 5 also shows that for every kilogram of fattened animal, there was a return of 3,292.47 shillings. This parameter is very important for investors in beef cattle fattening because they can use it to monitor the cost of feeding relative to the animals weight gain. Like any other investor they may wish to know the profit level to be generated and how cost can be minimized. This is particularly important under the increasing competitive business environment as the country moves to promote commercialization of the livestock and agricultural sector in general (MLD, 2006; MLDF, 2011).

The distribution of beef cattle fattening operators by profit levels is summarized in Table 6 and presented in detail in Appendix 1. The table indicates that most of the farmers (46.7%) had a net return of Tanzanian shillings (Tshs) between 1,001,000 and 5,000,000/=, while 23.3% had above or equal to 15,001,000/= Tshs and only 3.3% of the beef cattle fattening operators had profit below zero. The maximum net return was 77,729,200.00 Tshs and the minimum was a loss of Tshs 7,916,500/=. There were no operators who operated at break-even point, that is, TR-TC=0.

Model reliability

The reliability of the regression estimates may be undermined by a violation of the assumptions underlying OLS regression analysis. Any violation of the assumptions (independent variable not being normal distribution, autocorrelation, heteroscedasticity and multicollinearity) make the parameter estimates irrelevant for making inference or extrapolation. Using STATA 10.1 statistical analysis, the model was tested for reliability as

Table 5. Summary of costs, revenue and benefit of beef cattle fattening operators (n=90).

S/N	Description	Total		
1	Number of Animals	5,675		
2	Weight gain per Animal (kg)	58.6		
3	Total Weight gain for the enterprise (kg)	332,555		
	Variable costs (Tshs)	**Tshs**	**Percentage composition**	
4	Cost of Animals (Tshs)	2,303,733,500.00	73.0	
5	Feeds	550,624,516.00	17.5	
6	Minerals	3,110,410.00	0.3	
7	Treatment	43,212,600.00	1.4	
8	Labour	41,249,130.00	1.3	
9	Market fees	16,578,500.00	0.5	
10	Permit-buying	5,540,250.00	0.2	
11	Permit-selling	8,321,550.00	0.3	
12	Trans-buy	16,677,900.00	0.5	
13	Trans-sell	165,697,600.00	5.3	
14	**Total variable costs**	**3,154,745,956.00**	**100.0**	
	Fixed costs (Tshs) depreciated over 5 years			
15	Holding pens/Feed storage	8,053,800.00	76.5	
16	Trolleys	158,400.00	1.5	
17	Feeders	1,187,600.00	11.3	
18	Water points	1,078,600.00	10.2	
19	Equipments	52,200.00	0.5	
20	**Total fixed costs**	**10,530,600.00**	**100.0**	
21	Total costs (FC+VC) (14)+(20)	**3,165,276,556.00**		
	Benefits (Tshs)		**Benefits per farmer**	**Benefits per animal**
22	Revenue (sales from animals)	4,260,205,000.00	47,335,611.11	750,696.92
23	Gross margin (22)-(14)	1,105,459,044.00	12,282,878.27	194,794.55
24	Net profit (22)-(21)	1,094,928,444.00	12,165,871.60	192,938.93
25	Return per shilling Invested (24)/(21)	0.35		
26	Return per kg weight gain (24)/(2)	3,292.47		
27	Benefit-Cost Ratio (TR/TC) (22)/(21)	1.35		

Source: Field Survey (2011/2012).

Table 6. Distribution of beef cattle fattening operators by level of profit (N=90).

S/N	Profit level	Frequency	% Distribution	Max/min
1	<0	3	3.3	-7,916,500.00
2	1,000 - 1000,000	6	6.7	
3	1001,000 - 5,000,000	42	46.7	
4	5,001,000 - 10,000,000	12	13.3	
5	10,001,000 - 15,000,000	6	6.7	
6	≥ 15,001,000	21	23.3	77,729,200.00
	Total	**90**	**100.0**	

Source: Field Survey (2011/2012).

Table 7. Estimated regression model of the profit on several factors affecting profitability in beef cattle fattening enterprises (N=90).

Variable	Exp. Sign	Estimated coefficient	Standard error (SE)	T	P>t	F	Sig. F
Constant	+/-	-12951.92	30604.07	-0.42	0.673	161.3	0.0000
Herd size (X_1)	+/-	-57.62	48.01	-1.20	0.234		
Purchase Price (X_2)	-	-0.98***	0.04	-23.22	0.000		
Transportation costs-purchase (X_3)	-	-5.88***	2.22	-2.64	0.010		
Price of feeds (X_4)	+/-	0.21	12.71	0.02	0.987		
Transportation costs-selling (X_5)	-	-1.25***	0.21	-5.82	0.000		
Selling price (X_6)	+	0.98***	0.03	38.19	0.000		
Age of an Animal (X_7)	+/-	-3912.67	1976.26	-1.98	0.051		
Sex of an animal (X_8)	+/-	-33814.25	22166	-1.53	0.131		
Duration of fattening (X_9)	-	-134.15	145.96	-0.92	0.361		
Labor cost (X_{10})	-	-0.11	0.576	-0.19	0.847		
Adj. R-square					0.9481		

Durbin Watson d-statistics (11, 90) 1.603592; VIF 1.28. Source: Field Survey Data (2011/2012). *** significant at 0.01%.

reported in Appendix 2 and Table 7. The Durbin-Watson test was found to be 1.6 indicating absence of autocorrelation (Green, 1990) and the Variance Inflation Factor (VIF) was found to be 1.28 confirming absence of multi-collinearity among the independent variables and the dependent variable (Gujarati, 2004). The model was tested further for omission of variables and specification error. The Ramsey RESET test, using powers of the fitted values of y, found that the prob >F= 0.8683 is greater than the usual threshold of 0.005, hence the null hypothesis that the model is well specified and did not require the quadratic or higher powers link and that the model had no omitted variables was accepted. The specification errors test revealed a value of p[t]=0.662 for hatsq, therefore the null hypothesis that there was no specification error was also accepted.

The results of multiple regressions are presented in Table 7. As can be seen from Table 7, the sign of the relationships between the dependent variable and all independent variables were as expected. The price of buying animals for fattening (X_2), transportation cost of cattle to be fattened from source to the farm (X_3) and cost of transporting fattened animals to markets (X_5) had a negative correlation while the selling price per fattened animal (X_6) had a positive correlation with the dependent variable. This means increase in price of animals for fattening and transportation costs will reduce profit while increase in price of fattened animals will increase profit and vice versa. The table revealed that variation in profitability of beef cattle fattening is significantly influenced by the price of buying cattle for fattening (X_2), transportation cost from source of cattle for fattening (X_3), transportation cost from fattening farm to cattle markets (X_5), and the price of fattened beef cattle (X_6). The adjusted R^2 of the model was 0.9487 which means the independent variables explain 94.87% of the variation in the profit per animal in the beef cattle fattening enterprises. As seen in Table 7, herd size (X_1), age of an animal (X_7), sex of beef cattle (X_8), duration of fattening (X_9), and labor cost per animal (X_{10}) were found to be statistically insignificant at P<0.05. The feed cost per kilogram (X_4) was also insignificant because in the study area, selling of beef cattle fattening feeds was not based on quality. The duration of beef cattle fattening (X_9) was insignificant because all beef cattle fattening operators had similar fattening duration of 2 to 3 months (93.4%) and almost all the farmers fattened the same type of animals, that is, bulls (97.8%). Labor cost (X_{10}) was also found to be insignificant due to higher utilization of hired and family labor combination (86.7%) in which family labor was not paid for and hence not accounted.

Conclusion

The analysis of profitability of beef cattle fattening in the study area revealed that majority of the operators are realizing positive net income. Only about 3.3% of the respondents incurred net losses. On average, investors were able to get a 35% return for every shilling they invested; this is higher than the current banks' lending rates in Tanzania of between 16 to 20% (Bank of Tanzania-BOT, 2007; World Bank-WB, 2012), indicating that beef cattle fattening operators are credit worthy and that the enterprises they operate are profitable ventures. The prices of animals and transportation cost of animals from their source and fattened animals to the markets were found to be the main factors affecting variation in profit per animal in the study area. This implies that if these factors are optimized, and the beef cattle fattening enterprises are promoted and supported, they will have even greater impact on the incomes and livelihoods of participants as well as improving the country's economy.

RECOMMENDATIONS

Since beef cattle fattening enterprises are a profitable venture, expanding and scaling-up similar enterprises to other parts of the country would hasten the process of transforming the livestock sector which is consistent with the national goal under MKUKUTA II and the second phase of the Agricultural Sector Development Program (ASDP). However, policies to improve the limiting factors for example the transportation means for fattened live beef cattle in order to lower the transportation cost to distant markets like Pugu market in Dar es Salaam are of paramount importance. Furthermore, the pre-dominance of personal savings as a source of investment (87.7%) in the enterprises expansion is limited which possibly limits expansion of the enterprises. Expanding and up-scaling cattle beef fattening should entail providing adequate investment capital to operate so that they are guaranteed by funding through formal sources of credit like co-operative societies and micro-credit institutions.

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Appendix 1. Beef cattle fattening operators' net profit levels (N=90).

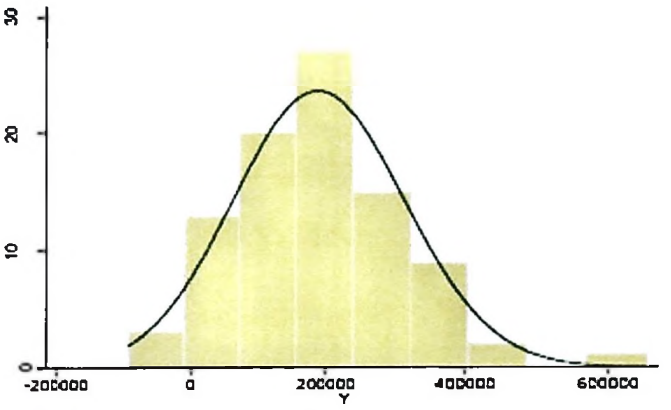
S/N	District	Respondent No.	Profit level (Tshs.)	Mean	Min	Max
		1	2,236,250.00			
		2	153,600.00			
		3	1,574,280.00			
		4	3,273,000.00			
		5	3,914,500.00			
		6	4,743,000.00			
1	Kahama	7	5,614,400.00	12,928,519.29	2,236,250.00	46,365,500.00
		8	6,528,340.00			
		9	9,380,200.00			
		10	12,937,700.00			
		11	14,707,400.00			
		12	32,215,000.00			
		13	41,828,600.00			
		14	46,365,500.00			
		15	380,000.00			
		16	402,100.00			
		17	466,000.00			
		18	785,300.00			
		19	1,034,000.00			
		20	1,209,240.00			
		21	1,215,200.00			
		22	1,296,210.00			
2	Kishapu	23	1,366,000.00	3,951,521.65	380,000.00	31,447,700.00
		24	1,748,200.00			
		25	2,323,550.00			
		26	3,674,892.00			
		27	4,127,900.00			
		28	4,210,000.00			
		29	4,243,200.00			
		30	7,246,376.00			
		31	31,447,700.00			
		32	1,268,600.00			
		33	1,610,500.00			
		34	1,834,499.00			
		35	2,261,580.00			
		36	2,622,600.00			
3	Meatu	37	4,925,000.00	11,884,942.90	1,268,600.00	51,346,250.00
		38	8,702,000.00			
		39	21,666,600.00			
		40	22,611,800.00			
		41	51,346,250.00			
		42	4,625,500.00			
		43	1,781,600.00			
		44	4,547,387.00			
4	Banadi	45	4,646,420.00	134,466,193.33	4,625,500.00	53,805,000.00
		46	5,786,860.00			
		47	10,498,650.00			
		48	12,735,823.00			

Appendix 1 Contd.

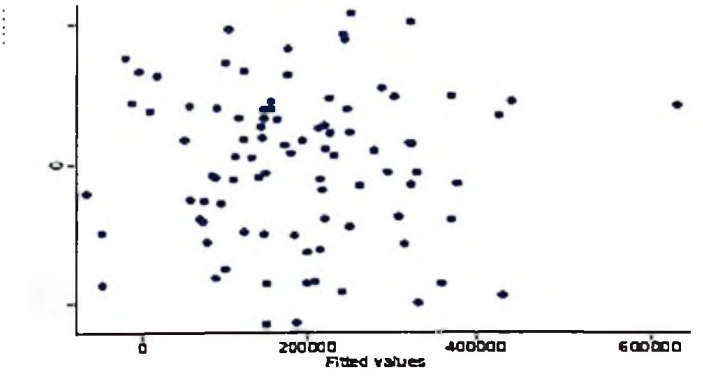
		49	31,839,500.00			
		50	53,805,000.00			
		51	1,218,300.00			
		52	2,918,460.00			
		53	5,754,400.00			
5	Maswa	54	8,719,839.00	21,560,457.00	1,218,300.00	77,729,200.00
		55	10,082,000.00			
		56	44,501,000.00			
		57	77,729,200.00			
		58	7,916,000.00			
		59	2,171,000.00			
		60	2,206,000.00			
		61	2,319,000.00			
		62	2,945,000.00			
		63	3,683,750.00			
		64	4,475,900.00			
6	Nyamagana / Ilemela	65	4,702,600.00	15,654,667.00	7,916,000.00	62,596,000.00
		66	11,728,500.00			
		67	17,576,500.00			
		68	18,479,600.00			
		69	20,506,000.00			
		70	21,155,414.00			
		71	39,333,400.00			
		72	44,512,000.00			
		73	62,596,000.00			
		74	761,700.00			
		75	3,060,000.00			
		76	3,473,300.00			
		77	3,968,000.00			
7	Magu	78	6,077,000.00	13,554,063.00	761,700.00	74,244,400.00
		79	6,851,200.00			
		80	9,996,900.00			
		81	74,244,400.00			
		82	1,361,100.00			
		83	1,471,600.00			
		84	2,408,100.00			
		85	3,050,900.00			
8	Sengerema	86	3,522,600.00	10,784,197.11	1,361,100.00	51,336,174.00
		87	3,562,300.00			
		88	7,118,000.00			
		89	23,227,000.00			
		90	51,336,174.00			

Source: Field Survey (2011/12); USD 1 = 1580/= Tshs.

Appendix 2. Histogram, standardized residual plot and correlation matrix.



Appendix 2a. Histogram of the dependent variable (y)-Profit per animal.



Appendix 2b. Relation between the dependent variable (y-Profit per animal) and the standardized errors.

Appendix 2c. Correlation matrix of all variables used in the regression analysis.

Variable	y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
y	1.000										
X_1	0.033	1.000									
X_2	-0.186	0.299	1.000								
X_3	0.131	0.161	0.082	1.000							
X_4	-0.043	-0.045	0.226	0.016	1.000						
X_5	0.117	0.239	0.254	0.043	0.027	1.000					
X_6	0.724	0.263	0.499	0.225	0.113	0.400	1.000				
X_7	-0.072	-0.141	0.181	-0.209	0.121	-0.045	0.089	1.000			
X_8	-0.037	-0.254	0.020	0.119	0.167	0.092	0.030	0.045	1.000		
X_9	0.016	-0.007	0.020	-0.024	-0.091	0.020	0.041	-0.161	0.022	1.000	
X_{10}	-0.079	-0.238	0.125	-0.111	0.240	-0.008	0.013	0.246	0.074	0.096	1.000

P<0.001.

2.5 Paper IV: Factors affecting Agro-pastoralists and Pastoralist's Willingness to adopt beef cattle fattening in the Lake Zone in Tanzania

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Factors Affecting Agro-Pastoralist and Pastoralists' Willingness to Adopt Beef Cattle Fattening in the Lake Zone in Tanzania

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Abstract

The study investigated the factors affecting Agro-pastoralists and Pastoralists willingness to adopt beef cattle fattening technology in Shinyanga and Mwanza regions of the lake zone in Tanzania. Data were collected from Agro-pastoralist and Pastoralist using structured questionnaire administered to 401 randomly selected cattle keepers. Eight districts were involved; five in Shinyanga region (Kahama, Kishapu, Meatu, Bariadi, Maswa) and three in Mwanza region (Nyamagana, Sengerema, Magu). Data were analyzed using descriptive statistics and binary logistic regression model. Results from this analysis indicate that 93.5% of the respondents were willing to fatten their cattle if given an opportunity, while14.7% had already started to fatten their cattle ranging from 30 to 100 animals per fattening cycle of three to four months. The results further indicated that the major factors influencing adoption of beef cattle fattening were marital status ($p<0.1$), awareness ($p<0.05$) and attitude towards the technology ($p<0.01$). Being married and being aware of the fattening technology increased the likelihood of adoption by 6.3% and 11.3% respectively. Mean while, a one unit change in attitude towards beef cattle fattening increased the likelihood of adoption by 0.3%. The major constraints limiting beef cattle fattening were lack of skills (22.6%), shortage of credit (20.4%), high costs of fattening (17%), limited availability of feeds (14.2%) and lack of infrastructure (e.g. water dam/borehole, roads, cattle dip, veterinary centers)that are adapted for fattening (12.4%).

Keywords: agro-pastoralists, adoption, beef cattle fattening, logit model, pastoralists, willingness to adopt

1. Introduction

Livestock production in Tanzania originates from a large resource base composed of different livestock species, breeds and types whose ownership and distribution differ from region to region. Three livestock production systems are commonly distinguished in the rangeland areas: commercial ranching, pastoralism and agro-pastoralism. Commercial ranching accounts for only 2% of the total cattle herd which is practiced by the National Ranching Company (NARCO). There are also a few (but rising number) private commercial ranches existing in different regions of the country most have few numbers raging from 4 to 330 (Mlote, Mdoe, Isinika and Mtenga, 2013). Pastoralism and Agro-pastoralism represent the traditional herd owned by small scale farmers which accounts for the remaining 98% of total cattle herd in the country. Pastoralism is concentrated in the northern plains of the country and is practiced in traditional grazing areas where climatic and soil conditions do not favor crop production. In this system livestock play a triple role; providing means for subsistence, serving as a store of wealth and a source of cash income. Agro-pastoralism involves cultivation of a range of crops and livestock keeping. This production system is thriving in many parts of the country due to the synergy between livestock and crops. Livestock production in these systems has been increasing at more than 2% per annum (Ministry of Livestock and Fisheries Development-MLFD, 2012). According to the 2007/2008 National Sample Census of Agriculture (NSCA), the number of cattle in Tanzania mainland increased from 16,837,150 in 2002/03 to 21,101,177 in 2007/08 making the country third largest in having stock of cattle in Africa, after Sudan and

Ethiopia; and first in the SADC Region (MLDF, 2011). However, these animals are characterized by low growth rates, high mortality rates, low production and reproductive rates, low off-take rates and poor quality of the final products (meat, hides and skins and milk as a by-product), which makes it difficult for the cattle keepers and traders to access niche markets in the region and beyond (Ministry of Livestock Development-MLD, 2006). Cattle management practices to improve cattle production and productivity such as Artificial Insemination (AI) and beef cattle fattening not practiced in the traditional cattle herd in the country.

Recently, the government has shown interest to improve the traditional cattle herd in order to assist cattle keepers and traders to access niche markets through various interventions that are geared to turn the vast traditional herd of cattle (as well as goats and sheep) into an important revenue generating resource. This entails providing an avenue for actors in the traditional livestock production systems (agro pastoralist and pastoralist) to add value to their animals through beef cattle fattening by improving feed management. This would raise the income of pastoralists and agro- pastoralists, consequently their livelihoods. Such improvement would also facilitate achievement of targets set under the National Strategy for Growth and Reduction of Poverty -NSGRP (MLD, 2006; MLFD, 2011), which are consistent with the Millennium Development Goals (MDGs) in relation to overcoming food insecurity and income poverty.

Since 1990's, the government has made various efforts to provide an enabling environment for commercializing the livestock sector. As a first step, the government formulated a National Livestock Policy of 2006 along with the corresponding Livestock Development Strategy of 2010 and program of 2011. These documents address and articulate the necessary actions for revitalizing the sector. In the cattle sub sector, one of the strategies was to promote private ranching. To facilitate this, the National Ranching Company (NARCO) has subdivided some of its ranches into pieces of 2000-4000 hectares each capable of holding over 120,000 beef cattle and subleased them to local investors for commercial cattle farming. The strategy also entails establishing a system for livestock identification, registration and traceability through the supply chain; and promoting beef cattle fattening through a feedlot system. However, the adoption of beef cattle fattening by supply chain actors has been very low. According to the MLDF (2012) a total of 132, 229 cattle were fattened in 2012 of which 46.6% were in Mwanza, Shinyanga and Kagera regions in the Lake zone. This represents only 0.6% of all the cattle in the country. Thus far, there have been no studies in the country to establish important factors that impede the adoption process. Understanding these factors would also contribute to ongoing efforts to improve the livestock sector in terms of enabling policies as well as technologies which will accelerate transformation of the livestock sector in a manner that it serves as a pathway out of poverty for agro-pastoralists and pastoralists while also sustaining the environment.

This study examined the determinants of adopting beef cattle fattening in Shinyanga and Mwanza regions of the Lake Zone in Tanzania. The specific objectives of the study were (i) to analyze the willingness of agro-pastoralist and pastoralists in the Lake zone to adopt beef cattle fattening (ii) to estimate the number of animals they would be willing to fatten (iii) to determine factors that influence agro-pastoralists' and pastoralists' decision to adopt beef cattle fattening as an alternative or complementary technology in their livestock production system (iv) to determine constraints that limit agro-pastoralist and pastoralist to adopt beef cattle fattening.

The paper is organized in five major sections. In the next section the paper briefly discusses recent development on beef cattle fattening in Tanzania. This is followed by a brief review of technology adoption theory in the third section. The fourth section describes the methodology including the theoretical model and the empirical model in which hypotheses regarding the determinants of whether a farmer adopts beef cattle fattening or not. The rest of the paper discusses the results and presents conclusions and policy implications.

2. Beef Cattle Fattening in Tanzania

Beef cattle fattening is a new technology for smallholder farmers in Tanzania, being practiced by the National Ranching Company (NARCO) farms and few private entrepreneurs in Mwanza, Shinyanga, Kagera, Tabora, Singida, Dodoma, Arusha, Manyara, Rukwa and Iringa regions (MLDF, 2013). Within the Lake Zone, beef cattle fattening started during 1996 when there was shortage of pasture due to recurrent drought (July-December months) and an increasing number of cattle in the area. At the same time agricultural by-products in the form of cotton seed cake and husks were freely available from cotton oil processing plants. Innovative farmers used this opportunity to establish rudimentary feedlots for cattle fattening, using the factory by-products to supplement limited grazing pasture around the site of the established feedlot.

Beef cattle fattening as practices by the innovative entrepreneurs involves buying lean mature animals that are above 4 years old, often from primary livestock markets. These are fed crop by-product (cotton seed cake, cotton

halls, and sunflower seed cake) and local minerals for about two to three months, after which they are sold at secondary livestock markets for higher prices. This has provided significant economic benefits to the entrepreneurs (Mlote et al., 2013). Apart from ensuring food security, beef cattle fattening also provides employment, investment opportunities; manure for sustainable agriculture and income generation through sale of fattened beef cattle from accrued enterprises profits (Mlote et al., 2013).

It would be expected that such returns would attract more followers and late adopters to enter into this seemingly lucrative business. However, as indicated earlier, the beef cattle fattening technology is spreading rather slowly, only 0.6% of the beef cattle herd are fattened cattle in the country. This raises the question: Are there any barriers to entry that can be addressed through policy and institutional changes? Such question calls for the need to investigate factors that limit the adoption of this technology. The technology could provide an assured outlet of cattle from the traditional herd into growing urban and export markets, thereby contributing to reducing poverty among pastoralists and agro-pastoralist in the country.

3. Technology Adoption Theory

Technology adoption involves an effective process that begins when an individual or operator learns about an innovation and ends at the final adoption stage (Hall, Dennis, Lopez, Marshall, 2009). According to Kilima, Mbilla, Erbough, Larson (2010), adoption is defined as a process where potential adopters go through technical evaluation of the technology in relation to the economic and social factors associated with using the technology. This process is often characterized by considerable uncertainty about potential benefits, costs and future profits streams from technology adoption.

Three models are commonly used to analyze technology adoption: innovation diffusion, economic constraints, and the adoption perspective. Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures (Rogers, 1962). Rogers, 1962 defined diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. The origin of the diffusion of innovations theory is varied and spans multiple disciplines. Rogers (1962) espoused the theory that there are four main elements that influence the spread of a new idea: the innovation, communication channels, time, and a social system. This process relies heavily on human capital. The innovation must be widely adopted in order to self-sustain. In the course of adoption, there is a point at which an innovation reaches a critical mass of adopters, which include: innovators, early adopters, early majority, late majority, and laggards (Rogers 1962, p. 150). Diffusion of innovations manifests itself in different ways in various cultures and fields and is highly subjective to the type of adopters and innovation-decision process. The model treats diffusion of technology as a disequilibrium (influenced by market imperfection) or equilibrium (not influenced by market imperfection) process. The disequilibrium process suggests that the number of adopters will increase as information is generated during the implementation phase and spreads to other potential adopters generating an S-shaped diffusion rate curve with time. This increase will occur as long as the stock of knowledge increases, and may eventually decrease as the technology depreciates or become obsolete (Kilima et al., 2010). The equilibrium process assumes innovation diffusion to be asymmetric, which may not always be the case because benefits realized from technology adoption may vary across the firms due to firm size, input costs and the technology sophistication.

The economic constraints model suggests that resource endowments play an important role in technology adoption and that the capacity to adopt new technologies may be affected by limited access to agricultural resources such as human and physical capital (Nzomoi, Byaruhanga, Maritin, Omboto, 2007). Technologies in this case diffuse at different rate based on the relative prices of resources that are needed to support adoption. It is therefore, expected that early adopters would be those with most severe resource constraints, while those with ample or less expensive resources may refrain from doing so particularly in the early stages of adoption (Kilima et al., 2010).

The adoption perspective model suggests that technology adoption is influenced by perception of attributes and other benefits derived from its use. The model aims at soliciting respondents' views about innovations and where possible identifying ways through which these perceptions can be integrated into agricultural research and extension services. However, direct quantification of farmers' perceived utility from adopting new technology has always been difficult. Consequently several studies use estimates of probabilities to adopt technologies as a proxy for preferences (Tamrat, 2007; Hall, 2009; Johnson, Doye, Lalman, Peel, Raper, Chung, 2010; Sulo, Koech, Chumo, Chapng'eno, 2012).

The three models presented above, reveal different causes for technology adoption. However, in many cases, farmers may not adopt a technology for a variety of reasons and therefore it is difficult to pinpoint the model that

most closely reflects farmers' decision making. Thus, the choice of empirical model might suffer from identification problems. The econometric inference problem is to identify factors that influence farmers' decision making. The specification adopted by this study encompasses elements from each of the three dominant models.

4. Methodology

4.1 Theoretical Model

Adoption of specific technologies is an individual producers' decision. A producer's utility from adopting a technology may be modeled as a linear function of the producers characteristics and the attributes of the technology. The probability that a producer will choose to adopt a particular technology is given by the probability that the utility of the alternative is greater than the utility that the producer would gain from any other given alternative. In making the decision to adopt or not adopt the producer chooses the alternative that maximizes utility (Kennedy, 1998). Following Rahm and Huffman (1984), the utility maximization function is specified as:

$$Max(U) = U(FC_{ji}, TA_{ji} \tag{1}$$

where U(.) is the non-observable utility function that ranks the preference of the i^{th} farmer for the j^{th} technology ($\forall j = 1,2$); 1 for improved and 2 for traditional technologies. The FC is defined as farm and farmer specific attributes and TA is defined as other attributes of the innovation that may be unobserved to the analyst but observed and acted upon by the decision maker. The basic assumption in equation (1) is that smallholder farmers perceive the innovation as an optimum course of action to maximize their expected utility and the decision is made in a situation where the decision maker is fully aware of the technology and its attributes. This utility function also assumes that decision makers are able to screen new innovations based on local circumstances. The relation between the utility derived from j^{th} technology is therefore a function of FC, TA and a disturbance term with zero mean. Equation (1) can therefore be presented as:

$$U_{ji} = \alpha_j F_i(M_i, A_i) + \varepsilon_{ji} \ldots\ldots\ldots\ldots \forall (j = 1,2; i = 1,2,\ldots,n) \tag{2}$$

Since the respondents' utilities U_{ji} are random, the i^{th} farmer will select the alternative j=1 when $U_{1i}>U_{2i}$ or the non-observable random variable $Y^*=U_{1i}-U_{2i}>0$

The probability that the farmer adopts an improved technology ($Y_i=1$) is a function of the independent variables and is represented as:

$$\begin{aligned} P_i &= P_r(Y_i = 1) = P_r(U_{1i} > U_{2i}) \\ &= P_r[\alpha_j F_i(M_i, \forall_i) + \varepsilon_{1i} > \alpha_j F_i(M_i, \forall_i) + \varepsilon_{2i}] \\ &= P_r[\varepsilon_{1i} - \varepsilon_{2i} > F_i(M_i, \forall_i)(\alpha_2 - \alpha_1)] \\ &= P_r[\mu_i > F_i(M_i, \forall_i)\beta] \\ &= F(X_i\beta) \end{aligned} \tag{3}$$

Where X is an the n x k matrix of the explanatory variables and β is a k x 1 vector of parameters to be estimated, $P_r(.)$ is a probability function, μ_i is a random error term, and $F(Xi\beta)$ is the Cumulative Distribution Function (CDF) for μ_i evaluated at $Xi\beta$. Equation (3) indicates that the probability that a farmer will adopt an improved technology is a function of the vector of explanatory variables, unknown parameters and the error term.

The function (F) in equation (3) may take the form of a normal, logistic or probability function. Following Pindyck and Rubinfeld (1998) the logistic model uses a logistic cumulative function which always takes values between zero and one to estimate the probability as follows:

$$f(t) = \frac{e^t}{e^t + 1} = \frac{1}{1 + e^{-t}} \tag{4}$$

Viewing t as a linear function of an explanatory variable x, we have:

$$\pi(X) = \frac{e^{(\beta_0 + \beta_1 X)}}{e^{(\beta_0 + \beta_1 X)} + 1} = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X)}} \tag{5}$$

We also define the inverse of the logistic function, the Logit function as:

$$g(x) = ln\frac{\pi(X)}{1-\pi(X)} = \beta_0 + \beta_1 X \tag{6}$$

and equivalently:

$$\frac{\pi(X)}{1-\pi(X)} = e^{(\beta_0+\beta_1 X)} \tag{7}$$

Where;

g(x) refers to the logit function of some given predictor X, Ln denotes the natural logarithm, $\pi(X)$ is the probability that the dependent variable equals 1, β_0 is the intercept from the linear regression equation, $\beta_1 X$ is the regression coefficient multiplied with some value of the predictor, base e denotes the exponential function. The logistic function is useful because it can take as an input any value ranging from negative infinity to positive infinity, whereas the output is confined to values between 0 and 1.

Equation (4) illustrates that the probability of the dependent variable equal to 1, is equal to the value of the logistic function of the linear regression expression. This is important in that it shows that the input of the logistic regression equation (the value of the linear regression expression) can vary from negative to positive infinity and yet, after exponentiation the odds of the expression, the output will vary between zero and one. Equation 6 illustrates that the Logit function (i.e., log-odds or natural logarithm of the odds) is equivalent to the linear regression expression. Likewise, equation 7 illustrates that the odds of the dependent variable being equal to 1 is equivalent to the exponential function of the linear regression expression. This illustrates how the Logit function serves as a link function between the probability and the linear regression expression. Given that the Logit function falls within the interval (1,0), it provides an adequate criterion upon which to conduct linear regression and the Logit function is easily converted back into the odds for adoption.

According to Green (2008) the probability model is a regression of the conditional expectation of Y on X giving the following equation;

$$E(Y/X) = 1[F(\beta' X)] + 0[1 - F(\beta' X)] = F(\beta' X) \tag{8}$$

Since the model is non-linear, the parameters are not necessarily the marginal effects of the various independent variables. The relative effect of each of the independent variables on the probability of adoption is obtained by differentiating equation (8) with respect to X_{ij} resulting into equation (9) (Green, 2008).

$$\frac{\partial P_i}{\partial X_{ij}} = [\frac{\lambda^{\beta' X}}{(1+\lambda^{\beta' X})^2}]\beta = F(\beta' X)[1 - F(\beta' X)]\beta \tag{9}$$

The marginal effect measures the effect on the conditional mean of y of a change in one of regressors say X_j, which provides a good approximation of the amount of change in y resulting from one-unit change in X_k. The goodness of fit in this case is examined using the pseudo R^2 and Mc Fadden R^2 values (SAS, 1994).

4.2 Empirical Model

The study applies the logit or logistic model to estimate factors that affect adoption of beef cattle fattening for pastoralists and agro-pastoralists in the study area. The Logit model was chosen over the probit model because of its simplicity and easy of interpretation in that the logistic CDF is very simple, while the normal CDF involves an unevaluated integral. The inverse linearizing transformation for the Logit model, $[\wedge^{-1}(\pi)]$, is directly interpretable as a log-odds, while the inverse transformation for probit $[\Phi^{-1}(\pi)]$, does not have a direct interpretation. Furthermore, the Logit model is a standard method for understanding the association between explanatory variables and a binary dependent variable (Green, 2003).

Logit model was used in this study to determine factors that influence adoption of cattle fattening technology. The dependent variable in this case was the willingness to adopt beef cattle fattening technology, denoted as "y", while the hypothesized independent variables were age, gender, marital status, household size, education level, herd size, attitude of the household head, awareness on beef cattle fattening, main source of income and location of the respondents. The explanatory variables were selected on the basis of the three models used to analyze technology adoption as described in section 3.0 above. The effect of each of these variables on the respondents' decision to adopt or not to adopt beef cattle fattening in the study area is discussed in the next section.

According to Akudugu, Guo, Dadzie (2012) age is an important factor that influences the probability of adoption of new technologies because it is said to be a primary latent characteristic in adoption decisions. However, there is contention on the direction of the effect of age on adoption. Previous studies which examined the role of age on adoption, found that the age of the household head could have a negative or positive effect on technology adoption because as age increases farmers become more risk averse and hence less willing to adopt new technologies signifying a negative influence on adoption (Hall et al., 2009; Kilima et al., 2010; Johnson et al., 2010; Qualls, 2011; Jing-na & Lu-tang, 2012; Howley, Donoghue, & Heanue, 2012). On the other hand, it was found that, as farmers' age increases, they accrued experience and became more aware of benefits associated with improved technologies and hence had positive influenced on technology adoption (Sajjad, Saif, Humayoun, 2009, Ward et al., 2008). Age in this study was assumed to influence the choice to engage in beef cattle fattening through experience in livestock rearing in relation with the socio-cultural roles prevailing in the study area. Age in a traditional society is an important indicator of one's position in society. Older agro-pastoralists are more deeply attached to traditional ways of rearing cattle than younger agro-pastoralist. In this study, the age of the household head (measured in years) is hypothesized to be negatively related with the adoption of beef cattle fattening.

The role of gender and marital status in technology adoption are contentious issues in the adoption literature. The literature suggest that women's role in agriculture production is increasingly important particularly as the number of female headed households in the rural areas of Sub-Saharan Africa increases (Kilima et al., 2010). Gender was a more pronounced characteristic in the study area where men are the main decision makers and women were decision maker only if were divorced or widowed and hence this variable was hypothesized to be positively influenced. Marital status is another increasingly important variable that may impact on technology adoption. Married couples tend to support each other in making decision, making them more likely to accept the positive side of new and emerging technologies. Married head of households are also expected to have more resources. This variable is expected to be positively associated with the adoption of new technologies.

Household size is another important variable in explaining technology adoption. Agro-pastoralists and pastoralist use family labor for most of the activities related to livestock rearing (grazing, watering, trekking, milking, tending to calves, treatment etc.). Most of the livestock management activities are easily done by family members (Tamrat, 2007). For this reason, large families are desirable. Adopting beef fattening introduces an additional activity into the family. It would be expected that larger families would be more easily inclined to adopt than smaller families. Family size takes a continuous value measured by the number of members within the households. Family size is hypothesized to have positive influence on decision to beef cattle fattening.

The level of education of households' heads is assumed to increase the ability to obtain, process, and use information relevant for adopting of beef cattle fattening. The education level of the respondents was a continuous variable which, ranges from zero to post-college education and it is a continuous variable. According to Kafle, (2010) and Dzadze, Osei, Aidoo and Nurah, (2012), the level of adoption was found to be positively influenced by the level of education. Ward et al. (2008) also found a positive and significant association between age, education and income from beef farming and adoption of technology. Contrary to previous research findings, education levels did not always had a positive impact on adoption probabilities, Interestingly, Johnson et al., (2010) found that education levels beyond a high school education negatively influenced the use of futures, options and/or cash contract. Based on previous studies, education is assumed to have a direct and positive influence on adoption of beef cattle fattening technology.

The number of Livestock Units is a proxy of the farmers' wealth and as such relates directly to their investment capacity to adopt new technologies (Kaliba et al., 2000). In this study, the number of livestock units or Tropical Livestock Unit (TLU) was assumed to take a continuous value, was calculated as prescribed by Tamrat (2007). Accordingly one (1) TLU is equivalent to one cattle of approximately 250 kg or above, 5 calves, 5 goats/ sheep. The total number and type of livestock species within a household within a village is a proxy of their relative wealth status (relative to other villagers). It is expected that households with larger TLU would be more inclined to take risks, such as venturing into adopting new technologies, including beef fattening. It is therefore expected that agro-pastoralists with higher TLU to be willing to accept beef cattle fattening, thus a positive coefficient is expected for this variable.

Past studies have established significant and positive relationships between awareness and adoption of technologies (Hall, 2009, Emukule, Ngigi, & Guliye, 2011; Al-Hassan, Egyir, & Abakar, 2013). A study by Prokopy, Floress, Klotthor-Weinkauf, Baumgart-Getz, 2008 indicated that education levels, capital, income, farm size, access to information, positive attitudes, awareness and utilization of social networks are generally positively, associated with the adoption of best management practices. Further more, an analysis of the use of Artificial Insemination (AI) for Ugandan dairy farmers revealed that the farmer's age, years of awareness of the AI

technology, total farm milk production and sales, extension visits per year, and quality of AI services provided to the farmers were positively associated with adoption and use of AI technology (Kaaya, Bashaasha, & Mutetikka, 2005). Based on such previous studies, it is hypothesized that awareness on beef cattle fattening in the study area positively influence the adoption of beef fattening technology.

Attitude measures the degree of liking or disliking an individual has towards an object, idea or practice. The level of attitude towards beef cattle fattening was measured using a total attitude score of agro-pastoralists and pastoralists, which is continuous. Responses to a sample of questions in relation to beef cattle fattening were collected following a five point Likert type attitude scale. Negative statements were rated from one (1) for strongly disagree to five (5) for strongly agree. Then the total attitude score was worked out for each respondent and used for analysis. The sum of all responses for a respondent constituted a total score which characterized the respondent. Based on the aggregate score, an agro-pastoralist's and pastoralist' attitude towards beef cattle fattening was expected to be either positive or negative. Each respondent's attitude score was used as an independent variable in the Logit model.

The location of operations has been found to influence positively the adoption of technology (Sulo et al., 2012). Hall et al. (2009) found that location was positive and statistically significant (P=0.087) indicating that growers in the Midwest were 4.72 times more likely to adopt sustainable practices than other growers in other parts of the United States. According to Mlote et al. (2013) most of the beef cattle fattening operators in the Lake Zone in Tanzania are located in the rural areas (53.3%) while 25.6% and 21.1% are located in urban and peri-urban respectively, often operating along the road side for easy access to services such as water and transport. In this model, the location of an enterprise is hypothesized to positively influence the adoption of beef cattle fattening.

Dependency on an activity as main source of income has positive influence on adoption of technology associated with that activity (Sulo et al., 2012; Johnson et al., 2010). According to Johnson et al. (2005) dependency on income from stocker positively impacted the probability in stocker operation where producers dependent upon income generated from stocker operation were 8.2% more likely to have long-term business plan. Vestal (2005) found producers depending on cow-calf income to be more likely to have a cow-calf business plan. In the study area, livestock is a major source of income. Thus the dependency on livestock as the main source of income was hypothesized to influence positively the adoption of beef cattle fattening technology.

The empirical model to assess factors that influence a respondent's willingness to adopt beef cattle fattening was therefore expressed using a binary regression as follows:-

$$y = \begin{bmatrix} 1: adopted \\ 0: Otherwise \end{bmatrix} \tag{10}$$

Following Garson (2009) and equation 6 above, the prediction equation is expressed as follows:

$$\begin{aligned} y &= ln(odds(adopted)) \\ &= ln\left(\frac{prob(adopted)}{prob(otherwise)}\right) \\ &= ln\frac{(prob(adopted))}{[1-prob(adopted)]} \\ &= \beta_0 + \beta_1 X_1 + ... + \beta_K X_k \end{aligned} \tag{11}$$

Thus, the analytical model can be expressed as follows:

$$\begin{aligned} Y = {} & \beta_0 + \beta_1 age + \beta_2 gend + \beta_3 marit + \beta_4 hhsize + \beta_5 edu + \beta_6 herdsize \\ & + \beta_7 altitude + \beta_8 aware + \beta_9 msi + \beta_{10} loc + \varepsilon \end{aligned} \tag{12}$$

Where;

Y is the probability of adoption; β_0 constant term, $\beta_1 .... \beta_{10}$ are coefficients to be estimated, ε is error term.

Equation 12 was run using STATA 10.1 to analyze the probability of adopting beef cattle fattening against the explanatory variables. Table 1 below summarizes the descriptive statistics of these variables.

Table1. Description of Variables used in the binary logistic model

Variable type	Description	How variable was inputted	Mean	Std
	Dependent			
Explained variable	Willingness to adopt beef cattle fattening (y)	Yes=1; No=0	0.94	0.2
	Independent			
Characteristic of farmers	Age of the respondent (age)	Number of years	51.6	13.3
	Gender (gend)	1=Male; 2= Female	1.2	0.4
	Marital status (marit)	1=Married; 0= otherwise		
	Household size (hhsize)	Number of family members	15	9.9
	Education level of household head (edu)	Year of schooling	4.7	3.3
Technological induction factor	Herd size or number of livestock (Herdsize)	Livestock Units	116.3	196.5
Attitude factors towards beef cattle fattening (Alt)	Livestock should be fattened first before selling in order to get higher prices	Strongly disagree=1; Strongly agree=5		
	A few productive animals can provide higher income than many unproductive animals	Strongly disagree=1; Strongly agree=5		
	The number of animals is the most important way to accumulate of wealth	Strongly disagree=1; Strongly agree=5	29.1	7.9
	Commercial selling of livestock predispose towards poverty	Strongly disagree=1; Strongly agree=5		
	Young and immature animals should be sold to get good profit	Strongly disagree=1; Strongly agree=5		
	Commercial selling of livestock is a way to become rich	Strongly disagree=1; Strongly agree=5		
	Decision to sell animals should be restricted to unproductive animals-barren	Strongly disagree=1; Strongly agree=5		
Other factors	Awareness about beef cattle fattening (aware)	Yes=1; No=0	0.96	0.2
	Main source of income (msi)	1= Livestock; 0= otherwise	0.27	0.5
	Location of the respondents (loc)	1=Urban; 0=otherwise	0.89	0.3

4.3 Study Location and Data Collection

Data for this study were collected from Agro-pastoralists and Pastoralist in Mwanza and Shinyanga regions in the Lake zone in Tanzania where according to MLDF (2012) beef cattle fattening is mainly practiced in the country. Geographically, Mwanza region lies between latitudes 1°30'3" South of Equator and 31° 45'34" East of Greenwich, while Shinyanga region is located at 03°39'43" South and 33°25'23"East. The sampling frame included all Agro-pastoaralist and Pastoralist in the selected districts of Magu, Nyamagana and Sengerema in Mwanza region and Kahama, Kishapu, Meatu, Bariadi and Maswa districts in Shinyanga region as shown in Figure 1. The list of agro-pastoralist and pastoralist was obtained from the respective village registration book, from which 401 respondents (50 respondents from each district except one district where there were 51 respondents) were randomly selected. Global Positioning System (GPS) devices were used to geo-reference all points where the interviews were held.

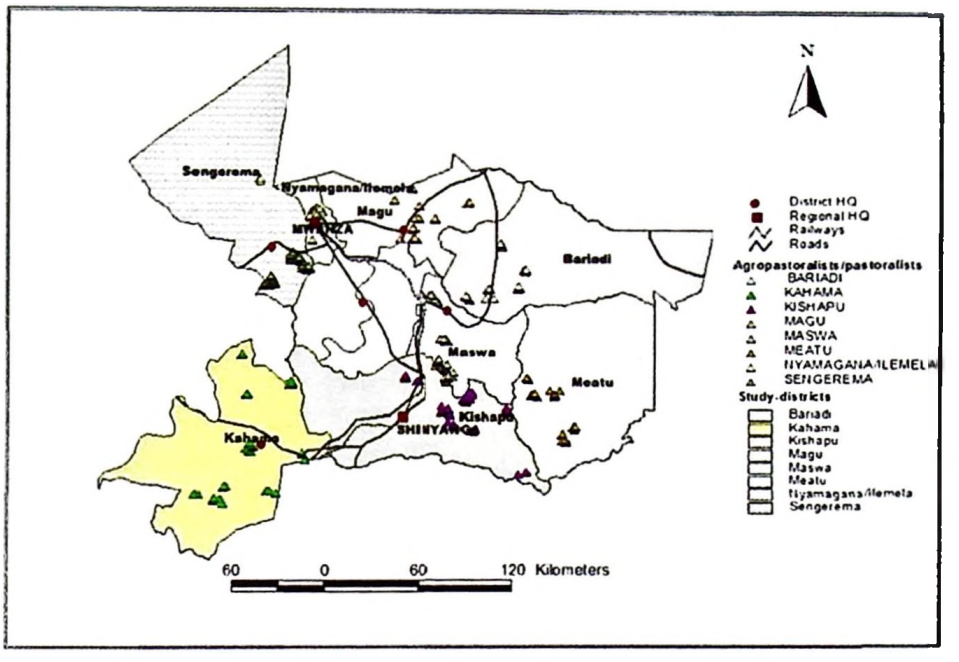

Figure1. Location of Agro-pastoralists and Pastoralists in the study area

A structured questionnaire which included questions for the Likert scale and open-ended questions in relation to the respondents' personal characteristics, awareness and sources of income was used to collect data through face to face interviews. Within the Lake zone, most of the beef cattle fattening activities are conducted during the dry season. Field data were therefore collected by the principal researcher during the dry season between July and September, 2011, with the assistance of local experienced interviewers who were adequately trained prior to the surveys.

5. Model Evaluation

Data for this study are cross-sectional and are more likely to be affected by heteroskedasticity. Two methods were used to determine whether or not the data were heteroskedacitic. First, a visual inspection was conducted by plotting the residuals against the fitted values. The scatter graph indicated non-constant variances. The Breusch-Pagan test was then applied to the data as a post-estimation test of an OLS regression model under the null hypothesis that there was constant variance or no heteroskedasicity. The test rejected the null hypothesis ($Chi^2(1)=372.71$ with prob $Chi^2=0.0000$)) for adopting beef cattle fattening, indicating that there was a problem of heteroskedasticity. To improve the efficiency of hypothesis testing, heteroskedasticity-robust variances were used to calculate robust standard errors for correcting the problem (Green, 2000).

The multicolinearity problem was tested using the variance inflation factor (VIF) and results indicated that VIF values were below the minimum threshold of 5 with a mean VIF of 1.27 which indicates that there was no multicolinearity problem.

6. Results and Discussion

6.1 Demographic Characteristics of Livestock Farmers and Operations

The agro-pastoralists and pastoralists age were above 20 years old with the majority (49.6%) being between 20 to 61 years old and were predominantly male (84.54%). Most of them had primary education (60.6%), while 24.7 percent had not attended school at all, 8.48% had an adult education, 5.74 had secondary education and only 0.5% had college education. The majority of the agro-pastoralists/pastoralists were married (90.27%) (Table 2).

Table 2. Demographic Characteristics of Respondents (N=401)

	Number of Respondents	(%)
Age of respondents (years)		
20 to 40 years	95	23.7
41 to 60 years	199	49.6
>61years	107	26.7
Sex		
Male	339	84.5
Female	62	15.5
Education level		
Not gone to school	99	24.7
Adult education	34	8.5
Primary Education	243	60.6
Secondary Education	23	5.7
College/University	2	0.5
Marital status		
Married	362	90.3
Single, divorced or widowed	39	9.7

About 88.5% of the respondents came from rural areas (Table 3). More than two thirds (70.3%) of the respondents reported crop production as their main source of income, while 26.9% largely depended on livestock as the main source of income. Employment and other sources of income accounted for less than 1.75% (Table 3). Most of the respondents reported their occupation to be crop farming (94.26%) followed by employment (8%), businessmen (8%), while 7% of the respondents reported to have no other business apart from livestock (Table 3). Close to one half of the respondents (47.13%) had herd size or livestock unit of over 100 animals, 25.94 percent of the respondents had herd size between 51 and 100 animals while 26.93% of the respondents had herd size equal to 50 animals or below (Table 3). According to National Bureau of Statistics (NBS) which is responsible for national census in the country, large scale livestock farmers involves all farmers who own 50 animals and above, while small scale farmers are those owning animals below 50. This means 74.06% of the respondents in the study area were large scale farmers who would be expected to adopt new technologies (Kaliba, Verkijl, & Mwangi, 2000).

Table 3. Demographic Characteristics of Respondents' operation (N=401)

Item	Number of respondents	(%)
Location		
Urban	46	11.57
Rural	355	88.53
Main source of Income		
Livestock	108	26.93
Crops	282	70.32
Employee	7	1.75
Others	4	1.00
Occupation		
None	7	1.75
Employee	8	2.00
crop farmer	378	94.26
Business man	8	2.00
Herd size		
≥ 50 animals	108	26.93
51 to 100 animals	104	25.94
≤101 animals	189	47.13

Overwhelmingly, 95.5% of the respondents had heard about beef cattle fattening (Table 4). The majority (93.5%) also viewed beef cattle fattening as "very important" especially this time when agro-pastoralists and pastoralists are under pressure for resource degradation caused by world climatic change leading to limited grazing land for animals and hence, they said "yes" they would like to adopt beef cattle fattening if given an opportunity. The main reason is that desertification, which is now accelerating in Sub-Saharan Africa at a rate that is more rapidly than before (Tamrat, 2007), a situation calling for change in livestock management systems. Out of the 93.5 percent of the respondents who indicated willingness to fatten beef cattle, 14.7 % had started fattening their cattle already (Table 4). The majority of the respondents (78%) who started fattening beef cattle indicated to have capacity to fatten up to 30 animals per fattening cycle of two to three months, while 13.6 percent of the respondents indicated to have capacity of fattening up to 50 animals. The remaining 8.4 percent of the respondents indicated to fatten animals up to 100 (Table 5).

Table 4. Awareness and adoption of beef cattle fattening (N=401)

Item	Number of respondents	Percent of total
Aware about beef cattle fattening	383	95.5
Aware and willing to adopt fattening if given an opportunity	375	93.5
Aware and started fattening without any assistance	59	14.7

Source: Field Survey, 2011/2012.

Table 5. Capacity of Agro-pastoralists/pastoralists to fatten beef cattle (N=59)

Beef cattle fattening capacity	Frequency	Percent
1 to 30 animals	46	78
31 to 50 animals	8	13.6
51 to 100 animals	5	8.4
101 to 200 animals	0	0
Total	59	100

Source: Field survey, 2011/12.

6.2 Constraints to Beef Cattle Fattening

The respondents were also asked to indicate and rank constraints limiting them from practicing beef cattle fattening in their locality. The first ranked problem was lack of fattening skills (22.8%) followed by low availability of credit (20.5%), high fattening costs (17.1%), availability of beef cattle fattening feeds (14.2%), equipped area for fattening (12.5%) and other factors which were below 5 percent as shown in Table 6.

Table 6. Responses on constraints and challenges associated to the adoption of beef cattle fattening by percentage and ranks (N=401)

Constraint	Frequency	(%)
Lack of fattening skills	144	22.8
Lack of credit	130	20.5
High costs of fattening	108	17.1
Limited availability of feeds	90	14.2
Lack of equipped area for fattening	79	12.5
Long distance to beef cattle fattening feeds	20	3.2
High transport costs	18	2.8
Lack of awareness creation	15	2.4
High treatment costs	10	1.6
Prevalent of livestock diseases	5	0.8
Shortage of extension officers	5	0.8
Tediousness of fattening activity	5	0.8
Lack of FMD vaccination	3	0.5
Lack of markets for fattened beef cattle	1	0.2
Total		100

Source: Field Survey 2011/12.

6.3 Determinants for Agro-Pastoralists/Pastoralists Willingness to Fatten Beef Cattle

The binary logistic model estimated to determine whether the agro-pastoralists/pastoralists are willing to adopt beef cattle fattening against explanatory variables of demographic characteristics, technological factors, agro-pastoralists attitudes and other factors along with the marginal effects are presented in Table 7. The model was significant (χ^2=45.65, P=0.0000) correctly predicting 69.5% of the observations. The McFadden's pseudo R^2 was 0.2781. This is within the highly satisfactory range of 0.2 to 0.4 (Langer, 2000).

Table 7. Estimates of logit model explaining factors affecting adoption (N=401)

Variable	Coefficient	S.E	z	P-value	Marginal effects (dy/dx)
Age	-0.015	0.02	-0.72	0.471	-0.015
Gend	1.278	0.839	1.52	0.128	0.033
Marit	1.376*	0.767	1.8	0.073	0.063
Hhsize	0.003	0.032	0.11	0.916	0.000
Edu	-0.079	0.082	-0.97	0.334	-0.002
Herdsize	-0.001	0.001	-0.64	0.523	0.000
Aware	1.852**	0.903	2.05	0.040	0.113
Attitude	0.152***	0.025	6.06	0.000	0.004
Msi	1.446	1.251	1.16	0.248	0.073
Loc	0.534	0.64	0.83	0.404	0.017
Constant	-6.012	2.765	-2.17	0.030	

Wald $Chi^2(10)$=45.65; Prob>Chi^2=0.000; Pseudo R^2=0.2781; Log pseudo likelihood=-69.494339;

*, **, *** indicates significance levels at 0.1, 0.05 and 0.01 respectively.

The results in Table 7 indicate that all variables had the expected signs as it was hypothesized in the methodology section, except education which had a negative sign. The negative sign for education can be explained by the fact that, educated people in the study area were rarely involved in livestock keeping. About 93.77% of the respondents in the study area were either standard seven or below (Table 2). Three variables; marital status, awareness and attitude had a significant effect on the probability of a respondent adopting the technology. A respondent's marital status had a significant positive effect on the likelihood and magnitude of beef cattle fattening adoption. This result is consistent with Kilima et al. (2010) who found marital status to have a significant effect on adoption of improved agricultural technologies by smallholder maize and sorghum farmers in central Tanzania. If the household head was married, the probability of adopting beef cattle fattening technology rose by 0.063(6.3%). This means a married couple is more likely to adopt beef cattle fattening technology than singles.

The significant and positive coefficient for awareness results is a sign which implies that; creating awareness among agro-pastoralist and pastoralists regarding beef cattle fattening would increase the likelihood of adoption by 0.113 (11.3%). This means that creating awareness is an important factor for scaling up this technology. This finding is consistent with the findings by Emukule et al. (2011) who established that the respondents' awareness about the product was positive and significantly influenced their willingness to pay for camel milk in Nakuru District in Kenya.

The agro-pastoralists attitude towards beef cattle fattening was also positive and significant at P<0.01 as hypothesized indicating that the attitude of agro-pastoralists and pastoralists positively influence the adoption of beef cattle fattening technology in the study area. The marginal effects for attitude indicate that a unit change in attitude towards beef cattle fattening would increase the probability of adopting beef cattle fattening technology by 0.3%.

Age, Gender, Household size, Herd size, Main source of income and the location of respondents though had the expected sign as hypothesized in the methodology section, but, they did not have any significant effect on adopting beef cattle fattening technology in the study area.

7. Conclusions and Policy Implications

The findings of the study suggest that 95.5% of agro-pastoralist and pastoralists are willing to adopt beef cattle fattening, 14.7% out of that had already started fattening their cattle, ranging from 30 to 100 animals per fattening cycle of three to four months. The results of Logit analysis show that a respondent's decision to adopt beef cattle fattening was strongly influenced by their marital status, their awareness and attitude towards cattle fattening. Therefore the hypothesis that awareness and positive attitude of the respondents towards beef cattle fattening will significantly influence adoption decision is accepted. A number of constraints limited the adoption or expansion of beef cattle fattening in the study area. These were lack of beef cattle fattening skills (22.8%), lack of Credit (20.5%), high costs of fattening (17.06%), low availability feeds (14.22%), inadequate facilities and equipment at fattening sites (12.43) among others as indicated in Table 6.

The adoption of beef cattle fattening by agro-pastoralist/pastoralists is expected to improve the beef cattle value chain not only to the Lake Zone regions, but also to the whole country and that the actors along the chain including the producers and consumers are going to benefit significantly (Mlote et al., 2013). These are farmers who have information (aware) about beef cattle fattening and they have a positive attitude towards about it. This study provides enough bases for researchers and policy makers within the Ministry of Livestock and Fisheries Development to conduct further research geared towards designing, promoting and helping to develop a vibrant and effective sub-sector of beef cattle fattening. Policy guidance may include guideline in order to facilitate the specific target groups to engage in beef cattle fattening enterprises.

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CHAPTER THREE

3.0 SYSTHESIS OF THE FINDINGS

This chapter synthesizes the main findings and implications of the four studies presented in Chapter Two which forms the focus of this thesis. The overall objective of the study as presented in Chapter One was to examine the economic viability of beef cattle fattening in the traditional cattle supply chain as a means of increasing income to cattle keepers and other actors in Tanzania. The specific objectives were to; (i) Analyze the supply chain strands for beef cattle so as to identify key actors and their relationships, challenges and opportunities for beef cattle fattening; (ii) Examine the technical efficiency and profitability of beef cattle fattening; and (iii) Determine factors that influence pastoralist and agro pastoralist's willingness to adopt beef cattle fattening technology for scaling up.

3.1 Findings in Relation to Specific Objective I

As indicted above, the first objective was to analyze the beef cattle supply chain so as to identify key actors and their relationship, challenges and opportunities. The findings of the analysis in relation to this objective as presented in paper I revealed that two supply channels existed for domestic beef cattle markets in the study area. The first was a direct channel where traders bought beef cattle from agro-pastoralists and pastoralists at primary markets for sale at profit to butcher operators. The second channel involved value addition through fattening where beef cattle operators bought cattle from agro-pastoralists and pastoralists at the primary markets or secondary markets and then kept them in feedlots for about three months as reported by 93.4% of the respondents. These animals are thereafter sold to exporters of live animals after the animals had gained weight or had been reconditioned. It was also observed

that, agro-pastoralists and pastoralist sold their animals in the primary livestock markets only when need for cash aroused. As a result, animals were sold at 5-7 years old or above, being of low value in terms of juiciness and tenderness (Prost *et al.*, 1975; Shackelford *et al.*, 1995; Kim *et al.*, 2007).

The key actors in the beef cattle supply chain were found to include: the agro-pastoralists and pastoralists, traders, butcher operators, retailers, service providers and consumers. The agro-pastoralists and pastoralists played the primary function of raising beef cattle up to the next level of the supply chain. Traders are involved in the beef cattle supply chain, purchasing cattle from agro-pastoralists through primary markets (97.6%) or directly from the producers (2.4%) with the purpose of reselling in other auctions or to butcher operators at higher prices. Two main types of traders were identified in the study area. The first type involved traders who bought relatively healthy and heavy animals from producers and re-sold the animals to other cattle buyers or butcher operators without fattening. The second type involved traders who bought lean or weak cattle from primary producers for the purpose of fattening (adding value) before re-selling to export or niche local markets. The butcher operators engaged with all actors in the supply chain, buying animals from farmers and traders at primary or secondary markets for immediate slaughter. Another category of actors involved the middlemen who bought cattle from farmers or traders and sold them at the same location by taking advantage of time and information asymmetry since they could buy an animal from one seller and immediately sell to another trader at a profit. Retailers were those actors who were involved in buying carcasses from butcher operators for distribution to supermarkets and other meat shops. The service providers included; stockists who supplied drugs and acaricides like super dips, ginners who owned ginneries that produced animal feed ingredients such as cotton seed cake and cotton

husks, and transporters who transported animals from one point to another. Government institutions provided extension services, while consumers were the end user of the product in the supply chain.

As already reported earlier, results of this study indicated that spot-market relations among the supply chain actors were the most common phenomena in the beef supply chain. There were no persistent network relationships or contractual agreements practiced among actors. Interactions in the supply chain only involved making transactions such as negotiations on price and the number of animals being sold, confirming underdevelopment of the supply chain. The absence of collaboration among the actors minimizes their potential to improve their business and hence increase their income.

This supply chain was characterized by low value addition among the Agro-pastoralists and Pastoralist but some value addition was practiced by a few enterprising individuals who engaged in cattle fattening (Paper I). The value addition supply chain channel emerged as a result of rising demand for quality beef and live animals requirements from neighboring countries of Kenya, Comoro and Middle East, but also in the local market. Value was added through supplementary feeding using agricultural by-products (cotton seed cake, cotton husks, maize bran and sunflower seed cake) to lean cattle purchased (Figure 2) from Agro-pastoralists and Pastoralists in order to increase the productivity and quality of beef cattle (Figure 3).

Fattened beef cattle are targeted for export markets while the local market is mostly supplied with cattle that are not fattened. Under the current marketing system the corresponding gross margins accruing to different actors differ also across the market chain. For example the

analysis revealed that the gross margin for beef cattle fattening operators was about 20.2% of the sale value of the fattened animals, almost twice as much as the corresponding GM for cattle that are not fattened which was only 11.2%. This implies that value addition through beef cattle fattening increases margins and hence has the potential of increasing income if this technology is adopted and operationalized directly by Agro-pastoralists and Pastoralists.

Figure 2: Lean animals being fed with concentrates using different designs of feeders

Figure 3: Fattened beef cattle ready for transport to export markets.

Considering the challenges that actors face in the livestock market chain, efforts to scale up beef cattle fattening for wider adoption by agro-pastoralists and pastoralists should also address other problems which the beef cattle fattening operators currently face. Apart from lack of specific area for fattening and limited availability of feed stuff, they also face high cost of inputs and lack of credit to operate their business. In addition, lack of fattening skills is a major challenge faced by agro- pastoralists and pastoralists. The government has made some efforts to formulate a National Livestock Policy and its strategies which address and articulate the needs of revitalizing the sub sector and now the formulation of livestock development program. These efforts however are not yet bearing tangible results. Livestock marketing facilities including water facilities (Figure 4), storage facilities (Figure 5), holding pens (Figure 6) and means of transportation (Figure 7) are still poor. Farmers are also facing problems to access credit from financial institutions.

Figure 4: Water facilities in the study area.

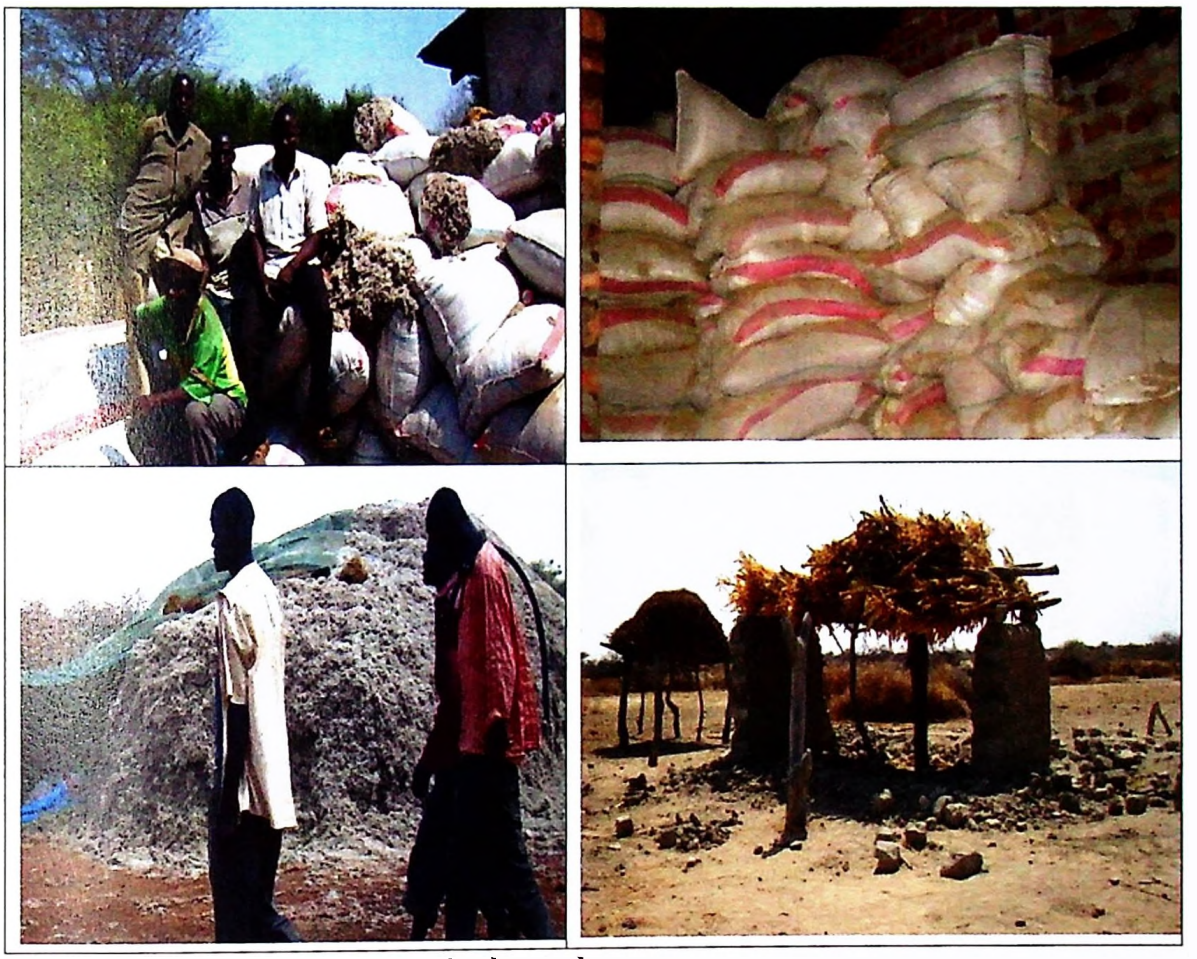

Figure 5: Animal feeds storage in the study area.

Figure 6: Beef cattle fattening holding pens

Figure 7: Transportation of fattened beef cattle to Pugu Market in Dar es Salaam

Despite these challenges there are opportunities for developing a vibrant beef cattle value chain in the study area and in the country as a whole. The domestic market and regional market prospects for beef and livestock by-product is bright as evidenced by high demand of live animals in neighboring countries and the growing population within the country, which currently stand at 44.9 million and growing at 2.7% per annum (NBS, 2013).

3.2 Findings in Relation to Specific Objective II

The second objective of the study was to analyze technical efficiency and profitability of beef cattle fattening. Results of the analysis of technical efficiency are presented in Paper II while the results of the profitability analysis are presented in Paper III. The results of technical efficiency analysis using a stochastic frontier production function for the supply chain of fattened beef cattle gave an average efficiency score of 91%. The majority (83%) of the beef cattle fattening operators were efficient (between 80%-98%) but the technical efficiency level ranged between 48% and 98%, showing that there was still room for improving technical

efficiency among farmers who were not operating efficiently. Only one beef fattening operator had an efficiency score below 50% of the technical efficiency level and only three fattening operators had efficiency scores between 51% and 79%. In the analysis of factors influencing technical efficiency, experience, ethnicity, access to credit, extension services and education of cattle fattening operators were found to be the major factors that had significant positive effect on efficiency.

These findings have important implications for improving beef cattle fattening in the study area. Firstly, the significant and positive influence of experience and the ethnicity of cattle fattening operator on efficiency suggest that operators with experience of keeping cattle and those whose ethnic group are traditionally cattle keepers have acquired technical skills on proper cattle shed construction and management, feeding and disease control. These factors are necessary for raising a healthy cattle herd. Secondly, the positive and significant influence of access to credit suggest that policies that will improve access to credit from government or non-government organizations would increase the cattle fattening operators' ability to acquire better technologies such as better cattle breeds and feeds through acquisition of mini to medium ranches where pastures could be improved and herd size expanded with a potential of increasing productivity for domestic and export market. Thirdly, the significant and positive influence of education and extension services suggest that providing appropriate knowledge and skills through education coupled with field extension services would facilitate better use of available cattle fattening technologies by the operators who are currently operating inefficiently.

The budgeting analysis (Paper III) showed positive net profit for most of the sampled cattle fattening operators, indicating that beef cattle fattening is a profitable venture. The average net farm income was TZS 12 165 872 equivalent to USD 7699 per fattening operator per year or USD 21per day equivalent to TZS 33 760 per day, much higher than the prevailing rural daily wage range of TZS 800 to 1600 per day at the time data were collected from the study area. This return is also higher than the average per capita income of USD 570 per year for Tanzania (WB, 2012). About 46.7% of the fattening operators had a net return of TZS between 1 001 000 and 5 000 000, while 23.3% had above or equal to TZS 15 001 000 and only 3.3% of the beef cattle operators had profit below zero. The maximum net return was TZS 77 729 200 and the minimum was a loss of TZS 7 916 500. The benefit cost ratio of the entire enterprise was 1.35, indicating that for every shilling invested in beef cattle fattening, there was a return of 35% and TZS 3 201 per kg of weight gain. The return per shilling invested is higher than the current bank lending rates of 16-20% operating in the country (BOT, 2007; WB, 2012), indicating that beef cattle fattening operators are credit worthy. This net return is higher than the findings established by Mdoe and Wiggins (1997) who reported a 20% return for dairy cattle farming in Kilimanjaro region in Tanzania and another finding by Okuruwa *et al.*, (2005) who found a 28% return in beef cattle fattening in Nigeria.

Analysis of factors influencing profitability of cattle fattening indicated that the prices of buying cattle for fattening, price of selling fattened cattle and transportation costs were the major determinants of profitability of beef cattle fattening enterprises in the study area. This implies that strategies that will improve livestock marketing infrastructure including low cost means of transporting fattened live beef cattle to distant markets like Pugu in Dar es Salaam are of paramount importance.

3.3 Findings in Relation to Specific Objective III

The third objective of this study was to determine factors that influence pastoralists and agro pastoralists' willingness to adopt the cattle fattening technology. In general the level of profitability is expected to be an incentive for adoption of a particular technology and up scaling it. Results of the binary logistic regression model presented in Paper IV indicate that 93.5% of the respondents are willing to fatten their cattle if given an opportunity, while 14.7% had already started to fatten their cattle herds ranging from 30 to 100 animals per fattening cycle of three to four months. The main factors influencing adoption of beef cattle fattening were marital status ($p<0.1$), awareness ($p<0.05$) and attitude towards the technology ($p<0.01$). The marginal effect which measures the amount of change (in this case the adoption) that will be produced by a 1 unit change in X_k (in this case the independent variable) was 0.063, 0.113 and 0.004 for martial status, awareness and attitude respectively. This means that, being married and being aware about the fattening technology would increase the likelihood of adoption by 6.3% and 11.3% respectively. Meanwhile, a one unit change in attitude towards beef cattle fattening will increase the likelihood of adoption by 0.4%.

The significance of awareness variable in these findings imply that, beef cattle fattening promotion campaigns along with training on the advantages of beef cattle fattening is essential for wider adoption of beef cattle fattening technology. While the significance of attitude implies that changing the attitude of agro-pastoralists and pastoralist regarding keeping large cattle herds as a sign of wealth to embrace keeping fewer animals that are more productive is important. Such changes will raise interests among the agro pastoralists and pastoralist to

embrace on beef cattle fattening, resulting to scaling up of the fattening technology in the study area and in the country as a whole.

3.4 Other Observations Noted in the Study Area in Relation to Beef Cattle Fattening

In addition to the findings presented in the four papers as synthesized above, it was also observed that, beef cattle fattening produce a lot of manure as movement of animals is minimized during fattening (feedlot) which could be used for agriculture and energy serving for cooking. Tanzania is importing fertilizers for agriculture to the tune of 385 000 tons per year (URT, 2011b) which could be replaced by manure produced from beef cattle fattening (Figure 8). Also, the wide extent of deforestation for firewood and charcoal for household use throughout the country could be reduced by using cow dung from the beef cattle fattening enterprises as it was observed in the study area (Figure 9). Cattle fattening could also be associated with improved biogas production.

Figure 8: Manure from the feedlot which could be used for agriculture.

Figure 9: Cow dung could be used as a source of energy for cooking.

CHAPTER FOUR

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The main conclusion to be drawn from the findings of this study is that beef cattle fattening enterprises in the study area is technically efficient and economically profitable. However, improvements at the supply chain level as well as at the farm level are still required in order to facilitate development of a vibrant beef cattle fattening chain where all actors are collaborating for their common good and they are constantly working to improve the product they supply to the consumers they serve. At the supply chain level, improvements are needed on actors' relationships, linkages, collaboration and coordination to take advantage of the emerging markets for fattened beef cattle. At the farm level, beef cattle fattening knowledge and skills, technology awareness and changing attitudes of agro pastoralists and pastoralists is imperative for scaling up the beef cattle fattening technology. These should be accompanied by improvement in the enabling environment including improvements in livestock marketing infrastructure, policies and guidelines related to beef cattle fattening, extension services and financing to enable exploitation of available opportunities to expand and improve beef cattle supply chain and foster economic growth both at the local and national level.

4.2 Recommendations

In view of the findings and conclusions from this study, the following recommendations are made in order to enhance the performance of the beef sub sector in Tanzania.

4.2.1 Improving vertical coordination among actors

The study findings indicated weak vertical coordination among actors in the beef cattle supply chain in the study area. In order to develop the beef cattle supply chain to a vibrant value chain, it is recommended that efforts should be made to promote establishment of linkages among actors in the cattle supply chain. The linkages should be established by the actors themselves: agro-pastoralists/pastoralists, traders and meat processors (butcheries) through mutual understanding among themselves. Beef cattle fattening provides the opportunity for doing this if government agencies and Non Government Organizations (NGO's) collaborate to facilitate and guide the transformation.

4.2.2 Strengthening organizations of farmers

Apart from weak vertical coordination as stated in recommendation 4.2.1 above, cattle keepers' organizations in the study area were also found to be weak or absent. Efforts should therefore be made to strengthen them where they exist and promote their establishment where they are absent. Cattle keepers should be educated on the benefits of being in organizations so that they can voluntarily decide to join. There are several benefits of cattle keepers' organizations including lobbying, advocacy, purchasing inputs like concentrates for cattle fattening in bulky at reduced prices. Also using farmers' organizations, beef cattle feed production can be emphasized as a specialized activity where actors are well coordinated by improving relations among them to develop equitable and sustainable market linkages.

4.2.3 Improve supply chain financing

Access to formal sources of finance was revealed by the study to be difficult and scarce to most of the supply chain actors. Most of them start livestock business from their own funding

sources. It is recommended that financial institutions should provide special facilities to support livestock farming based on government guarantee schemes. Also, there should be strategies to promote formation of Savings and Credit Cooperatives Societies (SACCO's) among livestock farmers, traders and processors as an alternative source of funding. In addition, efforts should be directed facilitating land titles among livestock farmers to establish personal and group ranches so that they may improve access to financial resources using land as collateral. In this case, the government is urged to speed up the implementation of "*Mpango wa Kurasimisha Rasilimali na Biashara za Wanyonge Tanzania*-MKURABITA", or in English version "The Property and Business Formalization Program and Legalization of Grazing Land Ownership".

4.2.4 Awareness creation on beef cattle fattening technology

Awareness was found to positively influence the decision to adopt beef cattle fattening technology by agro pastoralists and pastoralist in the study area. On this basis, it is recommended that up-scaling beef cattle fattening should go along with promotion campaigns and training on beef cattle fattening to improve knowledge and skills for agro pastoralists and pastoralist. Improving knowledge and skills through extension education will enhance diffusion of information on available technology for beef cattle fattening. The Ministry of Livestock and Fisheries Development offers extension education to livestock farmers through village extension officers. However, the number of extension staff at the moment is not enough to cover every village. The current effort by the government to train more livestock extension staff should continue.

4.2.5 Change agro-pastoralists and pastoralists attitude towards beef cattle fattening

Attitude was also found to be one of the variables with significant influence on the decision to adopt beef cattle fattening by agro-patoralists and pastoralists. It is therefore recommended that plans for scaling up beef cattle fattening must be cognizant of the attitude of potential beef cattle adopters. During planning stages, more attention should be paid to the development of appropriate educational programs as well as extension packages to ensure that potential adopters change their attitudes from keeping large herds of cattle as a sign of wealth and change towards beef cattle fattening technology.

4.3 Contribution of the Study and Suggestions for further Research

This study provide a basis for researchers and policy makers in the Ministry of Livestock and Fisheries Development and outside the Ministry to conduct further research geared towards designing, promoting and developing a vibrant and effective beef sub-sector especially on beef cattle fattening. Policy guidance may include guidelines to facilitate specific target groups to engage in beef cattle fattening enterprises. These results also, provide initial empirical evidence for policy makers and researchers to undertake further analysis regarding scaling up the technology country-wide and assessing the economic feasibility of beef cattle fattening in other parts of Tanzania where different types of feed stocks are available.

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APPENDICES

Appendix 1: CHECKLIST FOR MAPPING BEEF CATTLE SUPPLY CHAIN

Enumerator's name .....

Date.....

Variable code	Question or variable	Response	Coding Key	Skip rule
A001	Region		1 = Mwanza, 2 = Shinyanga	
A002	District		1 = Kahama, 2 = Bariadi, 3 = Ngudu, 4 = ……, 5 = ……	
A003	Village		Codes of Villages selected	
A: Questions for Key informants				
A004	Respondents number			
A005	Respondents name			
A006	Status		1 = National government staff 2 = Regional government staff 3 = District administrator 4 = District Extension staff 5 = District political leader 6 = Ward Extension worker 7 = Trader buying from farmers 8 = Fattening 9 = Transporting 10 = Slaughtering 11 = Others…. Specify	
A007	Role in the beef supply chain		1= Policy and institutional support 2= supply chain actor 3= Service provider 4= No role in supply chain	
A008	How important is beef fattening as an economic activity in your area		1= Very important 2= Somehow important 3= Not important at all	
A009	Do you have an inventory of people who are involved in the business of fattening cattle for sale		1=Yes 2=No	If no go to question A031
A010	How many are there in your region		1= Between 1 and 20 2= Between 21 and 30 3= Between 31 and 50 4= Above 51 (specify) 5= None	
A011	How many are there in your		1= between 1 and 10 2= between 11 and 20	

Variable code	Question or variable	Response	Coding Key	Skip rule
	District		3= between 21 and 30 4= above 31 (specify) 5= None	
A012	How many are there in your ward		1= between 1 and 5 2= between 6 an 10 3= between 11 and 20 4= above 21 5= None	
A013	Who are mainly involved in the business of beef fattening		1= Livestock traders 2= Agro pastoralists 3= Pastoralists, 4= Others (Specify)	
A014	What type/breed of animals are used for fattening		1= Indigenous (TSHZ) 2= Boran 3= Crosses between indigenous & improved cattle 4= goats 5= sheep 6= Other.....specify	
A015	Where do they buy the cattle from?		1= District Livestock market 2= Directly from pastoralist 3= Livestock trader 4= Other..... Specify	
A016	What inputs do they need for their business		1= Pasture 2= supplementary grass 3= cotton seed cake 4= Molasses 5= Other	
A017	From where do they get the pastures		1= from their own land 2= from rented land 3= From open village land 4= from open public land 5= from public reserved land 6= Others	
A018	From where do they buy supplementary grass such as hay		1= Other livestock farmers (e.g. Ngitiri) 2= government farmers 3= anybody selling grass 4= Other	
A019	From where do they buy Cotton seed cake		1=Nearby Ginnery 2=Shop 3=Others	
A020	From where do they buy Molasses		1=Nearby sugarcane farm 2=Shop 3=Others	
A021	From where do they buy maize bran		1= From own maize 2= Shop 3= Milling Machine 4=Others	
A022	From where do they buy Maize		1= From own maize 2= Nearby shop 3= Milling Machine 4=Others (specify)	

Variable code	Question or variable	Response	Coding Key	Skip rule
A023	From where do they buy Urea		1=Drug store 2=Nearby shop 3=Others (specify)	
A024	From where do they buy Mineral		1=Drug store 2=Nearby shop 3=Others (specify)	
A025	From where do they buy salt		1=Nearby shop 2=Others	
A026	What services do they need to facilitate their business		1=Transport 2=Veterinary 3=Finance 4=Business development 5=Other (specify) …	
A027	Who provides the transport services?		1= Local transporters 2= Sellers of the inputs 3= buyers of the cattle	
A028	Who provides veterinary services		1= Government extension services 2= Private input suppliers 3= Government extension services operating at personal level 4= Others…. (Specify)	
A029	Who provides financial services		1= Own funds (equity) 2= Family and friends 3= SACCOS 4= Banks 5= Others Specify	
A030	Who provides business development services		1= Banks 2= Individual free lance consultants 3= NGOs 4= Government extension services 5= Other	
A031	What are the top three policies that are supportive to beef fattening entrepreneurs		1= …….. 2= …….. 3= ……	
A032	How does policy 1 support			
A033	How does policy 2 support			
A034	How does policy 3 support			
A035	What are the top three policies that impede development of beef fattening enterprises		1= …….. 2=…….. 3=……	
A036	How does policy 1 impede			
A037	How does policy 2 impede			
A038	How does policy 3			

Variable code	Question or variable	Response	Coding Key	Skip rule
	impede			
A039	What should be done to improve the policy environment			
A040	What are the key institutions currently supporting beef fattening entrepreneurs		1=..... 2=..... 3=.....	
A041	What can be done to improve the institutional environment in support of beef fattening enterprises			
A042	Is the number of beef fattening enterprises increasing in your area?		1=Yes 2=No	
A043	Can the current model be scaled up?		1=Yes 2=No	If no go to A039
A044	If Yes How?			
A045	If No why not?			
B: Questions for Focused Group Discussion				
B001	Village		1=..., 2=...., 3=.... ,999=not applicable	Skip if not in focus group discussion
B002	Focus group code		1= Group one 2=Group two 3=Group three.....	
Boo3	What is your perception about beef cattle fattening for the past three years?		1=A good practice 2=A bad practice 3=Difficult to do 4=Don't understand 5=Others	
B004	Are there any differences between fattening and none fattening?		1=No differences 2=Big difference 3=Difficult to tell	
B005	Is beef cattle practices increasing		1=Increasing 2=Decreasing 3=Constant	
B006	What are the major reasons for beef cattle fattening		1=Earn higher income 2=Status quo 3=Others.....specify	

Variable code	Question or variable	Response	Coding Key	Skip rule
B007	How does beef cattle fattening compare with other income earning activities like shop or hotel		1=Beef cattle fattening earn higher 2=Other activities earn more 3=These activities and not comparable	
B008	What are the major problems facing beef cattle fattening		1..... 2..... 3..... 4.....	
B009	If increasing or decreasing explain why		1..... 2..... 3.....	
B010	Is there any price differences between fattened animals and none fattened animals		1=Yes 2=No	If No go to B012
B011	How big is the price differences		1=5 percent 2=10 percent 3=25 percent 4=By 50 percent 5=More than 50 percent	
B012	Is beef cattle fattening influence selling of animals		1=Yes 2=No	
B013	What situation determine higher sales		1= Number of animals present 2=Weight of animals 3=Good grades of animals 4=Presence of traders 5=Others (specify)	
B014	What is the cattle ownership pattern in the household		1=Father 2=Mother 3=Family 4=Others Specify	
B015	How the decision to fatten animals is made		1=Directive 2=Discussion 3=Adoption 4=Other specify	
B016	Who determine to do fattening		1=Father 2=Mother 3=Family 4= Other Please specify	
B017	Who determine which animal and when to sell		1=Father 2=Mother 3=Family 4=Other Please specify	
B018	Why the decision making is as mentioned above		1..... 2..... 3.....	
B019	What breed of cattle is preferred to fatten		1=Indigenous (TSHZ) 2=Boran 3=Crosses	

Variable code	Question or variable	Response	Coding Key	Skip rule
			4=Others please specify	
B020	Provides reasons for choice made above		1..... 2..... 3.....	
B021	What are the importance of beef cattle fattening		1=Improve meat quality 2=Having larger animals 3=fetching higher prices at the market 4=Others ...(specify)	
B022	How do you recognize a well off person		1=One with larger number of cattle 2=One with better housing 3=One with enough food 4=Others please specify	
B023	What is the appropriate herd size		1=Between 1 and 50 2=Between 51 and 100 3=Between 101 and 200 4=Between 201 and 500 5=Between, 501 and 1000 6=Above 1001 (specify)	
B024	What are the top three policies that are supportive to beef fattening entrepreneurs		1 = ... 2 = ... 3 = ...	
B025	How does policy 1 support			
B026	How does policy 2 support			
B027	How does policy 3 support			
B028	What are the top three policies that impede development of beef fattening enterprises		1 = ... 2 = ... 3 = ...	
B029	How does policy 1 impede			
B030	How does policy 2 impede			
B031	How does policy 3 impede			
B032	What should be done to improve the policy environment			
B033	What are the key institutions currently supporting beef fattening entrepreneurs			

Variable code	Question or variable	Response	Coding Key	Skip rule
B034	What can be done to improve the institutional environment in support of beef fattening enterprises			
B035	Is the number of beef fattening enterprises increasing in your area?			
B036	Can the current model be scaled up?			
B037	If Yes How?			
B038	If No why not?			

Appendix 2: Dodoso Kuhusu Unenepeshaji ea Mifugo

JINA LA MUULIZAJI.....

JINA LA MUULIZWAJI.....

GRIDI: LONGITUDE.....**LATITUDE**.....

NAMBA YA DODOSO.....

TAREHE.....

NA.	SWALI	JIBU	UCHAGUZI WA JIBU	MAELEKEZO
A: TAARIFA BINAFSI				
A001	Mkoa		1=Mwanza 2=Shinyanga	
A002	Wilaya			
A003	Sehemu		1=Mjini 2=Karibu na mji 3=Kijijini	
A004	Mjini -Mtaa -Tarafa -Kata		....	
A005	Karibu na mji -Mtaa -Tarafa -Kata		....	
A006	Vijijini -Kijiji -Tarafa -Kata		....	
A007	Namba ya Mkuu wa Kaya		.....	
A008	Jina la Mkuu wa Kaya		.....	
A009	Jinsia		1=Mwanamme, 2 = Mwanamke	
A010	Umri		1=Kati ya miaka 20-40 2=Kati ya Miaka 41-60 3=Kati ya miaka 61 na zaidi	
A011	Elimu		1=Hajasoma ( ) 2=Elimu ya watu wazima ( ) 3=Elimu ya shule ya msingi ( ) 4=Elimu ya Sekondari ( ) 5=Chuo ( ) 6=Chuo Kikuu ( )	
A012	Ndoa		1=Ameolewa 2=Wanaishi tu pamoja kinyumba 3=Hajawahi kuoa/kuolewa 4=Mjane 5=Ameachika	

<table>
<tr><th>NA.</th><th>SWALI</th><th>JIBU</th><th>UCHAGUZI WA JIBU</th><th>MAELEKEZO</th></tr>
<tr><td>A013</td><td>Kwa wanaume waliooa, una wanawake wangapi?</td><td></td><td>1=Mwanamke mmoja
2=Wanawake wawili
3=Wanawake watatu
4=Wanawake wanne
5=Vinginevyo .....(Tafadhali eleza)</td><td></td></tr>
<tr><td>A014</td><td>Kwa Wanawake walioolewa, unanafasi gani kama mwanamke?</td><td></td><td>1=Mwanamke wa Kwanza,
2=Mwanamke wa Pili,
3=Mwanamke wa Tatu,
4=Mwanamke wa Nne,
5=Vinginevyo.....(Tafadhali Eleza)</td><td></td></tr>
<tr><td>A015</td><td>Watu wangapi wa kudumu unaoishi nao katika nyumba yako?</td><td></td><td><table><tr><th>Miaka</th><th>Me</th><th>Ke</th><th>Jumla</th></tr><tr><td>0-5</td><td></td><td></td><td></td></tr><tr><td>6-13</td><td></td><td></td><td></td></tr><tr><td>14-25</td><td></td><td></td><td></td></tr><tr><td>26-35</td><td></td><td></td><td></td></tr><tr><td>36-50</td><td></td><td></td><td></td></tr><tr><td>50-60</td><td></td><td></td><td></td></tr><tr><td>60 na zaidi</td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>A016</td><td>Watu wangapi kati ya hao unaoishi nao wanasaidia katika shughuli ya unenepeshaji wa mifugo?</td><td></td><td>Wanaume.....

Wanawake.....

Jumla .....</td><td></td></tr>
<tr><td>A017</td><td>Tafadhali taja kabila lako?</td><td></td><td>.....</td><td></td></tr>
<tr><td>A018</td><td>Je, ulizaliwa katika Kijiji hiki?</td><td></td><td>1=Ndio
2=Hapana</td><td></td></tr>
<tr><td>A019</td><td>Kama sivyo, ulihamia kutoka wapi?</td><td></td><td>.....</td><td></td></tr>
<tr><td>A020</td><td>Mwaka gani ulihamia katika kijiji hiki?</td><td></td><td>.....</td><td></td></tr>
<tr><td>A021</td><td>Taja sababu zilizokufanya uhamie katika kijiji hiki</td><td></td><td>1=Kuolewa,
2=Kufuata wazazi,
3=Kutafuta malisho ya mifugo
4=Uhamisho wa kikazi,
5=Kutafuta kazi ya kuajiriwa,
6=Kulima,
7=Sababu nyingine...(Tafadhali taja)</td><td></td></tr>
<tr><td>A022</td><td>Je, Unamiliki nyumba yako mwenyewe?</td><td></td><td>1=Ndio
2=Hapana</td><td></td></tr>
</table>

NA.	SWALI	JIBU	UCHAGUZI WA JIBU	MAELEKEZO
A023	Kama ndiyo, Sakafu imejengwa kwa mali ghafi gani?		1=Udongo 2=Mbolea ya ng'ombe 3=Vigae 4=Cementi 5=Vinginevyo.....(Tafadhali Taja)	A023-25 (Jaza kwa kuangalia hali halisi)
A024	Ukuta umejengwa kwa mali ghafi gani?		1= Nyasi 2= Miti na matope 3= Matofali ya kukaushwa na jua 4= Matofali ya kuchoma 5= Mbao 6= Matofali ya Cementi 7= Mawe 8= Vinginevyo (tafadhali Eleza)	
A025	Paa limejengwa kwa mali ghafi gani?		1= Majani/matope 2= Bati 3= Vigae 4= Zege 5= Asbestos 6= Vinginevyo (Tafadhali taja)	
A026	Je, katika nyumba yako una umeme?		1= Ndio 2= Hapana	
A027	Kama una umeme, chanzo chake ni wapi?		1= Umeme kutoka Gridi ya Taifa 2= Umeme wa jua 3= Kwa kutumia Mafuta ya taa 4= Vyanzo vingine....(Tafadhali taja)	
A028	Chanzo chako cha maji ni wapi?		1=Maji ya bomba 2=Kisima kirefu 3=Kisima kifupi 4=Kwa kutegemea mto ulio karibu 5=Vyanzo vingine (Tafadhali eleza)	
A029	Je, nyumba yako inavyo vifaa vilivyoainishwa?		1=Taa ya chemli 2=Radio 3=Televisioni 4=Simu ya mezani/mkononi 5=Baisikeli 6=Pikipiki 7=Gari dogo 8=Gari kubwa 9=Friji	
A030	Je katika uzalishaji wa nyama wewe una nafasi gani?		1=Mfugaji 2=Mfugaji Mfanyabiashara 3=Mfanyabiashara Mnenepeshaji 4=Msafirishaji 5=Mchinjaji 6=Mengineyo.....(Tafadhali Taja)	

B: TAARIFA KUHUSU UNENEPESHAJI NA BIASHARA YA MIFUGO				
B001	Taja tegemeo lako kubwa katika maisha yako		1= Ufugaji wa mifugo: **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu),** 2= Kilimo cha Mazao **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo Muhimu),** 3= Unenepeshaji wa mifugo **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu),** 4= Uendeshaji wa Biashara (duka, hoteli n.k): **(4.1 Muhimu sana, 4.2 Muhimu, 4.3 Siyo Muhimu),** 5= Mwajiriwa: **(5.1 Muhimu sana, 5.2 Muhimu, 5.3 Siyo Muhimu),** 6= Mengineyo..... (eleza)	
B002	Kama unafuga au unanenepesha mifugo, mifugo hiyo uliipataje?		1= Ulinunua minadani 2= Ulirithi 3= Vinginevyo (Tafadhali eleza)	
B003	Tafadhali eleza mchanganyiko wa mifugo yako		1=Madume ..... 2=Mitamba ..... 3=Maksai ..... 4=Majike..... 5=Ndama..... 6=Jumla	
B004	Je ni mwaka gani ulianza biashara ya unenepeshaji?		.....	
B005	Je, Biashara ya Unenepeshaji ina umuhimu gani kwako katika kukupatia kipato kwa maisha yako?		1= Ina umuhimu mkubwa sana, 2= Ni kati ya shughuli nyingi nilizo nazo, 3= Siyo muhimu sana	
B006	Je, ni aina gani ya mifugo unayopendelea kununua kwa ajili ya unenepeshaji?		1=Madume yaliyohasiwa 2=Madume yasiyohasiwa 3=Mitamba 4=Majike yaliyoacha kuzaa/tasa 5=Ndama	
B007	Je, unapendelea ng'ombe wenye umri gani?		1=Wachanga miaka 2-3 2=Umri wa kati miaka 4-6 4=Umri mkubwa miaka 7 na zaidi 5=Wengine (tafadhali eleza)	
B008	Je, kati ya Madume na Majike unapendelea kununua ng'ombe wa aina gani?		1= Madume 2= Majike	
B009	Je, unasababu yoyote ya uchaguzi huo?		....	

B010	Je, ni vigezo gani huwa unaviangalia wakati unaponunua ng'ombe kwa ajili ya kunenepesha?		1= Umbo la Ng'ombe **(1.1 Muhimu sana, 1.2 muhimu, 1.3 Siyo Muhimu)** 2= Umri **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo Muhimu),** 3= Bei **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu)** 4= Ukubwa **(4.1 Muhimu sana, 4.2 muhimu, 4.3 Siyo Muhimu)** 5= Mengineyo... (Tafadhali eleza)	
B011	Je, Unaponunua ng'ombe mara nyingi huwa unanunua kutoka kwa nani?		1=Wafugaji **(1.1 Mara nyingi, 1.2 Mara chache, 1.3 Sinunui),** 2=Wafanya biashara **(2.1 Mara nyingi, 2.2 Mara chache, 2.3 Sinunui),** 3=Wanenepeshaji **(3.1 Mara nyingi, 3.2 Mara chache, 3.3 Sinunui),** 5=Vinginevyo .....(Tafadhali eleza)	
B012	Je, huwa unanunua kutoka minada ipi?		1=Minada ya msingi 2=Minada ya upili 3=Mengineyo.....(Tafadhali taja)	
B013	Je, unanunua kutoka mkoa gani?		1=Mwanza 2=Shinyanga 3=Mikoa mingine(Tafadhali taja)	
B014	Je, unanunua kutoka wilaya gani?			
B015	Je, kuna umbali gani katika kilometa kutoka unakonunua mifugo?		.....	
B016	Taja aina ya usafiri unaotumia katika kusafirisha mifugo uliyonunua		1=Magari makubwa 2=Magari madogo 3=Mabehewa ya mizigo 4=Njia ya Kuswaga 5=Njia nyingine.....(tafadhali eleza)	
B017	Je, ni kiasi gani unalipa katika kusafirisha mifugo hiyo?		**2009** **2010**	
B018	Kwa mifugo uliyonunua hivi karibuni, tafadhali taja wastani wa bei za kununulia		**Bei ya chini** **Bei ya juu** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mtamba .... Ndama	
B019	Je unaweza kunenepesha ng'ombe wangapi kwa wakati mmoja?		1= 1-30 2= 31-50 3= 51-100 4= 101-200 5= 201-500 6= 501-1000 7= 1001 na zaidi	

B020	Je, Kwa kawaida, huwa unapata kirahisi ng'ombe unaowahitaji kwa ajili ya kunenepesha?		1=Ndio 2=Hapana	
B021	Je, ni taarifa gani muhimu kwako wakati unaponenepesha ng'ombe?		....	
B022	Je, ni taarifa ipi kati ya zilizoorodheshwa ina umuhimu kwako unaponenepesha ng'ombe?		1= Bei ya ng'ombe **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 2= Bei za vyakula **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo muhimu)** 2= Idadi ya mifugo iliyopo mnadani **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 3= Mengineyo.....(Tafadhali eleza)	
B023	Mara nyingi taarifa huwa unapata kutoka kwa nani?		1=Serikali **(1.1 Mara nyingi, 1.2 Mara chache, 1.3 Sipati)** 2= Kutoka kwa rafiki **(1.1 Mara nyingi, 1.2 Mara chache, 1.3 Sipati)** 3= Wafanya biashara wenzangu **(1.1 Mara nyingi, 1.2 Mara nyingine, 1.3 Sipati)** 4= Wengine .....(Tafadhali eleza)	
B024	Taarifa hiyo huwa unaipataje?		1=Kwa njia ya simu 2=Kwa njia ya Radio 3=Kwa njia ya Radio and Televisheni 4=Kwa kuonana ana kwa ana 5=Njia nyingine.(Tafadhali eleza)	
B025	Je, ng'ombe uliowanenepesha unawauzaje?		1 = Ng'ombe hai 2 = Nyama	
B026	Je wanunuzi wakubwa wa ng'ombe wako ulionenepesha ni wepi?		1= Watu binafsi 2= Wenye mabucha 3= Magaragaja (watu wa kati) 4= Wengine.....(Tafadhali taja)	
B027	Mara nyingi huwa unauza wapi ng'ombe ulionenepesha?		1= Minadani **(1.1 Mara nyingi, 1.2 Mara chache, 1.3 Sijawahi kuuza)** 2= Machinjioni **(2.1 Mara nyingi, 2.2 Mara chache, 2.3 Sijawahi kuuza)** 3= Kuuza nje ya nchi **(3.1 Mara nyingi, 3.2 Mara chache, 3.3 Sijawahi kuuza)** 4=Sehemu ya kunenepeshea mifugo **(4.1 Mara nyingi, 4.2 Mara chache, 4.3 Sijawahi kuuza)** 5=Sehemu nyingine(Tafadhali eleza)	
B028	Kama unauza ng'ombe ulionenepesha minadani, Je ni minada ipi?		1=Minada ya awali 2=Minada ya upili 3=Minada mingine(Tafadhali eleza)	

B029	Je, kuna umbali gani kwa kilometa kutoka sehemu unayonenepeshea mifugo kwenda sehemu unayouzia?		.....	
B030	Je ng'ombe ulionenepesha unawasafirishaje kwenda sehemu unayouzia?		1=Kwa kutumia magari makubwa 2=Kwa kutumia magari madogo 3=Kwa kutumia mabehewa 4=Kwa kuswaga 5=Njia nyingine (Tafadhali eleza)	
B031	Gharama ya kusafirisha ni kiasi gani kwa ng'ombe?		.....	
B032	Je, ni vigezo gani muhimu mara nyingi huwa unaviangalia wakati wa kuuza ng'ombe ulionenepesha?		.....	
B033	Ni kwa vipi vigezo vilivyoorodheshwa vina umuhimu katika kufanya maamuzi ya kuuza ng'ombe ulionenepesha?		1=Kuwa na muonekano mzuri **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu).** 2= Kuwa na uzito mkubwa **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo Muhimu).** 3=Nalazimika kuuza kutokana na faida kupata faida kidogo au hasara **(3.1 N muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu)'** 4=Nguvu ya soko **(4.1 Muhimu sana, 4.2 Muhimu, 4.3 Siyo muhimu).** 5=Mengineyo.....(tafadhali eleza)	
B034	Ni makubaliano gani huwa mara nyingi unaingia unapouza mifugo yako		1= Kwa fedha tasilimu 2= Kwa mkopo 3= Nyingine.....(Tafadhali eleza)	
B035	Tafadhali orodhesha idadi ya wanunuzi uliowahi kuwauzia ng'ombe wako kwa kipindi cha mwaka mmoja uliopita		1= 2= 3= 4= 5=	Unaweza kumtumia afisa mifugo kukukumbusha
B036	Tafadhali taja bei ya wastani ambayo huwa mara nyingi unauza ng'ombe ulionenepesha?		**Bei ya Chini** **Bei ya juu** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	
B037	Je, umeshanenepesha ng'ombe wangapi kwa kipindi cha miaka miwili iliyopita?		**2009** **2010** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	

B038	Kwa mifugo uliyonenepesha, kwa wastani ng'ombe walikuwa na umri gani?		**Umri wa chini** **Umri wa juu** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	
B039	Katika kipindi hicho cha miaka miwili kati ya ng'ombe wote uliowanenepesha uliuza ng'ombe wangapi?		**2009** **2010** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	
B040	Kwa mifugo uliyonenepesha, takriban, ng'ombe wangapi walipotea kwa kuibiwa?		**2009** **2010** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	
B041	Kwa mifugo uliyonenepesha, takriban, ng'ombe wangapi walipotea kwa kwa kufa kwa magonjwa?		**2009** **2010** Madume hasiwa..... ..... Majike .... Madume siyohasiwa..... ..... Mitamba .... Ndama	
B042	Kwa kawaida nani huwa anapanga bei ya kuuza ng'ombe wako?		1=Mnunuzi 2=Muuzaji 3=Utaratibu wa Mnada (Auction system) 4=Mwenye ng'ombe 5=Wengine.....(Tafadhali eleza)	
B043	Kwa ng'ombe ulionenepesha, ulitumia muda gani mpaka kuwauza?		1=Miezi mitatu 2=Miezi minne 3=Miezi mitano 4=Miezi sita 5=Vinginevyo...(Tafadhali eleza)	
B044	Je, ni vigezo gani ambavyo ni muhimu sana unapopanga bei ya kuuza ng'ombe?		1=Muonekano wa ng'ombe **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Umri wa ng'ombe **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo muhimu)** 3=Uzito **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu)** 4=Nguvu ya Soko **(4.1 Muhimu sana, 4.2 Muhimu, 4.3 Siyo Muhimu)** 5=Gharama iliyotumika kunenepesha **(5.1 Muhimu sana, 5.2 Muhimu, 5.3 Siyo muhimu)** 4=Mengineyo...(Tafadhali eleza)	
B045	Je, mara nyingi huwa unaridhika na bei unayoipata?		1=Ndio 2=Hapana	
B046	Kama, Hapana tafadhali toa sababu		.....	

B047	Je, ni juhudi gani zaidi unafanya ili kutangaza biashara ya unenepeshaji wa mifugo?		1=Kuingia mikataba isiyo rasmi 2=Kufanya mikataba rasmi 3=Kufanya mikataba kwa njia ya simu na barua pepe 4=Kufanya matangazo kwa njia ya radio, televisini na magazeti 5=Njia nyingine……(Tafadhali eleza)	
B048	Je, una mkataba wa kupata ng'ombe wa kunenepesha?		1=Ndiyo 2=Hapana	Kama ndiyo nenda B046 & BO47
B049	Je, Una mkataba na wanunuzi wa kununua ng'ombe ulionenepesha?		1=Ndiyo 2=Hapana	Kama ndiyo nenda B046 & BO47
B050	Kama ndiyo, ni aina gani ya mkataba?		1= Rasmi 2= Usiyo Rasmi 3= Mengineyo….(Tafadhali eleza)	
B051	Je mkataba unazingatia mambo gani?		1= Bei 2= Ubora 3= Uzito 4= Muda 5= Mengineyo…(Tafadhali eleza)	
B052	Je, kuna juhudi zozote za kuongeza thamani ya ng'ombe walionenepeshwa kwa njia ya kuchinja na kuuza kwa mikato ya nyama?		1= Ndio 2= Hapana	Kama ndiyo nenda BO49
B053	Kama ndiyo, Tafadhali eleza jinsi inavyofanyika		…… ……	
B054	Je kuna matatizo yoyote unayopata wakati wa kunenepesha?		1=Ndiyo 2=Hapana	Kama ndiyo nenda B055
B055	Je, kuna changamoto zozote unazozikabili wakati wa unenepeshaji mifugo?		1=Mitaji **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Ardhi/Eneo **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo Muhimu)** 3=Upatikanaji wa vyakula vya mifugo **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu)** 4=Bei kubwa ya Vyakula vya mifugo **(4.1 Muhimu sana, 4.2 Muhimu, 4.3 Siyo Muhimu sana)** 5=Uuzaji wa mifugo iliyonenepeshwa **(5.1 Muhimu sana, 5.2 Muhimu, 5.3 Siyo muhimu)** 6=Mengineyo…(Tafadhali eleza)	

B056	Je, una mipango yoyote ya kupanua na kuboresha biashara ya unenepeshaji wa mifugo?		1= Ndiyo 2= Hapana	Kama ndiyo, nenda swali linalofuata
B057	Kama ndiyo, una mipango gani?		.....	
B058	Je, unafikiri serikali ya mitaa inaweza kukusaidia katika kuboresha biashara yako ya unenepeshaji?		1=Ndiyo 2=Hapana	
B059	Kama ndiyo, tafadhali eleza jinsi serikali ya mitaa inavyoweza kukusaidia		....	
B060	Je, unapata huduma yoyote toka afisa ugani?		1=Ndiyo 2=Hapana	
B061	Je, uliwahi kupata mkopo katika shughuli yako ya unenepeshaji?		1=Ndiyo 2=Hapana	
B062	Je una mapendekezo yoyote au ushauri jinsi ya kuboresha biashara ya unenepeshaji wa ng'ombe kwa ajili ya kuinua sekta ya mifugo hapa nchini?		....	
C: TAARIFA KUHUSU GHARAMA ZA ULISHAJI MIFUGO				
C001	Je ni aina gani ya vyakula unavyotumia kunenepesha mifugo?		1=Majani pekee kwa kuchunga 2=Majani pekee lakini hawachungwi 3=Majani kwa kuchunga na vyakula vya ziada 4=Majani lakini hawachungwi na vyakual vya ziada 5=Njia nyingine(Tafadhali eleza)	
C002	Kama ng'ombe hawachungwi na unalisha majani unayapata wapi?		1=Kununua Sokoni (Hei) 2=Kumwajiri mtu wa kukata 3=Kuzalisha kutoka shamba lake 4=Mengineyo...(Tafadhali eleza)	
C003	Kama unatumia vyakula vya ziada, Je, vinajumuisha vyakula gani?		1=Pumba za Mahindi **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Mahindi **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo Muhimu)** 3=Mashudu ya Alizeti **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo Muhimu)**	

			4=Mashudu ya Pamba **(4.1 Muhimu sana, 4.2 Muhimu, 4.3 Siyo Muhimu)** 5=Molasses **(5.1 Muhimu sana, 5.2 Muhimu, 5.3 Siyo Muhimu)** 6=Makapi ya Pamba **(6.1 Muhimu sana, 6.2 Muhimu, 6.3 Siyo Muhimu)** 7=Urea **(7.1 Muhimu sana, 7.2 Muhimu, 7.3 Siyo Muhimu)** 8=Madini **(8.1 Muhimu sana, 8.2 Muhimu, 8.3 Siyo Muhimu)** 4=Mengineyo...(Tafadhali eleza)	
C004	Je, mara nyingi unapata wapi mashudu ya pamba?		1=Ginnery ya karibu 2=Wafanyabiashara mjini (Tafadhali fafanua) 3=Wengine...(tafadhali fafanua)	
C005	Je, mara nyingi unapata wapi mashudu ya alizeti?		1=Ginnery ya karibu 2=Wafanyabiashara mjini(fafanua) 3=Wengine...(Tafadhali fafanua)	
C006	Je, mara nyingi unapata wapi pumba za mpunga?		1=Kiwanda cha sukari cha karibu 2=Wafanyabiashara mjini...(fafanua) 3=Wengine...(Tafadhali fafanua))	
C007	Je, ni kiasi gani cha chakula huwa unatumia kwa siku		1=Mashudu ya pamba .....kg 2=Mashudu ya Alizeti .....kg 3=Pumba za mahindi.....kg 4=Makapi ya pamba.....kg 5=Chumvi.....Kg 6=Pumba za Mpunga.....kg	
C008	Kwa mifugo uliyonenepesha hivi karibuni, Je, uliweka kumbukumbu za gharama zote ulizotumia?		1= Ndiyo 2= Hapana	Kama ndiyo nenda C009

C009. Kama ndiyo, tafadhali jibu maswali yaliyomo kwenye jedwali lifuatalo.

Banda la kunenepeshea mifugo/Gharama za kudumu

C0091 Kipengele	C0092 Idadi iliyotumika	C0093 Bei ya kununu/ kujenga	C0094 Mwaka iliponunuliwa/ ilipojengwa	C0095 Inatarajiwa kudumu kwa kipindi gani
C00911 Banda/Nyumba/Zizi				
C00912 Matoroli				
C00913 Sehemu ya kulishia mifugo				
C00914 Sehemu ya kunyweshea maji				
C00915 Vifaa vya tiba kama mikasi ya kukata pembe				
C00916 Mengineyo (tafadhali taja)				

C010. Kwa gharama za kila mara tafadhali jibu yafuatayo:-

C0101 Kipengele	**C0102** Kiasi kilichotumika		**C0103** Bei ya kununua		**C0104** Jumla ya Gharama	
	2009	**2010**	**2009**	**2010**	**2009**	**2010**
C01011 Mashudu ya Pamba						
C01012 Makapi ya Pamba						
C01013 Mashudu ya Alizeti						
C01014 Pumba za Mpunga						
C01015 Molasses						
C01016 Hei						
C01017 Maji						
C01018 Chumvi						
C01019 Matibabu						
C01020 Ulinzi						
C01021 Usafirishaji (wakati wa kununua)						
C01022 Usafirishaji (wakati wa kuuza)						
C01023 Wafanyakazi						
C01024 Kuweka alama						
C01025 Kuogesha (ng'ombe wote)						
C01026 Kukata pembe						
C01027 Gharama za ukaguzi						
C01028 Mahindi						
C01029 Pumba za mahindi						
C01030 Mabua ya mahindi						
C01031 Majani ya maharage						
C01032 Ushuru wa minada						
C01033 Kibali cha kusafirisha wakati wa kununua						
C01034 Kibali cha kusafirisha wakati wa kuuza						
C01035 Mengineyo (tafadhali taja)						

C011. Tafadhali orodhesha magonjwa ambayo mara nyingi yanatokea unaponenepesha mifugo yako;

1.....

2.....

3.....

4.....

5.....

C012. Kwa mifugo uliyonenepesha, tafadhali jaza uzito uliopatikana baada ya kunenepesha kwa kila aina ya ng'ombe kama ifuatavyo:-

	C0121 Uzito wakati wa kuingia kwa kg	**C0122** Uzito wakati wa kuuza kwa kg	**C0123** Uzito ulioongezeka (Uzito wakati wa kutoka -Uzito wakati wa kuingia) kwa kg
C0121 Madume hasiwa...			
C0122 Majike...			
C0123 Madume yasiyohasiwa			
C0124 Mitamba...			
C0125 Ndama....			

C013 Tafadhali toa maoni yako kuhusu unenepeshaji wa aina mbalimbali za mifugo

.....

.....

.....

ASANTE SANA

Appendix 3: Dodoso kwa ajili ya Wafugaji wa Mifugo

JINA LA MUULIZAJI.....

JINA LA MUULIZWAJI.....

GRIDI: LONGITUDE.....**LATITUDE**.....

NAMBA YA DODOSO.....

TAREHE.....

NA.	SWALI	JIBU	UCHAGUZI WA MAJIBU	MAELEKEZO
A: TAARIFA BINAFSI				
A001	Mkoa		1=Mwanza 2=Shinyanga	
A002	Wilaya			
A003	Eneo		1=Karibu na Mjini 2=Vijijini	
	Karibu na Mji -Mtaa -Tarafa -Kata		....	
A004	Vijijini -Kijiji -Tarafa -Kata		....	
A006	Namba ya mkuu wa kaya		.....	
A007	Jina la mkuu wa kaya		.....	
A008	Jinsia		1=Mme 2=Mke	
A009	Umri		1=Miaka Kati ya 20 na 40 2=Miaka kati ya 41 na 60 3=Miaka kati ya 61 na zaidi	
A010	Elimu (andika miaka aliyokuwa shuleni)		1=Hajasoma ( ) 2=Elimu ya watu wazima ( ) 3=Elimu ya shule ya Msingi ( ) 4=Elimu ya Sekondaril ( ) 5=Chuo ( ) 6=Chuo Kikuu ( )	
A011	Ndoa		1=Ameoa 2=Wanaishi pamoja kinyumba 3=Hajaolewa 4=Mjane 5=Ameachika 6=Mengine.... (Tafadhali fafanua)	
A012	Kwa wanaume waliooa ana wake wangapi?		1=Mke mmoja 2=Wake wawili 3=Wake watatu 4=Wake wanne 5=Vinginevyo (Tafadhali fafanua)	
A013	Kwa wanawake walioolewa ni mke wa		1=Mke wa kwanza 2=Mke wa pili,	

<table>
<tr><th>NA.</th><th>SWALI</th><th>JIBU</th><th>UCHAGUZI WA MAJIBU</th><th>MAELEKEZO</th></tr>
<tr><td></td><td>ngapi?</td><td></td><td>3=Mke wa tatu
4=Mke wa nne
5=Mengineyo (Tafadhali fafanua)</td><td></td></tr>
<tr><td>A014</td><td>Je, unaishi na watu wangapi wa kudumu katika familia yako?</td><td></td><td><table><tr><th>Umri</th><th>Me</th><th>Ke</th><th>Jumla</th></tr><tr><td>0-5</td><td></td><td></td><td></td></tr><tr><td>6-13</td><td></td><td></td><td></td></tr><tr><td>14-25</td><td></td><td></td><td></td></tr><tr><td>26-35</td><td></td><td></td><td></td></tr><tr><td>36-50</td><td></td><td></td><td></td></tr><tr><td>50-60</td><td></td><td></td><td></td></tr><tr><td>60 na zaidi</td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>A015</td><td>Je, kati ya wanafamilia unaoishi nao, ni wangapi wanaosaidia katika shughuli za ufugaji?</td><td></td><td>Wanaume.....

Wanawake.....

Jumla .....</td><td></td></tr>
<tr><td>A016</td><td>Je, ulizaliwa katika kijiji hiki?</td><td></td><td>1=Ndiyo
2=Hapana</td><td></td></tr>
<tr><td>A017</td><td>Kama hapana, Ulihamia kutoka Wilaya gani?</td><td></td><td></td><td></td></tr>
<tr><td>A018</td><td>Je, ni mwaka gani ulihamia katika kijiji hiki?</td><td></td><td></td><td></td></tr>
<tr><td>A019</td><td>Je, ni sababu gani zilikufanya uhamie katika kijiji hiki?</td><td></td><td>1=Ndoa,
2=Ulifuatana na wazazi wako
3=Kutafuata malisho
4=Uhamisho wa kikazi,
5=Kutafuta kazi ya ajira,
6=Kilimo,
7=Mengine.....(Tafadhali fafanua)</td><td></td></tr>
<tr><td>A020</td><td>Je, unayo nyumba ya kuishi unayomiliki?</td><td></td><td>1=Ndiyo
2=Hapana</td><td></td></tr>
<tr><td>A021</td><td>Kama ndiyo, Je sakafu ya nyumba yako imejengwa na mali ghafi ipi?</td><td></td><td>1=Udongo / mchanga
2=Mbolea ya ng'ombe
3=Vigae
4=Sementi
5=Mengineyo.....(Tafadhali eleza)</td><td>A021-25 (Jaza kwa kuangalia hali halisi)</td></tr>
<tr><td>A022</td><td>Ukuta umejengwa kwa mali ghafi gani?</td><td></td><td>1=Nyasi
2=Miti na matope
3=Matofali ya kukaushwa na jua
4=Matofali ya kuchoma
5=Mbao
6=Matofali ya simenti
7=Mawe
8=Mengine.....(Tafadhali eleza)</td><td></td></tr>
<tr><td>A023</td><td>Paa limeezekwa kwa mali ghafi gani?</td><td></td><td>1=Majani
2=Bati
3=Vigae
4=Zege
5=Asbestos
6=Mengineyo.....(Tafadhali eleza)</td><td></td></tr>
<tr><td>A024</td><td>Je, Nyumba yako ina umeme?</td><td></td><td>1=Ndiyo
2=Hapana</td><td></td></tr>
</table>

NA.	SWALI	JIBU	UCHAGUZI WA MAJIBU	MAELEKEZO
A025	Je, nyumba yako ina maji?		1=Maji ya bomba 2=Kisima kirefu 3=Kisima kifupi 4=Mto wa karibu 5=Mengineyo……(Tafadhali eleza)	
A026	Je, nyumba yako ina vitu vilivyorodheshwa hapa?		1=Taa ya mafuta ya taa 2=Redio 3=Televisheni 4=Simu ya mkononi/mezani 5=Baiskeli 6=Pikipiki 7=Gari dogo 8=Gari Kubwa 9=Friji	
A27	Je, una kazi nyingine kubwa Unayoendesha?		1=Hakuna 2=Mwajiriwa 3=Mkulima wa mazao 4=Mfanyabiashara 5=Kazi za mikono 6=Mwanafunzi 7=Nyingine……..(Tafadhali eleza)	
A28	Mapato yako makubwa yanatokana na nini?		1=Mifugo **(1.1 muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Kulima mazao **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo Muhimu)** 3=Mwajiriwa **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo muhimu)** 4=Mengine……(Tafadhali eleza)	
B: TAARIFA KUHUSU UFUGAJI WA MIFUGO				
B001	Je, una mifugo kiasi gani kwa ujumla?		**2009 2010** 1=Majike…….. …… 2=Madume…… …… 3=Vidume…….. …… 4=Ndama…… …… 5=Mbuzi…… …… 6=Kondoo…….. …… 7=Nguruwe…….. …… 8=Kuku…….. ……	
B002	Ng'ombe ulionao ni wa kizazi gani?		1=Majike …….. 2=Madume …….. 3=Vidume…….. 4=Ndama……	
B003	Je, Ng'ombe wako unawatambuwaje?		1=Kupiga chapa 2=Kukata masikio 3=Alama nyingine….(tafadhali eleza)	
B004	Je, ni aina gani ya uchungaji ambayo mara nyingi unayoitumia?		1=Uchungaji mifugo malishoni 2=Kuwalisha nyasi bandani 3=Njia nyingine(Tafadhali eleza)	
B005	Je, unalo eneo lenye ukubwa gani kwa ajili ya kilimo na ufugaji? (malisho yaliyoendelezwa)		Eneo la kilimo ni eka--------- acres Eneo la Malisho ni eka------- acres (kwa ajili ya malisho yaliyoendelezwa tu)	

NA.	SWALI	JIBU	UCHAGUZI WA MAJIBU	MAELEKEZO
B006	Je, kwa kawaida huwa unauza mifugo yako?		1=Ndiyo 2=Hapana	Ndiyo, B008; Hapana B007
B007	Kama huuzi mifugo yako, tafadhali toa sababu zinazokufanya usiuze		....	
B008	Kama unauza, mifugo yako huwa unauzia wapi?		1=Minada ya mifugo ya msingi 2=Minada ya mifugo ya upili 3=Machinjioni 3=Sehemu nyingine...(Tafadhali taja)	
B009	Mifugo yako unauzaje?		1= Kwa Fedha tasilimu 2= Kwa Mkopo 3= Vinginevyo....(Tafadhali eleza)	
B010	Kwa kawaida, huwa unauza kwa bei gani?		**Bei ya chini Bei ya juu** Madume..... ..... Majike .... Vidume .... Mitamba .... Ndama .... Mbuzi .... Kondoo	
B011	Je, bei ni tatizo kubwa unapouza mifugo?		1= Ndiyo 2= Hapana	Ndiyo, nenda B012
B012	Eleza matatizo yanayohusu bei		....	
B013	Kwa wastani, ni ng'ombe wangapi uliwauza kwa miaka miwili iliyopita (tafadhali taja idadi ya mifugo)		**2009 2010** 1= Ng'ombe..... ..... 2= Kondoo..... ..... 3= Mbuzi	
B014	Mara nyingi, nani huwa anapanga bei?		1= Mnunuzi 2= Muuzaji 3= Dalali 4= Mwenye mifugo (mimi) 5= Mwingine...(tafadhali fafanua)	
B015	Je, ni vigezo gani huwa unavifikiria unapopanga bei ya kuuza mifugo yako?		1=Uzito **(1.1 Muhimu sana, 1.2 Muhimu, 1.3 Siyo muhimu)** 2=Umri **(2.1 Muhimu sana, 2.2 Muhimu, 2.3 Siyo muhimu)** 3=Nguvu ya soko **(3.1 Muhimu sana, 3.2 Muhimu, 3.3 Siyo muhimu)** 4=Mengineyo(Tafadhali fafanua)	
B016	Je, umeridhika na bei unayouzia mifugo yako kwa wakati uliopo sasa?		1= Ndiyo 2= Hapana	
B017	Kama ndiyo au Hapana, Toa sababu		1 = Ndiyo 2 = Hapana Sababu.....	
B018	Kama hapana, Nini kinahitajika ili kubadilisha hali		1=Kunenepesha mifugo **(1.1 Muhimu sana 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Kuboresha Kizazi **(2.1 Muhimu sana**	

NA.	SWALI	JIBU	UCHAGUZI WA MAJIBU	MAELEKEZO
	iliyopo?		**2.2 Muhimu, 2.3 Siyo Muhimu)** 3=Kubadilisha mfumo wa soko **(3.1 Muhimu sana 3.2 Muhimu, 3.3 Siyo Muhimu)** 4=Mengineyo (tafadhali fafanua)	
B019	Unapouza Mifugo yako, ni aina gani ya ng'ombe huwa mara nyingi unauza zaidi?			
	B0191 Mifugo yenye umri mdogo		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
	B0192 Mifugo yenye umri wa kati		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
	B0193 Tasa		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
	B0194 Mifugo iliyozeeka		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
	B0195 Mifugo ambayo haitumiki kulima tena		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
	B0196 Ng'ombe waliokonda na wagonjwa?		1=Mara nyingi sana 2=Mara nyingi 3=Mara chache 4=Siuzi	
B020	Uuzaji wa mifugo yako mara nyingi ni wa namna gani?		1=Mkataba 2=Anayekuja ndiye anayeuziwa 3=Mengineyo(Tafadhali fafanua)	
B021	Je, ni Mwezi gani ambapo unauza sana mifugo yako?		1=Masika 2=Kiangazi 3=Vuli 4=Kipupwe	
B022	Tafadhali toa sababu kwa uchaguzi ulioufanya		.....	
B023	Je, ni matatizo gani unakutana nayo wakati wa kuuza mifugo yako?		....	
B024	Je, ni vigezo gani huwa vinakusababisha uamue kuuza mifugo yako?		....	
B025	Tafadhali panga vigezo vilivyoorodheshwa kulingana na		1=Nguvu ya soko **(1.1 Muhimu sana 1.2 Muhimu, 1.3 Siyo Muhimu)** 2=Mahitaji ya kifedha	

NA.	SWALI	JIBU	UCHAGUZI WA MAJIBU	MAELEKEZO
	umuhimu wake unapoamua kuuza mifugo yako		**(2.1 Muhimu sana 2.2 Muhimu, 2.3 Siyo muhimu)** 3=Vinginevyo(Tafadhali fafanua)	
B026	Je, umewahi kusikia kuhusu unenepeshaji wa mifugo?		1=Ndiyo 2=Hapana	
B027	Kama ndiyo, Unanenepesha mifugo?		1=Ndiyo 2=Hapana	
B028	Kama hunenepeshi, una msimamo gani kuhusu unenepeshaji wa mifugo?		1=Anapenda kunenepesha mifugo 2=Hapendi kunenepesha mifugo 3=Vinginevyo (tafadhali eleza)	
B029	Kama unanenepesha, Ulianza lini?		…… ……	
B030	Ni kizazi aina gani cha ng'ombe unachonenepesha ?		…… …… ……	
B031	Kwa ujumla ni ng'ombe wangapi ulinenepesha kwa kipindi kilichopita?		**2009** **2010** …… ……	
B032	Je, ng'ombe ulionenepesha uliwatoa wapi?		…… …… ……	
B033	Je, unauwezo wa kunenepesha ng'ombe wangapi kwa wakati?		1= 1-30 2= 31-50 3= 51-100 4= 101-200 5= 201-500 6= 501-1000 7= 1001 and above	
B034	Kama unayo habari kuhusu unenepeshaji na hujaanza kunenepesha, ni matatizo gani yanayokufanya ushindwe kunenepesha? Panga matatizo hayo kutokana na umuhimu wake		…… …… …… ……	
B035	Je, kama utapatiwa nafasi, unapenda kunenepesha mifugo?		1= Ndiyo 2= Hapana	

B036 Katika sentensi zifuatazo, tafadhali onyesha kama unakubaliana sana, unakubaliana, Hunauhakika, Hukubaliani, au Hukubaliani kabisa kuhusiana na kuuza mifugo.

Sentensi	**B0361** Nakubaliana sana	**B0362** Nakubaliana	**B0363** Sina uhakika	**B0364** Sikubaliani	**B0365** Sikubaliani kabisa
B03611 Biashara ya kuuza mifugo inakufanya uwe maskini					
B03612 Biashara ya kuuza mifugo inakufanya uwe tajiri					
B03613 Uuzaji wa mifugo lazima ulenge kuuza mifugo ambayo haizai yaani tasa					
B03614 Mifugo yenye umri mdogo lazima iuzwe ili kupata faida kubwa					
B03615 Ng'ombe lazima wanenepeshwe kwanza kabla ya kuuza ili kupata bei kubwa					
B03616 Kuwa na Mifugo mingi kunaongeza thamani ya mtu katika jamii					
B03617 Thamani ya mtu inaweza kupatikana kwa njia nyingine si lazima kuwa na mifugo tu					
B03618 Idadi ya mifugo ni kielelezo kikubwa cha utajiri wa mtu					
B03619 Ng'ombe wachache wenye thamani wanaweza kukupa mapato makubwa kuliko ng'ombe wengi wasio na thamani					

ASANTE SANA

Appendix 4: Questionaire for Beef Cattle Fatteners

Enumerator's name.....
Name of the respondent.....
GPS Coordinates: Longitude.....**Latitude**.....
Questionnaire Number.....
Date.....

Variable code	Question or variable	Response	Coding key	Skip rule
A: PERSONAL CHARACTERISTICS				
A001	Region		1 = Mwanza 2 = Shinyanga	
A002	District		1= Kahama, 2 = Bariadi, 3 = Ngudu, 4 = ..., 5 = ...	
A003	Area		1= Urban 2= Peri-urban 2= Rural	
A004	Urban -Steet -Ward -Division		....	
A005	Peri-urban -Street -Ward -Division		....	
A006	Rural -Village -Ward -Division		....	
A007	Tel. Number of the head of household			
A008	Respondents name			
A009	Sex of respondent		1 = Male, 2 = Female	
A010	Age		1=20 to 40 years ( ) 2= 41 to 60 years ( ) 3= 61 and above years ( )	
A011	Education		1= Not gone to school ( ) 2= Adult education ( ) 3=Primary Education ( ) 4=Secondary education ( ) 5= College education ( ) 6=University education ( )	

<table>
<tr><th>Variable code</th><th>Question or variable</th><th>Response</th><th>Coding key</th><th>Skip rule</th></tr>
<tr><td>A012</td><td>Marital status</td><td></td><td>1 = Married
2 = Cohabiting
3 = Single never married
4 = Widow
5 = Divorced
6 = Other …. Specify</td><td></td></tr>
<tr><td>A013</td><td>For married male respondents, how many wives do you have</td><td></td><td>1= One wife
2=Two wives
3=Three wives
4=Four wives
5=Others ….specify</td><td></td></tr>
<tr><td>A014</td><td>For married female respondents what is your status as a wife</td><td></td><td>1 = First wife,
2 = Second wife,
3 = Third wife,
4 = Fourth wife, 5 = Other ….</td><td></td></tr>
<tr><td>A015</td><td>How many people live in you household</td><td></td><td><table><tr><td>Years</td><td>M</td><td>F</td><td>Total</td></tr><tr><td>0-5</td><td></td><td></td><td></td></tr><tr><td>6-13</td><td></td><td></td><td></td></tr><tr><td>14-25</td><td></td><td></td><td></td></tr><tr><td>26-35</td><td></td><td></td><td></td></tr><tr><td>36-50</td><td></td><td></td><td></td></tr><tr><td>51-60</td><td></td><td></td><td></td></tr><tr><td>61 and above</td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>A016</td><td>How many actively provide labor into the beef fattening enterprise</td><td></td><td>Male……..
Female……
Total……</td><td></td></tr>
<tr><td>A017</td><td>What is your ethinicity</td><td></td><td>……..</td><td></td></tr>
<tr><td>A018</td><td>Were you born in this village?</td><td></td><td>1 = Yes
2 = No</td><td></td></tr>
<tr><td>A019</td><td>If no, which district did you migrate from</td><td></td><td>Codes for all district of Tanzania</td><td></td></tr>
<tr><td>A020</td><td>Which year did you migrate into this village</td><td></td><td>……
.</td><td></td></tr>
<tr><td>A021</td><td>What was the reason for migrating into this village</td><td></td><td>1=Marriage,
2=Accompanied parents, 3=Search for pastures
4=Employment transfer, 5=Search for wage work,
6=Farming,
7=others specify</td><td></td></tr>
<tr><td>A022</td><td>Do you own a house</td><td></td><td>1=Yes
2=No</td><td>If No go to A029</td></tr>
</table>

Variable code	Question or variable	Response	Coding key	Skip rule
A023	If Yes, What are the main materials of the floor		1= earth or sand 2=Dung 3=Ceramic tiles 4=Cement 5=Others (specify)	
A024	What are the main materials for walls		1= Grass 2= Poles and mud 3=Sun-dried Bricks 4= baked bricks 5= Timber 6= Cement Bricks 7= stones 8=Others 9specify	
A025	What are the main materials for roofing		1= Grass/leaves/mud 2= Iron sheets 3=Tiles 4=Concrete 5=Asbestos 6=Others (specify	
A026	Does your house have Electricity		1=Yes 2=No	
A027	What is the source of the electricity		1=National Grid 2=Solar power 3= Kerosine 4= Other sources....Please specify	
A028	Does your house have water		1= Tape water 2= Borehole 3=Shallow well 4= Depend on a river nearby 5=Others (specify)	
A029	Does your house own the listed items?		1= A paraffin lamp 2= A Radio 3= a Television 4= A telephone/Mobile 5=Bicycle 6=Motorbike 7=Car/truck 8=a refrigerator	
A030	What is you status in the beef supply chain		1= Livestock Farmer 2 = Trader buying from farmer and selling 3= Fattening 4 = Transporting 5 = Slaughtering 6 = Others ....(specify)	
B: ABOUT THE BEEF CATTLE FATTENING ENTERPRISE				
B001	How does beef fattening rank as an economic activity for your livelihood		1 = Livestock keeping (**1.1 Most important, 1.2 Important, 1.3 Not important**) 2 = crop farming (**1.1 Most**	

Variable code	Question or variable	Response	Coding key	Skip rule
			important, 1.2 Important, 1.3 Not important) 3= Beef cattle fattening **(1.1 Most important, 1.2 Important, 1.3 Not important)** 4= Business such as shop, hotel**(1.1 Most important, 1.2 Important, 1.3 Not important)** 5=Employee**(1.1 Most important, 1.2 Important, 1.3 Not important)** 6= Others (specify)	
B002	If you are engaged in beef cattle fattening, where did you get the animals for fattening?		1 = Bought from the livestock market 2 = Inherited 3 = Other (specify)	
B003	What categories of animals do you fatten		1=Bulls 2=Heifers 3=Steers 4=Cows 5=Calves 6=Others (specify)	
B004	Which year did you start cattle fattening enterprise		…… ……	
B005	How important is beef cattle fattening in your income earning?		1= Very important 2=Is among other activities 3=Not impotant	
B006	What type of animals do you normally buy in the supply chain for your fattening enterprise		1= Castrated bulls 2= Uncastrated bulls 3= Heifers 4= Culled cows 5= Calves	
B007	What age of animals do you prefer to buy for fattening		1=2-3 years 2=4-6 years 3=7 years and above 4= Others (specify)	
B008	Please specify your preference between Bulls and cows		1 = Bulls 2 = Cows 3=Others (specify)	
B009	Do you have any reasons for the choice made		…… ……	
B010	Which factors do you consider when buying animals for fattening		1= Body comformation **(1.1 Most important, 1.2 Important, 1.3 Not important)** 2=Age **1.1 Most important, 1.2 Important, 1.3 Not important)** 3=Price**1.1 Most important, 1.2 Important, 1.3 Not important)** 4=Animals size**1.1 Most important, 1.2 Important, 1.3 Not important)** 5= Others (specify)	

Variable code	Question or variable	Response	Coding key	Skip rule
B011	From which supply chain actor do you buy your animals for fattening		1= Farmers (**1.1 Frequently,1.2 often, 1.3 not at all**), 2 = Trader buying from farmers(**1.1 Frequently,1.2 often, 1.3 not at all**) 3= Fattening, (**1.1 Frequently,1.2 often, 1.3 not at all**), 4 = Others (specify)	
B012	From which livestock markets do you normally buy your animals		1= Primary markets 2= Secondary markets 3=(Others, specify)	
B013	From which region do you buy it from		1 = Mwanza 2 = Shinyanga 3= Others (specify)	
B014	From which district do you buy it from		1 = Kahama, 2 = Bariadi, 3 = Ngudu	
B015	What is the distance in km from where you buy animals for fattening from		.....	
B016	What type of transport do you normally use for purchased animals		1= Large trucks 2= Medium size Trucks 3= Rail wagons 4= Trek on hoof 5= Others (specify)	
B017	How much do you normally pay for transportation		2009 ..... 2010	
B018	For the last stock bought, what was the average buying prices		Low price High price Bulls .... Cows .... Steers .... Heifers .... Calves	
B019	On averave, what is you capacity to fatten animals		1=1-30 2=31-50 3=51-100 4=101-200 5=201-500 6=501-1000 7=1001 and above	
B020	Are you getting enough animals to fatten		1=Yes 2=No	

Variable code	Question or variable	Response	Coding key	Skip rule
B021	What kind of information is important to you when fattening		....	
B022	From the category of information listed, what is the most important to you		1= Cattle prices(**1.1 Most important, 1.2 Important, 1.3 Not important)** 2=Animal feeds prices(**1.1 Most important, 1.2 Important, 1.3 Not important)** 3=Number of animals available at the market day(**1.1 Most important, 1.2 Important, 1.3 Not important)**	
B023	Who provides you with such information		1=The government(**1.1 Frequently,1.2 often, 1.3 not at all)** 2= Fellow friends(**1.1 Frequently,1.2 often, 1.3 not at all)** 3=Business partners (**1.1 Frequently,1.2 often, 1.3 not at all)** 4=Others ....specify	
B024	How does the information required delivered		1= Through Telephone 2= Through Radio 3= Through Radio and Television 4= Physical contact 5= Others (specify)	
B025	How do you sell your fattened beef cattle?		1 = Fattened live animals, 2 = Meat from slaughtered fattened animals,	
B026	Who is the main buyer of your product?		1=Private people 2=Butcher owners 3=Middlemen 4=Others (Specify)	
B027	Where do the market transactions occur?		1= At the market (**1.1 Frequently,1.2 often, 1.3 not at all)** 2= At the fattening area(**1.1 Frequently,1.2 often, 1.3 not at all)** 3= At the abattoir(**1.1 Frequently,1.2 often, 1.3 not at all)** 4= Export markets(**1.1 Frequently,1.2 often, 1.3 not at all)** 4=Others .....specify	
B028	Please specify livestock markets where fattened animals are sold		1= Primary livestock markets 2=Secondary livestock markets 3= Other livestock markets (please specify)	
B029	What is the distance in kilometers from the fattening area to the selling point		....	
B030	How do you transport a fattened animal to the selling point		1= Large trucks 2= Medium size Trucks 3= Rail wagons 4= Trek on hoof 5= Others (specify)	

Variable code	Question or variable	Response	Coding key	Skip rule
B031	What is the average transportation cost per animal		....	
B032	What factors determine the sale of fattened animals		....	
B033	How important are the listed factors to you when selling fattened animals		1= Good body comformation **(1.1Most important, 1.2 Important, 1.3 Not important)** 2=Attainment of body weight **(1.1 Most important, 1.2 Important, 1.3 Not important)** 3=Forced to sell when profit margins get too little or loss making**(1.1 Most important, 1.2 Important, 1.3 Not important)** 4=Market forces**(1.1 Most important, 1.2 Important, 1.3 Not important)** 5=Others, (specify).....	
B034	At what terms do you sell your animals		1= Cash 2= Credit 3= Other (specify)	
B035	Please provide list of your customers to whom you sold your animals over the last 12 months		1= 2= 3= 4= 5=	
B036	At what prices do you normally sell your animals		Low price High price Bulls .... Cows .... Steers .... Heifers .... Calves	
B037	How many animals have you fattened for the past two years		2009 2010 Bulls .... Cows .... Steers .... Heifers .... Calves	
B038	For the last stock you fattened, what was the		Minimum age Max. age Bulls (castrated).....	

Variable code	Question or variable	Response	Coding key	Skip rule
	average age group		..... Cows .... Steers .... Heifers .... Calves	
B039	How many fattened animals were sold for the last two years		2009 2010 Bulls .... Cows .... Steers .... Heifers .... Calves	
B040	Out of the fattened animals, how many were lost through thefty		2009 2010 Bulls .... Cows .... Steers .... Heifers .... Calves	
B041	Out of the fattened animals, how many were dead due to livestock diseases		2009 2010 Bulls .... Cows .... Steers .... Heifers .... Calves	
B042	Under normal circumstances, who sets the prices for your animals		1= Buyer 2= Seller 3=Market arragements (auction system) 4=The owner of the animal 5=Others(specify)	
B043	For the last stock what was the duration for fattening		1=Three Months 2=Four Months 3=Five Months 4=Six months 5= Others (specify)	

Variable code	Question or variable	Response	Coding key	Skip rule
B044	What are the factors considered when setting prices of an animal		1= Body Conformation(**1.1 Most important, 1.2 Important, 1.3 Not important**) 2=Age(**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Weight(**1.1 Most important, 1.2 Important, 1.3 Not important**) 4=Market forces(**1.1 Most important, 1.2 Important, 1.3 Not important**) 5=Others (specify)	
B045	In most cases are you satisfied with animal prices?		1=Yes 2=No	
B046	If No, please give reasons		…… ……	
B047	Is there any efforts to promote fattening business		1= Informal contracts with customers 2= Formal contracts with customers 3=Telephones, mail 4= Advertisements in Radio, Television or Newspapers 5=Others (specify)	
B048	Do you have any contractual arrangements with suppliers of animals to fatten?		1= Yes 2=No	If Yes go to BO49, Bo50, B051
B049	Do you have any contractual arrangements with buyers of fattened animal?		1= Yes 2=No	If Yes go to Bo50, B051
B050	If yes, what are they?		1= Formal 2= Informal contracts 3=Others (specify)	
B051	What does the contract specify?		1= Price 2= Quality 3= quantity (weight) 4= Time 5= others please specify……	
B052	Is there any efforts to add value to fattened cattle (in partnership or self) through slaughter, processing and packaging of meat products		1=Yes 2=No	If Yes Go to 53
B053	If Yes, briefly describe how it is being done		…… …….	

B054	Is there any problems you encounter during fattening?		1=Yes 2=No	If Yes Go to B055
B055	What constraints are you facing in fattening activity?		1= capital(**1.1 Most important, 1.2 Important, 1.3 Not important**) 2=Land/ area for fattening(**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Availablity of animal feeds(**1.1 Most important, 1.2 Important, 1.3 Not important**) 4= High cost of animal feeds(**1.1 Most important, 1.2 Important, 1.3 Not important**) 5=Selling of fattened animals(**1.1 Most important, 1.2 Important, 1.3 Not important**) 6=Others (specify)	
B056	Do you have any plans to expand and improve your fattening enterprise?		1= Yes 2= No	
B057	If yes, what are the plans		…… ……	
B058	Do you think the Government (DC, Municipality, and MLFD) could assist you in order to improve your fattening business?		1=Yes 2= No	If Yes Go to 59
B059	Please explain how the government can assist		…… ……	
B060	Do you normally get extension services from the government		1=Yes 2=No	
B061	Have ever received any credit to run your business		1=Yes 2=No	
B062	Do you have any recommendation on how to improve beef cattle fattening and hence meat industry in this country?		…… ……	
C: ABOUT FEEDING COSTS				
C001	What type of animal feeds do you use in fattening		1=Graze Only 2= Zero grazing on grass only 3= Graze and supplementary feed 4= Zero grazing on grass and supplementary feed 5=Supplementary feed only 6= Other (Specify)……	

C002	In case of zero grazing using grass only, where do you get the grass from?		1=Buy from market 2= Hire labor to collect 3= Produce from own pasture 4=Other (specify)……..	
C003	In case of supplementary feed, what does it comprise of?		1=Maize bran(**1.1 Most important, 1.2 Important, 1.3 Not important**) 2=Maize(**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Sunflower seed cake(**1.1 Most important, 1.2 Important, 1.3 Not important**) 4=Cotton seed cake(**1.1 Most important, 1.2 Important, 1.3 Not important**) 5= Rice bran (**1.1 Most important, 1.2 Important, 1.3 Not important**) 6=Cotton husks(**1.1 Most important, 1.2 Important, 1.3 Not important**) 7=Salt(**1.1 Most important, 1.2 Important, 1.3 Not important**) 8= Other (specify)……..	
C004	What is the source of supply for cotton seed cake		1=Nearest ginnery 2=Traders at nearest town (specify)… 3= Other (specify)……..	
C005	What is the main source of supply for sunflower seed cake?		1=Nearest sugar factory (Specify)……. 2=Nearest town (Specify)…… 3=Other (Specify)……..	
C006	What is the main source of supply for rice bran?		1=Nearest milling machine (Specify)…. 2=Nearest town (Specify)…… 3=Other (Specify)……..	
C007	What ration of animal feeds do you use per day		1= Cotton seed cake……..kg 2=Sunflower seed cake……..kg 3=Maize barn……..kg 4=Cotton Husks……..kg 5=Salt……..kg 6=Rice bran…….kg	
C008	For the last stock of cattle that you fattened, did you keep records of all the fixed and variable cost that incurred?		1=Yes 2= No	If Yes Go to C009

C009. If Yes, for each fixed input please indicate in the table below the information requested.

Fixed inputs

C0091 Name of item	C0092 Number used	C0093 Buying price or construction cost	C0094 Year Bought	C0095 Expected lifespan
C00911 Shelter/housing				
C00912 Trolleys				
C00913 Feeding structure				
C00914 Watering Points				
C00915 Equipments such scissors for dehorning				
C00916 Others (Specify)				

C010. For each of the variable inputs please indicate the information requested in the table below:

C0101 Name of item	C0102 Amount used		C0103 Buying price		C0104 Total Cost	
	2009	2010	2009	2010	2009	2010
C01011 Cotton seed cake						
C01012 Cotton husks						
C01013 Sunflower seed cake						
C01014 Rice bran						
C01015 Molasses						
C01016 Hay						
C01017 Water						
C01018 Salt						
C01019 Drugs						
C01020 Watchmen						
C01021 Transportation-buying						
C01022 Transportation-selling						
C01023 Labour						
C01024 Identification						
C01025 Dipping						
C01026 Ear notching						
C01027 Inspection cost						
C01028 Maize						
C01029 Maize bran						
C01030 Maize stover						
C01031 Beans stover						
C01032 Market fee						
C01033 Permit fee-buying						
C01034 Permit fee-selling						
C01035 Others (specify)						

C011. Please list the most common diseases or parasites encountered upon entry at fattening place;

1.....

2.....

3.....
4.....
5.....
6.....

C012. For the last stock, indicate the weight gain in each type as follows

	C0121 Weight (entry) in kg	C0122 Weight (exit) in kg	C0123 Increased weight (entry-exit) in kg
C0121 Bull...			
C0122 Cow...			
C0123 Steer...			
C0124 Heifer...			
C0125 Calf...			

C013 Please, provide your opinion about beef cattle fattening

.....
.....

THANK YOU

Appendix 5: Questionnaire for Livestock Keepers

Enumerator's name.....
Name of the respondent.....
GPS Coordinates: Longitude.....**Latitude**.....
Questionnaire Number.....
Date.....

Variable code	Question or variable	Response	Coding key	Skip rule
A: PERSONAL CHARACTERISTICS				
A001	Region		1 = Mwanza 2 = Shinyanga	
A002	District		1= Kahama, 2 = Bariadi, 3 = Ngudu, 4 = …., 5 = ….	
A003	Area		1= Peri-urban 2= Rural	
A004	Peri-urban -Street -Ward -Division		…… …… …… …… …… …….	
A005	Rural -Village -Ward -Division		…… …… …… …… …… …….	
A006	Tel. Number of the head of household			
A007	Respondents name			
A008	Sex of respondent		1 = Male, 2 = Female	
A009	Age		1=20 to 40 years ( ) 2= 41 to 60 years ( ) 3= 61 and above years ( )	
A010	Education		1= Not gone to school ( ) 2= Adult education ( ) 3=Primary Education ( ) 4=Secondary education ( ) 5= College education ( ) 6=University education ( )	
A011	Marital status		1 = Married 2 = Cohabiting 3 = Single never married 4 = Widow 5 = Divorced 6 = Other …. Specify	
A012	For married male respondents, how many wives do you have		1= One wife 2=Two wives 3=Three wives 4=Four wives 5=Others ….specify	
A013	For married female respondents what is your status as a wife		1 = First wife, 2 = Second wife, 3 = Third wife, 4 = Fourth wife, 5 = Other ….	
A014	How many people live in you household			

Variable code	Question or variable	Response	Coding key	Skip rule
			Years | M | F | Total 0-5 6-13 14-25 26-35 36-50 51-60 61 and above	
A015	How many are actively providing labor into the beef fattening enterprise		Male..... Female..... Total.....	
A016	Were you born in this village?		1 = Yes 2 = No	
A017	If no, which district did you migrate from		Codes for all district of Tanzania	
A018	Which year did you migrate into this village		.....	
A019	What was the reason for migrating into this village		1=Marriage, 2=Accompanied parents, 3=Search for pastures 4=Employment transfer, 5=Search for wage work, 6=Farming, 7=others specify	
A020	Do you own a house		1=Yes 2=No	
A021	If Yes, What are the main materials of the floor		1= earth or sand 2=Dung 3=Ceramic tiles 4=Cement 5=Others (specify)	
A022	What are the main materials for walls		1= Grass 2= Poles and mud 3=Sun-dried Bricks 4= baked bricks 5= Timber 6= Cement Bricks 7= stones 8=Others 9specify	
A023	What are the main materials for roofing		1= Grass/leaves/mud 2= Iron sheets 3=Tiles 4=Concrete 5=Asbestos 6=Others (specify	
A024	Does your house have Electricity		1=Yes 2=No	
A025	Does your house have water		1= Tape water 2= Borehole 3=Shallow well 4= Depend on a river nearby 5=Others (specify)	
A026	Does your house own the listed items?		1= A paraffin lamp 2= A Radio 3= a Television 4= A telephone/Mobile 5=Bicycle	

Variable code	Question or variable	Response	Coding key	Skip rule
			6=Motorbike 7=Car/truck 8=a refrigerator	
A027	Other main occupation		1=None 2=Salaried employment 3=Farming crops 4=Businessman/woman 5=Handcraft 6=Student 7=others (specify).....	
A028	What is the main source of income		1= Livestock (**1.1 Most important, 1.2 Important, 1.3 Not important**) 2= Crops farming (**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Employment (**1.1 Most important, 1.2 Important, 1.3 Not important**) 4= Others (please specify)	
B: ABOUT LIVESTOCK KEEPING				
B001	Ow many animals did you own for the past three years		2009 2010 2011 Bulls ..... Cows ..... Steers ..... Heifers ..... Calves	
B002	Breeds of the animals owned		Bulls ..... Cows ..... Steers ..... Heifers ..... Calves	
B003	How do you identify your animals?		1=Branding 2= Ear notching 3= Others (specify)	
B004	What type of grazing are you practicing?		1=Free range grazing 2= Zero grazing 3= others (specify).....	
B005	How many acres of land do you have for farming or grazing (established pasture)		Area for livestock farming.....acres (Applicable only for established pastures) Area for crop farming .....acres	
B006	Normally, do you sell your animals?		1=Yes 2=No	If, No go to B008
B007	Please give reasons, if you normally dont sell your		.....	

Variable code	Question or variable	Response	Coding key	Skip rule
	animals		.....	
B008	Where do you normally sell your animals?		1=Primary livestock markets 2=Secondary livestock markets 3=Slaughter houses 4=Others (specify)	
B009	At what terms do you sell your animals		1= Cash 2= Credit 3= other (specify).....	
B010	At what price do you sell your animals?		Min. Price Max. price Bull .... Cow .... Steer .... Heifer .... Calves .... Goats .... Sheep	
B011	Are you satisfied with the current prices offered for your animals?		1=Yes 2=No	
B012	If Yes/No Why provide reasons			
B013	Approximately, how many animals were sold by you for last two year (indicate numbers)		o 2010 Cattle .... Goats .... Sheep	
B014	Who normally sets the price for your animals?		1= Buyer 2= Seller 3=Owner of the animals (you) 3= Other (specify)	
B015	What factors are considered when setting the selling prices for your animals		1= Weight(**1.1 Most important, 1.2 Important, 1.3 Not important**) 2=age (**1.1 Most important, 1.2 Important, 1.3 Not important**) 3= Market force(**1.1 Most important, 1.2 Important, 1.3 Not important**) 4=Others (specify).....	
B016	Are you satisfied with the current prices offered		1= Yes 2= No	
B017	If Yes/No Why provide reasons		....	
B018	If No, What can be done to change the situation		1=Fattening (**1.1 Most important, 1.2 Important, 1.3 Not important**) 2= Improve animal breeds(**1.1**	

Variable code	Question or variable	Response	Coding key	Skip rule
			Most important, 1.2 Important, 1.3 Not important) 3=Change livestock marketing system(**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Others (specify)	
B019	When selling cattle, which type do you sell most?			
	B0191 Young and immature		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
	B0192 Mature animals		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
	B0193 Barren (infertile)females		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
	B0194 Old animals		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
	B0195 Unused draught animals		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
	B0196 Emaciated or sick animals		1= Most frequently 2= Frequently 3= Less frequently 4=Don't sell	
B020	What was the mode of the trade practiced?		1= Contract 2= First come/first saved 3= Others (specify).....	
B021	Which season /month of the year do you sell your animals most?		1= Rain season 2= Dry season 3= Just before rain season 4= Just after rain season	
B022	Please provide reasons for your choice		.....	
B023	What problems do you face when selling cattle?		.....	
B024	What are the major factors normally influence your decision to sell your animals?		.....	
B025	Please arrange the factors listed in order of their imprtance to you when deciding to sell your animals		1=Market forces(**1.1 Most important, 1.2 Important, 1.3 Not important**) 2=Need for cash(**1.1 Most important, 1.2 Important, 1.3 Not important**) 3=Others (specify)	
B026	Are you aware about beef cattle fattening?		1=Yes 2=No	

Variable code	Question or variable	Response	Coding key	Skip rule
B027	If yes, are you fattening your animals?		1=Yes 2=No	
B028	If No, what do you think about doing fattening?		1=Like doing fattening but not started 2=Do not like doing fattening 3=Others (specify)	
B029	If Yes, when started fattening?		…… ……	
B030	Whicha animal breeds do you fatten		…… ……	
B031	How many animals did you fatten for the past two years		2009 2010 Cattle …… …… Goats …… …… Sheep …… ……	
B032	Where did you get the animals you fattened		…… ……	
B033	What is your capacity to fatten animals		1= 1-30 2=31-50 3=51-100 4=101-200 5=201-500 6=501-1000 7=1001 and above	
B034	If you are aware about fattening and you do not want to practice it, what are the major challenges you are facing? Arrange the challenges according to their importance to you		…… …… …… ……	
B035	If you are given an opportunity are you ready to do beef cattle fattening?		1=Yes 2=No	

B036 In the following statements, could you indicate whether you strongly agree, agree, uncertain, disagree or strongly disagree towards selling animals.

Statement	B0361 Strongly Agree	B0362 Agree	B0363 Uncertain	B0364 Disagree	B0365 Strongly Disagree
B03611 Commercial selling of livestock predisposes towards poverty					
B03612 Commercial selling of livestock is a way to become rich					
B03613 Selling of animals should be restricted to unproductive animals (e.g barren females, old, debilitating animals)					
B03614 Young and immature animals should be sold to fetch good profit					
B03615 Livestock should be fattened before selling in order to get higher prices					
B03616 Livestock provides the most prestigious social status					
B03617 Status can be equally achieved in other ways rather than livestock					
B03618 Number of livestock is the most determinant to accumulation wealth					
B03619 Few productive animals can provide higher income than many animals unproductive					

THANK YOU