

**EVALUATION OF CATTLE FINISHING SYSTEMS AND AVAILABILITY
OF ANIMAL FEEDSTUFFS IN MAGU AND ILEMELA DISTRICTS,
MWANZA REGION**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
TROPICAL ANIMAL PRODUCTION OF SOKOINE UNIVERSITY OF
AGRICULTURE. MOROGORO, TANZANIA.**

2014

ABSTRACT

A study was carried out in Magu and Ilemela districts in Mwanza region to characterize cattle finishing systems and identify the factors limiting cattle growth performance. A total of 120 agro pastoralists and 30 cattle finishing entrepreneurs were interviewed using questionnaires. Seven focus group discussions were also performed. In addition, monitoring study on cattle growth performance was done for 56 days on a total of 105 cattle, of which body weight gain of cattle was measured fortnightly. Forages and concentrates used by farmers were collected and subjected into chemical analysis and *in vitro* dry matter digestibility estimated. The identified cattle finishing systems were grazing alone (GrazAlo), grazing with concentrate supplementation (GrazSup) and feedlotting. Cattle under GrazAlo showed lower ($P<0.001$) body weight gain (0.21kg/day) than those under GrazSup (0.51 kg/day). Natural forages exist in both districts whereas the dominant crop residues in Ilemela and Magu districts were indicated to be maize stover (97.5% and 100% of respondents, respectively) and rice straws (92.5 % and 98.8% of respondents, respectively). Supplements for cattle finishing in both districts were shown to be cotton seed hulls and cotton seed cake with crude protein of 93.91 and 363.9 g/kg DM, respectively. The identified constraints for agro pastoralists in Ilemela and Magu districts were inadequate grazing land (65.9% and 34.5% of respondents, respectively) and inadequate feed resources (31.7% and 60.5% of respondents, respectively). All interviewed cattle finishing entrepreneurs in Ilemela district reported inadequate grazing lands whereas those in Magu district reported high cost of drugs (100% of respondents) and inadequate water (100% of respondents) to be the main challenges. It is concluded that, the growth performance

of cattle under grazing alone in the study areas is poor due to inadequate nutritional supply. Concentrate supplementation to these animals will improve cattle productivity.

DECLARATION

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

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Date

The above declaration is confirmed by;

Prof. Laswai, G. H

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ACKNOWLEDGEMENTS

All thanks and praises are to the Almighty God who brings light in the success of my study. I extended my good will to Prof. Laswai, G. H. for her tireless work in supervising this research; her useful guidance; comments and suggestions bring this work into an academic and developmental material.

I feel pleasure to express my heartiest gratitude and profound indebtedness to my sponsor Irish Aid for their great support in funding my studies. It is my will to express my special thanks to coordinator of postgraduate in the Department of Animal Science and Production Dr. Mbagwa S. H. for his tireless guidance and advice during my study. I am highly indebted to express my special thanks to Prof. Katule, A. M, Dr. Shirima, E. J. M. and Mr. Nziku, Z. for their tireless help during data analysis of this work.

I am highly expressing my thanks to my respectable professors, lectures, technicians and secretaries in the Department of Animal Science and Production for their constructive advice, unfailing patience and inspiring attitude during my course, research and writing this thesis. Special appreciations go to my fellow students in MSc. Tropical Animal Production 2011 for their cooperation during my studies, without their support I could not reach this step.

I am greatly indebted to Lake Victoria Research Initiative (VicRes), through the Inter-University Council for East Africa (IUCEA) for their support during preparation of tools and collection of data in Mwanza. The author is also extending

his appreciations to stakeholders of cattle production in Mwanza, which includes agro pastoralists, cattle finishing entrepreneurs and cattle traders for good information during Value Chain Workshop held in Mwanza on 31 October 2012, questionnaire survey and focus group discussions. Without forgetting Mwanza regional leaders, Magu and Ilemela district administrative leaders, livestock and agricultural officers are highly thanked.

I am greatly indebted to my friends, Edwin Chang'a and Cyril Massawe for their good support during my studies in Mwanza and Morogoro. Special thanks go to my wife, parents, relatives whose concern and cooperation brings the success of this study.

Nevertheless, it is difficult to acknowledge everyone. I wish to give my full thanks to everybody who in one way or another contributed to the success of this study.

DEDICATION

I dedicate this work to my beloved wife Edina Mmanywa for her strong patience during my study. Also this work is dedicated to my parents Polycarp James and Maria Shangali for their moral and financial support throughout my study.

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LIST OF ABBREVIATIONS AND SYMBOLS

ADF	Acid Detergent Fibre
ADG	Average Daily Gain
BW	Body Weight
CF	Crude Fibre
CP	Crude Protein
CSC	Cotton seed cake
CSHs	Cotton seed hulls
CVL	Central Veterinary Laboratory
DM	Dry matter
EE	Ether Extra
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
g	gram
HG	Heart Girth
IVDMD	<i>In vitro</i> dry matter digestibility
IVOMD	<i>In vitro</i> organic matter digestibility
Kg	Kilogram
kgBW ^{0.75}	Metabolic body weight
KJ	Kilo joules
ME	Metabolizable energy
MJ	Mega joules
MLD	Ministry of Livestock Development

MLFD	Ministry of Livestock and Fisheries Development
NARCO	National Ranching Company
NDF	Neutral Detergent Fibre
NIRS	Near Infrared Reflectance Spectrophotometer
NSCA	National Sample Census of Agriculture
REPOA	Research on Poverty Alleviation
RP	Rice polishing
SAS	Statistical Analysis System
SEM	Standard Error of the Mean
SL	Significant Level
SSC	Sunflower seed cake
TSZ	Tanzania Shorthorn Zebu
UGA	University of Georgia
UNIDO	United Nations Industrial Development Organization
URT	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

Tanzania has a large number of cattle with approximately population of 22.8 million (MLFD, 2012). The country has not utilized well this opportunity to raise its economy (URT, 2010; Mlote *et al.*, 2012). Most of cattle production is under traditional sector of which 80 % are under agro pastoral while 14 % are under pastoral production systems and only 6 % of the cattle are under commercial sector (MLFD, 2010). Cattle breeds found in the country are Tanzania Shorthorn Zebu (TSZ), Ankole, Boran and their crosses (MLD, 2006). Commercially, cattle are raised in ranches and some are finished under small cattle finishing units owned by cattle finishing entrepreneurs. Mwanza region in the Lake Victoria basin is one of the regions in Tanzania with high population of Livestock. The number of cattle in Mwanza is estimated to be 1 976 971 heads produced by agro pastoralists (NSCA, 2007/2008). Most of these cattle are grazing on natural pasture and crop residues, which face shortage of grazing lands and inadequate supply of quality animal feeds especially during dry season. These challenges force intensification of cattle production under landless production system where animals are grazed with concentrate supplementation (Mathew *et al.*, 2013). Cattle are confined to be finished before selling for slaughter.

Cattle finishing is a short period of maximum weight gain to allow well grown animals to maximise meat yield and optimise fat cover before slaughtering (Brown *et al.*, 2008). The practice of cattle finishing in Mwanza region is mainly done by

cattle finishing entrepreneurs who are the business men. They purchase cattle and feed them well for some months before selling with the aim of improving their body condition for good price. Cattle finished by cattle finishing entrepreneurs are bought from auction markets and agro pastoralists. Usually finishing of cattle in Mwanza region is done during the dry season. In this season cattle from agro pastoralists are weak due to shortage of feeds, hence sold at quite low prices. Cattle entrepreneurs normally feed them with concentrate diets with little roughages to provide structure. Cattle finished under concentrate supplementation increase muscle turn over which results into large carcass weight. Some cattle finishing entrepreneurs finish their cattle through feedlotting. Feedlotting is a practice of confining cattle and providing concentrates with drinking water and for the purpose of meat production. Cattle under feedlotting are mainly provided with concentrate diets *ad libitum* and little forage to supply structure.

Most of agro pastoralists in developing countries raise their cattle on grazing alone which is the major finishing system. This system faces many challenges, such as shortage of pasture, shortage of water, shortage of grazing land, diseases and parasites, which lead into low body weight of animals (Mutibvu *et al.*, 2012). Animals harvested from grazing alone are often not well finished, resulting in low dressing percentage and low meat tenderness (Weisbjerg *et al.*, 2007). Shortage of grazing land is contributed by expansion of crop cultivation, increase in human population and industrialization (Baiden, and Duncan, 2008, Severe and ZoBell, 2011 and Chibinga *et al.*, 2012). Shortage of feeds is even worse during the dry seasons which lead into emaciation of animals. In Mwanza region, cattle are largely

raised on sole grazing by agro pastoralists whereas some cattle entrepreneurs raise their cattle on grazing with concentrate supplementation. Documented information on feed availability and performance of cattle on both grazing system and grazing with concentrate supplementation is scarce in Mwanza region.

Mwanza region with large number of cattle and crop cultivation could be used as a hub for cattle finishing. Cattle finished under grazing with concentrate supplementation reported to perform better than those on grazing alone based system (Asizua, 2010). Reinhardt *et al.* (2012) reported the average daily gain of cattle on feedlotting to range from 0.79 to 2.43 kg/day while Msanga and Bee (2006) reported weight gain of Friesian x Boran bulls under grazing alone in Handeni and Bagamoyo Tanzania to be 0.335 kg/day. It has been reported that, energy spent by muscle on chewing, ruminating and locomotion accounted for 23% of energy requirements of extensively grazing animals (Caton and Dhuyvetter, 1997). Thus, intensification of cattle during finishing retain large amount of energy for growth. The reported low weight gain of cattle under grazing is attributed to inadequate nutrients to meet the animal requirements for both maintenance and growth. It has been reported that, the most important factors limiting livestock productivity are feed quantity and quality (Buttery *et al.*, 2005; Asizua, 2010) and these might be the factor rendering cattle production in some areas of Mwanza region.

In addition, seasons which include wet season and dry season have an influence on cattle performance (Abusuwar and Ahmed, 2010). During wet season there are plenty of livestock feeds which promote high growth rate of cattle (Abusuwar and

Ahmed, 2010). Growth rate of cattle can also be influenced by year in the sense that, the year with less diseases, optimum rainfall and temperature result into good growth performance. Another factor which influences growth performance and seasonal dependant is feed availability. Also growth performance of cattle depends on cattle breed (Zahradkova *et al.*, 2010), for instance Brahman cattle grows faster compared to TSZ. Other factors which influence growth performance are sex. Bulls and steers grow faster compared to female animals. Diseases and parasites have negative effect on the growth performance of an animal as they interfere with feed intake (Tolera and Abebe, 2007).

Generally the factors affecting growth performance of an animal are controlled by proper feeding. Proper feeding of animals is influenced by seasonal availability of feeds. Forages are scarce with poor quality during dry season, which contributes to low body weight of cattle in the auction markets (Mugerwa 2001 cited by Asizua, 2010). Thus, growth performance of cattle depends on the availability of feeds.

To produce cattle with good body condition in all seasons, adequate and quality feeds are needed. Studying seasonal availability and quality of livestock feeds will give insight on the improvement of cattle in Mwanza region. Apart from feeding, cattle finishing are constrained by diseases and shortage of water (Mutibvu *et al.*, 2012). These are the challenges faced by cattle production in many parts of Tanzania. Limited information is available on the constraints affecting cattle finishing in Mwanza region. Therefore, research on the characteristics of cattle finishing systems, availability of feeds, growth performance of cattle and constraint

on cattle finishing could give insight on cattle improvement. The general objective of the study therefore, was to evaluate the cattle finishing systems, feed availability and identify the factors limiting cattle performance in selected areas of Mwanza region.

The specific objectives of the study were:-

- i) To assess the general characteristics of cattle finishing systems in Ilemela and Magu districts of Mwanza region
- ii) To determine the growth performance of cattle finished under different systems.
- iii) To evaluate the seasonal availability and quality of feed resources for finishing cattle in the study areas
- iv) To identify and assess constraints to cattle production in the study area.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Preamble

Cattle finishing through different finishing systems in the tropics have been emerging as the feeds are still becoming scarce. Natural forages are still becoming scarce due to population growth and prolonged droughts. Most of cattle in the tropics are finished by traditional agro pastoralists who depend on natural forages. Optimal performance of cattle under traditional agro pastoralists has not been realized due to several constraints such as inadequate feeds, low grazing lands and diseases. Most of the feeds used during dry season are of low quality and they are inadequate due to drought condition. Thus, there is a need for concentrate supplementation during dry season. This chapter provides information on the overview of cattle finishing systems, feed availability for cattle finishing, common feeds used for cattle finishing, and the main constraints affecting cattle production under traditional systems of the Lake Victoria basin. The main purpose of the chapter is to identify knowledge gaps in relation to cattle production systems.

2.2 Cattle Finishing Systems in Tanzania

Cattle finishing is a short period of maximum weight gain to allow well grown animals to maximise meat yield and optimise fat cover (Brown *et al.*, 2008). Efficiency of weight gain to maximize meat yield increased when rations are consumed at a level to supply a large amount of energy in relation to body weight. Cattle under finishing should be provided with high energy and protein

requirements for maintenance and body weight gain. Usually in developing countries, Tanzania inclusive, cattle are finished when matured at age 4 to 10 years and are normally finished for 3 to 4 months to attain good slaughter weight (Mlote *et al.*, 2012). Cattle can be finished on grazing based, grazing with concentrate supplementation or feedlotting systems.

2.2.1 Grazing based system

Grazing based system of finishing cattle is a system whereby cattle depend entirely on pasture and forage diets as source of nutrients. Finishing cattle on grazing alone need abundant forages with good quality to supply enough nutrients to meet animal requirements. Most of cattle in Tanzania depend on grazing alone, which is practiced by pastoralists and agro pastoralists. Cattle are grazed under extensive system, where animals walk long distances for pasture and water, especially during dry season. Long distance walking for pasture and water need high energy requirement for maintenance, which reduce productivity of grazing animals (Asizua, 2010). Brosh *et al.* (2010) showed that grazing cows needed between 89 and 103 KJ/kgBW^{0.75}/day for walking and grazing compared to 42 to 47 KJ/kgBW^{0.75}/day required for standing. There is potential energy wastage from cattle when searching for forages and water which could be retained through intensification. Feeding cattle on grazing alone during dry season faces challenges of inadequate feed and shortage of water whereby animals become emaciated. Meat from animals under grazing alone is of low quality, because cattle are sold while they are old, low body weight, emaciated with poor body condition score (Luziga, 2005 cited by Mwilawa *et al.*, 2011). It has also been found that Boran x Friesian

bulls under grazing alone system could attain average daily weight gain of only 0.335 kg (Msanga and Bee, 2006). Low productivity of animals on grazing alone is attributed to shortage of forages (Assefa *et al.*, 2013) and the energy needed for walking long distances searching for food and water during dry season. When dry season advances it may lead into death of cattle (MMA and CDP, 2008).

Another challenge which faces cattle finishing on grazing alone is reduced grazing lands due to crop cultivation and increase of human population, which reduce pasture production (Komwihangilo *et al.*, 2009). These challenges are compounded by the fact that the herders lack land tenure rights (FAO, 2006). In addition, large land taken by investors has resulted into shortage of grazing lands in some areas (Mtengeti, 1994). The author also reported that, most pastoralists have lost grazing rights of large grazing areas of pasture due to government policies that support private and state farms or ranches. In addition, increase of livestock population and poor management of feed resources in grazing areas reduce forages availability for cattle production (Chibinga *et al.*, 2012). Therefore, the challenges mentioned could be solved by finding alternative cattle finishing systems, which will improve cattle production.

2.2.2 Grazing with concentrate supplementation system

Grazing with concentrate supplementation is a system where cattle are grazed for some hours and stall fed with concentrates. It is a system commonly practiced by cattle finishing entrepreneurs in Mwanza and Shinyanga (Mlote *et al.*, 2012). The need for concentrate supplementation to cattle production is increasing as the

grazing lands are becoming scarce. Human population is increasing and land for grazing is devoted for food crop cultivation and residential areas resulting into shortage of forages, which force livestock keepers to intensify cattle production (Massawe *et al.*, 1996). Grazing with concentrate supplementation is one of the common strategies used to improve performance of ruminants. Animals supplemented with concentrates put more weight and possess good body condition scores after receiving enough energy and protein, which attracts customers in the markets (Mwilawa, 2012). It has been observed by Asizua (2010) that cattle supplemented with concentrate in Uganda had higher average daily gain (ADG) of 0.55 kg/day than those on grazing alone, which had ADG of 0.27 kg/day. McDonald *et al.* (2002) noted that steers weighing 300 kg can gain 1 kg live weight per day after utilizing 23 MJ of net energy for maintenance and 16 MJ of net energy for growth. In addition, meat produced from such animals is more tender than meat from cattle finished under grazing alone (Mwilawa *et al.*, 2009). Thus, cattle finished under grazing with concentrate supplementation have shown better performance with good quality meat. However, this kind of finishing practice in Tanzania and other developing countries is underdeveloped.

2.2.3 Feedlot system

A beef feedlot is a confined yard area with watering and feeding facilities where cattle are completely hand or mechanically fed for the purpose of production (Mawona, 2010). It is an intensive cattle finishing system where animals grow faster than the grazed alone because of high energy and protein supply and good management. Restriction of cattle movement under feedlotting reduces energy for

maintenance, which lead to energy being deposited in muscles in form of intramuscular fat. Animals kept under this system produce tender meat with marbling and juiciness (Mwilawa *et al.*, 2011). Eating quality of this meat is high, hence increases demand in the internal and external markets of Tanzania (Mwilawa, 2012). Cattle under feedlot have weight gains ranging from 1 to 1.5 kg per day and feed conversion rates are about 8 to 10 kg feed per kilogram of weight gain (Steinfeld and Maki-Hokkonen, 1995). However, Mawona (2010) reported weight gain of 0.44 to 0.78 kg/day and feed conversion ratio ranging from 11.3 to 17.4 kg feed DM per kg weight gain in Mwanza region.

2.3 Factors Influencing Growth Performance of Cattle

Growth is defined as an increase in body weight and it includes cell multiplication (hyperplasia) and cell enlargement (hypertrophy) (Ndlovu *et al.*, 2007). Growth performance of cattle is determined by feed availability in both quantity and quality (Charles, 2012). The main factors influencing growth performance of cattle are animal genetics, animal nutrition, sex, climate, diseases and parasites, age of an animal and seasonal availability of feeds.

2.3.1 Animal genetics

The genetic makeup of an animal has influence on growth performance as animals differ on genetic potential for growth. It has been found by Zahradkova *et al.* (2010) that Limosin and Charolais cattle of the same age finished under the same concentrates had average daily gain (ADG) of 0.911 kg/day and 1.194 kg/day, respectively. This difference in ADG was due to breed differences (Zahradkova *et*

al., 2010). In addition, there is breed differences on adaptation to a given environmental conditions. Indigenous breeds, such as Tanzania short horn zebu (*Bos indicus*) can thrive well on harsh environmental conditions, such as high temperature, extreme humidity, poor nutrient soils and threats of parasites (Magnabosco *et al.*, 2002 cited by Pico, 2004). The Zebu breeds and performs well, whereas *Bos taurus* breeds cannot survive well in a stressed environmental condition (ATPS, 2013). It has been observed that when animals are genetically adapted to extreme conditions, they are more productive (ATPS, 2013), implying that, keeping well adapted cattle breed could give good production. Cattle breeds with small body size such as TSZ are well adapted in tropical countries because there are inadequate feeds, diseases, parasites, high temperature, and high humidity, which cannot favour *Bos taurus* breeds. Cattle breeds found in Tanzania are mainly TSZ, Ankole, Boran and their crosses which are used as source of meat and some milk (MLD, 2006). Some improved cattle breeds in Tanzania are Mpwapwa, Ankole, Boran, and strains of TSZ such as Ufipa. The TSZ and Ankole are the main source of meat in Tanzania (MLD, 2006).

2.3.2 Animal nutrition

An animal needs proper nutrients to meet maintenance and production functions. The nutrient requirement for cattle is influenced by functions, such as maintenance and growth. Nutrient requirement depends on the age, weight, sex and physiological status of the animal (McDonald *et al.*, 2002). In addition, nutrient requirement of cattle depends on the growth rate of cattle. For proper growth, cattle will require energy, protein, vitamins, fat, minerals and water. The limiting nutrients for animal

production in the tropics are protein, energy and minerals (Crowder and Chheda, 1982). However, optimum protein and energy is required for proper growth of cattle. The recommended energy for cattle finishing ranging from 12.5 to 13.6 MJ ME/kg under East and Central Africa conditions (Topps and Oliver, 1993; Mwilawa, 2012). Brown *et al.* (2008) reported protein requirement for cattle finishing to be 120g/kg DM to 150g/kg DM, which is within the values of 135 g/kg DM to 171 g/kg DM reported by Weisbjerg *et al.* (2009). However, optimum energy and protein is needed to promote feed intake.

Poor quality feeds have negative effect on feed intake due to low energy and protein, which necessitate concentrate supplementation. It has been reported that, cattle which depends on poor quality roughages has low feed intake due to stomach fill (Tahir, 2008). When stomach is full with feed material, the rumen will fail to accommodate more feed. During dry-season, perennial forages at advanced stages of maturity have inadequate supply of crude protein, which effectively limits energy intake (Mathis, 2003). Daily dry matter intake has a great influence on body maintenance and production performance. Forbes (1995) reported that, feed intake has more effect on cattle performance than digestibility of feed. Forages during dry season need to be supplemented with concentrates to increase protein and energy to improve forage intake and digestibility. Daily dry matter intake to supply nutrients depends on seasonal availability of livestock feeds. Availability of feeds depends on prevailing climate change. It has been reported that, prolonged drought condition and unreliable rainfall which vary from year to year due to climate change has caused the shortage of forages for cattle production (Assefa *et al.*, 2013).

The variation in annual precipitation and its distribution result into variation of forage biomass yield, quality and availability from time to time. It has been reported by Mohammed and Abate (1995) and Tebeje (2012) that availability of livestock feeds depends on the amount of crops harvested and amount of rainfall. Lanyasunya *et al.* (2006) reported that surplus of forage material exists during the rainy season while there is severe shortage during the dry season. Also Mutimura and Everson (2011) reported that during rainy season a wide range of forages are available whereas during dry season feed resources become scarce sometimes leading to death of cattle. Season influences forage and crop production and determine the quantity of animal feeds. It has been reported that level of crop production determine the quantity of crop residues (Wortman *et al.*, 2012). Season with low production of crops affects production of crop residues negatively due to crop failure (Owen and Jayasuriya, 1989). The major available feed resources for ruminants in tropics fall into the category of natural forages, straws and stovers, agro industrial byproducts such as cotton seed hulls which are deficient in nutrient and vary from season to season (IAEA, 2000).

Water is also very important element in animal nutrition for cattle production as it influences feed intake and other body processes. It is an important component in many body functions including temperature regulation, growth, reproduction, lactation, and many metabolic functions. In addition water is used to dissolve glucose, amino acids, mineral ions, water soluble vitamins and metabolic waste transport in the body (Schlink *et al.*, 2010). Limited availability of water or presence of contaminants in the supply has found to have a significant effect on

animal health and productivity (Schlink *et al.*, 2010). Reduced water intake will reduce feed intake and consequently decrease weight gain. It has been reported that cattle require an average of 38 litres of water per day (Ward and Mckague, 2007).

2.3.3 Sex

Growth performance of cattle is also influenced by the sex of an animal. The growth rate of intact bulls is higher compared to steers and cows. It has been found by Bures and Barton (2012) that average daily gain of bulls and heifers of the same breed (crossbreed of Charolais × Simmental) of the same age and finished under identical management conditions had ADG of 1.31 kg/day and 0.93 kg, respectively. The author also reported that, slaughter weights of bulls and heifers after 18 months of age in the same experiment were 683.8 kg and 543.3 kg respectively. Thus, there is a sex difference in weight gain of cattle reared under the same environmental condition and management. It has also reported by Morris (2003) that entire males have greater growth potential than castrates and females. Therefore, entire male cattle demand more energy and protein for growth than heifers and steers.

2.3.4 Climate

Environmental temperature and humidity has an influence on dry matter intake. Dry matter intake declined linearly with respective increases in temperature humidity index during hot period (West *et al.*, 2003). Temperature humidity index cause heat stress to animals. It has been stated that, heat stress is of great enough duration and magnitude to threaten a rise in core temperature, of which an animal will reduce

intake of feed in order to reduce metabolic heat production (Sunil *et al.*, 2011). Thus, reduction of feed intake will lead into low growth rate of an animal. Heat stress can be reduced by proper housing, construction of sheds in the feeding troughs, planting trees around the finishing unit and setting sprinkles. Sprinkling has been seen as a useful tool to alleviate heat stress and improve feed intake which ultimately improve cattle performance during hot seasons (Mader, 2003). In developing countries simple structures can be made using locally available materials like thatch grass for animals to hide during hot season. Also trees can be planted to provide natural shadings but care should be taken to reduce excess shed which can affect pasture growth. Cost implications on constructing shadings and facilities for cooling should be observed to reduce cost of production.

2.3.5 Diseases and Parasites

An ill condition due to internal and external parasites affects normal performance of an animal. This is because animals will reduce feed intake. Controlling parasites for instance deworming increase feed intake by about 3% (Cundiff *et al.*, 2004). Disruption in feed intake due to sick cattle may be sufficient in some individuals to cause them to have fewer effective days on feed than pen mates. Variation in feed intake due to sickness may have indirect effect on carcass composition due to change in rate and extent of fat deposition with days on feed (Larson, 2005). Parasites have negative effect to the growth performance of cattle on body weight gain and milk production (Tolera and Abebe, 2007). However, it has also been reported that parasites can cause significant losses in cattle production and severe diseases which can lead to death of cattle (UGA, 2012). In addition, diseases like

Bovine respiratory disease (BRD) are associated with decreases in average daily gain in feedlotting. Also quality of meat is affected by diseases, for instance marbling or muscle tenderness is negatively impacted by lung lesion.

2.3.6 Age of an animal

Age of an animal is an important issue to consider during finishing of cattle. Young cattle has high growth rate compared to old cattle. It has been reported that, cattle can enter into finishing at 1 to 2 years depending on the required slaughter weight by a producer (Chiba, 2009). The range of age for finishing cattle is almost similar to that reported by Iwuanyanwu (2001), which was 2 to 2 ½ years.

2.4 Common Feeds used for Finishing Cattle

Feeds which are commonly used for cattle production are pastures, fodder crops, crop residues and industrial byproducts. Most cattle depend solely on pasture as source of food but in tropics there is seasonal variation of both quantity and quality of pasture and crop residues which affect the year round availability and quality feeds. It has been reported that, during dry season forages lose many nutrients such as proteins and energy which are necessary for animal growth (Alhassan, 1987 cited by Amole *et al.*, 2013). Also the area for grazing and pasture production is dwindling due to increased land requirement for crop production and climatic change; this has lead to serious shortage of the pastures during dry season and conflicts between livestock and crop farmers (MLFD, 2011). Variation in feed availability and quality due to dry condition cause uneven growth performance of cattle resulting into cattle with low body weight in the market (Tolera and Abebe, 2007).

2.4.1 Forages and crop residues for cattle feeding

2.4.1.1 Forages

Forages are the common feed found in rangelands for cattle production. They are naturally available or can be cultivated. Forages in rangelands of tropics vary in both quantity and quality where as during dry season loss of nutrients such as vitamins, minerals and crude protein are common (Abusuwar and Ahmed, 2010). A study done by Lazaro *et al.* (1999) in Arumeru, showed that seasonal availability of forages is a problem, whereby green fodder is scarce during dry season. During dry season, cattle lose much weight and some of them die from extreme emaciation and they are only regaining in the wet season or through concentrate supplementation (UNIDO, 2012). Information on seasonal availability and quality of forages for cattle production in Mwanza region is limited. Scarcity of forages is still increasing due to expansion of crop cultivation, drought condition and increased in population, which lead to the shrinkage of grazing lands (Komwihangilo *et al.*, 2009). Forages in tropics have high quality nutrients during wet season and the quality drops during dry season. The amount and quality of forage consumed by the animals is very important as it affects total nutrient intakes and therefore affects animal performance. Chemical composition of forages such as crude protein (CP), crude fibre (CF), neutral detergent fibre (NDF) vary from one forage specie to another (McDonald *et al.*, 2002). The variation in protein contents of forages which is caused by variation of forage types was also reported by Nkenwa (2009). Legumes may contain 150 to 230g CP/kg DM where as grasses contain 80 to 180 g CP/kg DM while crop residues such as maize stover and rice straws may contain 20 to 60 g CP/kg DM (Doto *et al.*, 2004). However, chemical composition of forages is

influenced by a number of factors, such as stage of growth, seasonal variation, plant species, sampling and processing procedures.

Forages on the early stage of growth have high nutrient content including energy, protein, minerals and low cell wall constituents (McDonald *et al.*, 2002). Forages at mature stage have higher fibre content due to decreased proportion of leaves and increased proportion of stem. Crowder and Chheda (1982) found that, the CP content of forages during early wet season and at early stage of growth is above 70 g CP/kg DM. Grasses at advanced maturity during dry season, CP drops to values of 40 to 60 g/kg DM after 3 to 5 months, while NDF content increases (Crowder and Chheda, 1982). The low protein of feeds during dry season can be corrected through concentrates supplementation to maintain animal growth performance. During wet season, forages have high content of water, crude protein, vitamins and minerals whereas during dry season they have low water content, low crude protein, low minerals, low vitamins and energy. Stage and age of forages affect their digestibility in which influences on growth performance of cattle. Plant species differ in chemical composition. The variation on CP and energy contents in plant species could be due to anatomical differences between plant species, which depends on effect of plant development (Phuc, 2006; Fadiyimu, 2011). Methods of processing forages may influence their chemical composition (Kung, 2001). Poor processes of silage may lead to loss of some nutrients, such as vitamins and proteins (Kung, 2001). Improper hay making result into low CP and energy contents, which reduce growth rate of cattle. Digestibility values of forages differ according to seasonal variation and stage of growth. Digestibility of forages during wet season at

early stages of growth is high while during dry season forages become mature and have low digestibility values. Skerman and Riveros (1990) reported digestibility of pasture in tropics ranges from 300 to 750g/kg DM with a mean value of 540g/kg DM while that for temperate pastures ranges from 400 to 850 g/kg DM. Growth performance of cattle fed forages varies depending on season whereas during dry season most of cattle under grazing alone become emaciated. Meat from animals which depend on forages during dry season is of poor quality with low tenderness (Weisbjerg *et al.*, 2007). Forages during wet season are plenty with good quality nutrients which lead into good body condition of animals.

2.4.1.2 Crop residues

The agro pastoralists practice both livestock keeping and crop cultivation. Animals benefit from crops through eating crop residues whereas manure will fertilize the crops/forages. Crop residues are the plant materials that remain after crops have been harvested. Residues may be grouped according to the crop type for example cereals, grain legumes, roots and tubers. Crop residues such as maize stover, rice straw, sorghum straw and wheat straw are commonly used by cattle in developing countries, Tanzania inclusive. Crop residues are the major component of diet for ruminants in tropic and sub tropic countries (Leng, 1990). Dung *et al.* (2013) reported that, rice straw is the most crop residue used by cattle in Vietnam.

Crop residues normally have low energy and protein contents (Tesfaye and Chairatanayuth, 2007). Crop residues contain ME that range from 5-7 MJ ME/kg DM and CP values range from 20 – 50 g/kg DM (Smith, 2002; Lukuyu *et al.*,

2011). In some areas, crop residues are left in the crop fields without being cut and conserved. Conservation of livestock feeds in tropics is still a new idea to majority of pastoralists and agro pastoralists (Lukuyu *et al* 2011). Aregheore (2000) also found that proper utilization and conservation of crop residues for ruminants are still low. Thus, there is underutilization of these crop residues in developing countries (Onwuka *et al.*, 1997), which result into shortage of feeds during dry season. Conservation and utilization of crop residues could save animal feed shortage during dry season. Little information is available in Mwanza region about conservation and utilization of crop residues. The low nutritive quality of these feeds is the main challenge limiting utilization of crop residues.

Crop residues can be conserved and treated to increase their intake by animals. These can be treated by ammonia, urea, wood ash and urine to improve their digestibility (Owen and Jayasuriya, 1989). Digestion and intake of forages and crop residues can be improved through concentrate supplementation at the optimum level (Nguyen *et al.*, 2008). Low growth rate of cattle in developing countries can be improved through concentrate supplementation during dry season. Poor quality forages and crop residues during dry season can be improved through concentrate supplementation to increase their digestibility (Urassa, 2012). It has been shown that feeding animals with untreated cereal residues alone can result into weight loss of animals from about 11 to 16 % but when mixed with legume residues can increase body weight of animals (Singh *et al.*, 2011). Quality of crop residues is generally inadequate to provide weight gain in young cattle unless significant grain remains in the field after harvest. Study done by Ocen (1992) in Uganda showed

that, cattle fed on maize straw alone had an ADG of 357 g/day while those treated by urea and supplemented with immature fresh green elephant grass had ADG of 611 g/day and 525 g/day respectively. Thus, when crop residues are treated with nitrogen source, supplementation of quality forages animals result into good growth performance. Cattle fed crop residue alone become emaciated with poor quality meat.

2.4.2 Common supplementary feeds for cattle finishing

Feeds which are commonly used as supplements for finishing cattle in Mwanza are agro- industrial byproducts. These are available after the crop products have been processed in the industries; for example dehusking of paddy, refining of cotton oil and delinting of cotton. The agro-industrial byproducts are mostly available after harvesting and processing of crops. Common feeds used as supplements in cattle fattening are rice polishing, cotton seed hulls, cotton seed cake and sunflower seed cake.

2.4.2.1 Rice polishing

Rice polishing (RP) is a byproduct of rice milling and is the cheapest source of energy and protein for livestock feeding particularly in cattle fattening. Rice polishing comes from the inner layer covering the grain (Ambreen *et al.*, 2006). It is a good source of proteins, energy, vitamins and minerals (Ambreen *et al.*, 2006). Rice polishing is available after harvesting. It has crude protein ranging from 47 to 145 g/kg DM feed (Hossain *et al.*, 2012). The values of chemical composition and energy content of RP reported by different authors are presented in Table 1.

Table 1: Chemical composition (g/kg DM) and energy (MJ/kg DM) contents of rice polishing from different studies

DM	CP	CF	Ash	EE	ME	Source
926.00	114.50	38.50	108.0	146.50	15.66	Malik and Chughtai, (1979)
927.50	129.70	157.10	171.50	107.10	15.66	Ghazi, (1992)
913.80	149.70	118.60	107.50	140.70	12.63	Nadeem, (1998)
-	110.00	-		150.00	11.51	Leeson and Summers ,(2001)
920.50	130.00	151.50	106.00	135.10	9.37	Ambreen, (2006)
921.00	68.90	249.00	194.00	75.80	5.37	Mawona, (2010)
920.00	88.00	252.00	125.00	78.50	8.74	Hossain <i>et al.</i> (2012)

Rice polishing can be used as substitute of other feed types for cattle finishing. Rice polishing has been used as an economical substitute of wheat bran as a supplement to wheat straw diet for cattle finishing in the Northern Plains of India (Lamba *et al.*, 2002). Rice polishing improve dry matter intake, stimulate volatile fatty acid concentration, microbial numbers and efficiency of rumen synthesis (Cardenas *et al.*, 1992 cited by Dutta *et al.*, 2003).

The use of rice polishing by monogastric animals is limited by the high fibre content. In ruminants however, it is well utilized (Urassa, 2012). Rice polishing contain anti-nutritive factors such as lipases, trypsin inhibitors, haemagglutinin-lectin and phytates (Younas, 2004), which reduces availability of amino acid and other nutrients to animals (Khalique *et al.*, 2004). In addition, utilization of RP is limited by the presence of oil ointment, which limits its storage shelf life. The fat content in RP tends to develop rancidity quite rapidly. Rice polishing has been found to be an energy source for cattle finishing. Thus, in areas were paddy is

produced there is an opportunity of utilizing RP as concentrate feed for cattle production.

2.4.2.2 Cotton seed hulls

Cotton seed hulls (CSHs) are the by-products of cotton seeds removed from the whole seed. The proportion of CSHs is about 20 % to 30 % by weight of the whole cotton seed (Chamatata, 1996). Cotton seed hulls are highly fibrous and bulky roughage material (Blasi and Drouillard, 2002). Cotton seed hulls are produced through dehulling of cotton seeds. They can be stored for 6 months to be used when there is a shortage of these feeds. Cotton seed hulls are useful for ruminants due to their high fibre content as they act as roughage. Thus, they act as intake regulator of high grain diets fed in self- feeders of cattle fattening. Cotton seed hulls are palatable and increase intake in young cattle fed grain-based diets. The inclusion level can be at 25 to 50 percent of the diet, depending on desired performance level (Stewart, 2010). Cotton seed hulls are mainly used for both growing and fattening cattle (Hale *et al.*, 1989).

Availability of CSHs depends on season of cotton production. They vary with year and season, where they can be high or low depending on production level. Cotton seed hulls have low crude protein, phosphorus and calcium. Cotton seed hulls have high Neutral Detergent Fibre (NDF) (Stewart, 2010). Also have high ADF and crude fibre as reported by different workers shown in Table 2.

Table 2: Chemical composition (g/kg DM) of cotton seed hulls from different studies

DM	CP	CF	Ash	NDF	ADF	EE	Source
-	31	411	94	-	-	4	Rao and Reddy,(1984)
899	50	486	28	869	670	19	Calhoun <i>et al.</i> , (1995)
929	88.5	408	41.7	624	463	42	Chamatata, (1995)
900	41	480	30	870	680	19	Blasi and Drouillard, (2002)
876	60.6	472.3	52.5	809	590	26.8	Mawona, (2010)

The high NDF of CSHs which includes a relatively large proportion of acid detergent lignin tend to be negatively correlated with digestibility, which is reflected in the low digestibility values of NDF ranged from 319 – 387 g/kg DM (Moore *et al.*, 1990; Torrent *et al.*, 1994). It has been reported that little lignin disappears after rumen fermentation, and the remaining cellulose is rather crystalline (Garleb *et al.*, 1991). Low protein and energy level of CSHs attributed to their low digestibility efficiency.

The major limitations of CSHs as animal feed are low Calcium, protein (40 to 120 g/kg DM) and phosphorus (Hall and Akinyode, 2000). Low nutritive value of cotton seed hulls reduces growth performance of cattle when fed with low amount of concentrate. Cotton seed hulls are bulky thus cannot easily be transported and handled. In addition, CSHs contain chemicals such as Cyclopropane fatty acids, phytic acids and gossypol. The first two chemicals are not a limitation in ruminants but gossypol has some detrimental effect at high levels. Gossypol is a yellow polyphenolic pigment synthesized in the roots and transported in the gland of cotton seeds.

2.4.2.3 Cotton seed cake

Cotton seed cake (CSC) is a by-product obtained after extraction of oil from cotton seeds using either mechanical or solvent oil extraction methods. It is the second most valuable product of cotton seed after cotton oil and it is the third of the total product value (Cathoum *et al.*, 1995). Cotton seed cake has high protein content ranging from 36-40% (Tolera, 2008). It is an excellent protein supplement for ruminants. It has low vitamin D, carotene and calcium but rich in phosphorus. Cotton seeds can be decorticated before oil extraction which reduces the fibre content in cotton seed cake thereby improving digestibility of the other nutrients. Undecorticated cotton seeds produce cotton seed cake with high fibre content which has low digestibility of nutrients.

The Chemical composition of cottonseed cake from different workers is presented in Table 3. Generally, the crude protein content of cotton seed cake may vary from 250 to 510 g/kg DM feed where as the neutral detergent fibre (NDF) vary from 210 to 550 g/kg DM feed depending on the extraction method and whether the seeds were decorticated before extraction (Tolera, 2008). It has also been reported that, CSC has a range of crude protein from 230 to 475 g/kg DM for undecorticated and decorticated, respectively (McDonald *et al.*, 1995). Metabolizable energy of CSC reported by Mawona (2010) was 10.7 MEMJ/kg DM which is lower than 11.6 ME MJ/Kg DM reported by Urassa (2012).

Table 3: Chemical composition (g/kg DM) of cotton seed cake from different studies

DM	CP	CF	Ash	EE	Source
880.00	231.00	248.00	66.00	55.00	McDonald <i>et al.</i> , (1988)
920.00	230.00	208.00	50.00	175.00	Coppock and Wilkis, (1991)
877.00	230.00	247.00	66.00	55.00	Forster <i>et al.</i> , (1995)
929.00	268.00	-	57.40	-	Machibula, (2000)
926.00	243.00	226.00	52.40	130.00	Mawona, (2010)

Digestibility of CSC depends on whether cotton seeds are decorticated or not. Decorticated cotton seeds produce CSC with low fibre content compared to undecorticated cotton seeds. Cotton seed cake from decorticated cotton seed hulls have high digestibility compared to those from undecorticated cotton seeds. Generally CSC is a good source of protein. When mixed with other feed types increase digestibility because of its high protein content. In regions which produce cotton one could utilize this opportunity to finish cattle. Cotton seed cake with high CP promote high growth rate of an animal. It has been reported that, calve on grazing supplemented with 0.3% and 0.6 % CSC can attain body weight gain of 1.1 kg/day and 1.2 kg/day, respectively while those not supplemented can have an ADG of 0.8 kg/day (Gadberry *et al.*, 2009).

Forages and crop residues alone do not meet requirements for proper growth performance of cattle. Forages and crop residues become scarce and poor in quality during dry season which do not meet body requirement. Some agricultural industrial by products as concentrate ingredients have shown to have high energy and protein

contents while others have some limitations. More research on evaluation of feed quality is needed to come up with feeds containing potential nutrients to improve poor quality forages for cattle production.

2.5 Feeds and Feeding Related Constraints on Cattle Finishing

Feeds and feeding is the crucial entity on cattle performance. Good feeding practice is very important for high body weight gain and good body condition score. Cattle production in the tropics is mainly affected by seasonal variation of availability on both quantity and quality of feeds (Darrag, 1995; Abusuwar and Ahmed, 2010). During dry season, forages and crop residues are inadequate and lose many nutrients especially minerals, vitamins and protein. Inadequate and low quality feeds affect performances of cattle, which are finished on grazing alone due to the fact that, animals are not getting nutrients to meet their body requirement. Supplementary feeding is needed as the dry season advances to compensate for the nutrient deficit from the forages (Abusuwar and Ahmed, 2010).

Availability of concentrates is another constraint which hinders cattle finishing in many parts of Tanzania (Mlote *et al.*, 2012). Even in those areas which practice crop cultivation, concentrates are not easily accessible since processing of crop products is done in urban areas, hence, the feeds need to be transported to the rural areas. This adds more cost, making cattle fattening unaffordable in rural areas. Efforts are needed to assess the locally available feed resources, which could be conserved and utilized for improvement of cattle finishing. Feed resources available in local areas of pastoral and agro pastoral communities in most areas of Tanzania

are not yet been utilized well to improve cattle production (IAEA, 2000). Livestock feeds are plenty during wet season and immediately after harvesting of crops. Despite of this availability there is little technical knowhow on feeds conservation/storage in developing countries Tanzania inclusive. Lukuyu *et al.* (2011) reported that, lack of information on appropriate feed technologies was among the factors limiting cattle farmers from producing sufficient feeds, hence contributing to dry season feed scarcity in parts of Kenya. Thus, feed technology dissemination to livestock keepers is very important for improvement of livestock production.

2.6 Conclusion from Literature Review

Reported findings have shown three cattle finishing systems, that are grazing alone, grazing with concentrate supplementation and feedlotting systems. The reported good performance of cattle under grazing with concentrate supplementation and feedlotting has proved the importance of concentrate supplementation. Despite finishing of cattle in Ilemela and Magu districts by some cattle entrepreneurs through concentrate supplementation there is limited information on the status of the finishing systems and performance of cattle finished in the different systems. Evaluation of cattle performance in different finishing systems is very important to come up with proper methods of finishing cattle. Seasonal variation of quantity and quality of forages and crop residues has shown to be a challenge on the growth of cattle on grazing alone. Thus, there is a need of determining seasonal availability and nutritive quality of locally available feeds to come up with proper feed for cattle finishing in the study area. Also to understand which seasons have adequate feeds

for conservation and utilize them for cattle production. Moreover, there are several factors affecting cattle growth performance including shortage and poor quality of feeds during dry season. There is limited information addressing constraints which affect cattle finishing in Mwanza region. Thus, there is a need for further investigation on the constraints affecting cattle production in the study area for improvement of practice of cattle finishing.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

The study was carried out in Ilemela and Magu districts in Mwanza Region. The districts are located between latitude 2° 10' and 2° 50' South and longitude 33° and 34° East. The area has tropical temperatures range between 25 and 30° C (Fig. 1). The rainfall pattern is bimodal with short rains starting from mid-October to December and long rains between March and mid-May with annual rainfall ranging from 700mm to 1 000mm. Dry seasons are short dry spell starting from January to February and long dry season from May to mid-October.

The districts are in the cotton – cereal based farming system of the Lake Victoria zone of Tanzania. The main crops grown in the districts include cotton, paddy, maize, sorghum, sweet potatoes, groundnuts and cassava. Horticultural crops such as tomatoes, onions and other vegetables are grown. Livestock kept in this area include beef and dairy cattle, goats, sheep, pigs and poultry.

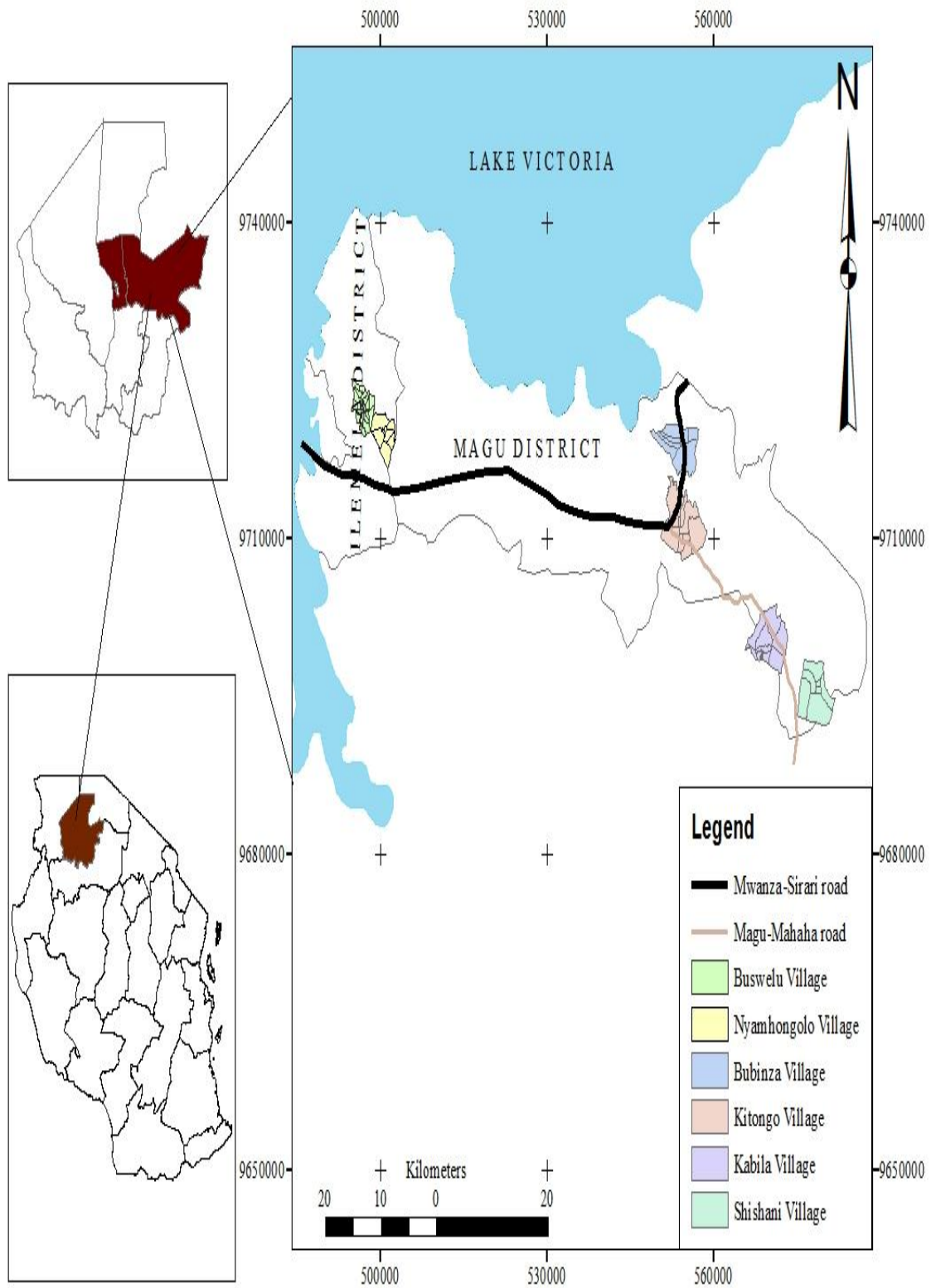


Figure 1: Location of Ilemela and Magu including villages under study

3.2 Nature of the Study

3.2.1 Household survey study

Preliminary survey was done in August 2012 followed by detailed survey in November 2012. A cross-sectional research design was employed. This method involved collection of data at one point in time and made it possible to determine relationships between different variables that were in focus at the time of the survey.

A multistage sampling procedure was employed in the study area. Within Mwanza region, two districts that are Ilemela and Magu were selected. Two villages were selected in Ilemela district which are Nyamhongolo and Bulola (Buswelu) and four villages that are Shishani, Kabila, Kitongo and Bubinza in Magu district. In each village, 20 agro-pastoralists were randomly selected from the total number of agro pastoralists present in each village by the use of random names written in pieces of paper which make a total of 120 agro pastoralists.

A well designed open and closed structured questionnaire was used for the interview (Appendix 1). Basic questions on individual household characteristics (for example gender and education) were asked. Other required data were cattle finishing systems, feed resources availability, coping mechanisms during shortage of feeds, management practices and constraints facing cattle production. Another interview was conducted with cattle finishing entrepreneurs in the two districts by the use of open and structured questionnaire (Appendix 1). Twenty eight (28) cattle finishing entrepreneurs from Ilemela and two (2) from Magu were selected for the

interview. Information collected were gender of finishing unit owner, age of finishing unit owner, cattle finishing systems, supplementary feeds used for finishing cattle, cattle management practices and constraints affecting cattle performance.

3.2.2 Focus group discussion

Focus group discussions (FGDs) were done in each district to both agro pastoralists and cattle finishing entrepreneurs. Seven FGDs were conducted in the study area. The aim of FGDs was to capture general information such as cattle finishing systems, seasonal feed availability, cattle management practices and constraints facing cattle production. Pebbles were used to quantify seasonal feed availability. Separate checklists were designed for agro pastoralists (Appendix 2) and cattle finishing entrepreneurs (Appendix 3). Key informants such as District leaders, livestock officers, village leaders and village senior elders were invited. A group of six to ten persons were involved in each FGDs.

3.2.3 Field Monitoring study

The aim of the monitoring study was to triangulate the information obtained from the livestock farmers and measure the growth performance of cattle finished under the different systems. Physical observation and photo taken were done during field monitoring. The monitoring study involved 4 villages that are Nyamhongolo and Bulola (Buswelu) in Ilemela district and Kitongo and Bubinza in Magu district.

3.2.3.1 Experimental design and treatments

Two villages were selected from each district whereby, three agro pastoralists and three cattle finishing entrepreneurs were purposively selected from each village based on their willingness to participate in the experiment and having the type and number of cattle needed for the experiment. From each agro pastoralists and cattle finishing entrepreneurs, five male cattle with age range of 4 to 6 years were selected. Feeding systems practiced by agro pastoralists and cattle finishing entrepreneurs were considered as the treatments, that is grazing alone and grazing with concentrate supplementation systems.

3.2.3.2 Experimental animals and management

The animals were managed by the farmers without much interference. Ticks were controlled by spraying acaricides using knapsack pumps, usually at the entry into the finishing unit for cattle finishing entrepreneurs. Agro pastoralists were also using knapsack pumps to spray acaricides to their cattle. Cattle were treated for worms control at the early days of finishing by cattle finishing entrepreneurs. Cattle under agro pastoralists practiced grazing early in the morning and returned in the late evening to the enclosures normally grazed for 8 to 12 hours. Cattle under finishing entrepreneurs were grazed with concentrate supplementation. They grazed for 1 to 4 hours and resumed back to the finishing unit for concentrate feeding. The types of concentrate offered were cotton seed hulls, cotton seed cake, rice polishing and sunflower seed cake

3.2.3.3 Estimation of body weights

Body weights of selected cattle were measured after every two weeks. Heart girth circumference was measured using weighing band while an animal was standing on four legs with head maintained in an upright position to control errors due to measurements. Average daily gain (ADG) was derived as a proportion of total weight change to the monitoring period of 56 days. The difference between final weight and initial weight was divided by 56 to obtain ADG. Animals were identified by the use of branded number, local names and letter/number written on their horns.

3.2.3.4 Forages and concentrate sample collection

Sample of forages from three grazing lands in each study village were collected. During sampling a quadrant of 0.25 m² was used to sample forages. A quadrant was randomly thrown to avoid biasness. Forages under the quadrant were clipped. The clipped forage samples were taken to Ukiriguru Agricultural Research Institute laboratory in Mwanza region and dried in an oven at 70 °C to constant weight. The dried samples were then taken to the laboratory of Animal Science and Production at Sokoine University of Agriculture and Central Veterinary Laboratory Temeke for subsequent chemical analysis. Similarly, the common supplements used for cattle finishing in the study area were taken for subsequent chemical analysis. The collected feed samples were bulked according to feed type and sub-sampled to obtain representative samples. The sub-samples were ground to pass through 1 mm sieve for subsequent chemical analysis.

3.2.3.5 Chemical analysis of feed samples

All the collected feed samples were analyzed for dry matter (DM), Metabolizable Energy (ME), Crude Protein (CP), Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF). Analyses were done by the use of Near Infrared Reflectance Spectrophotometer (NIRS) Instrument at Central Veterinary Laboratory (CVL) –Temeke, Dar es salaam. Ash content was determined according to the standard analytical procedures of Association of Official Analytical Chemists (A.O.A.C, 1990) at the Department of Animal Science and Production laboratory in Sokoine University of Agriculture. The *in vitro* digestibility values of feed samples were determined in the laboratory of Animal Science and production using two stage techniques according to Tilley and Terry (1963).

3.2.4 Secondary data collection

Secondary data, such as demographic, climate and livestock numbers were collected using reports from the District Agricultural and Livestock development offices and local government offices. The collected secondary data provided additional information on the cattle finishing system and performance of cattle in the study area.

3.3 Data Analysis

The primary data collected through structured questionnaire was analyzed using Statistical Package for Social Sciences (SPSS, 2007) software. The data from FGDs were subjected to excel spread sheet. The data from average daily body gain from monitoring study were subjected to analysis of variance using general linear model

(GLM) of SAS (2003). Initial body weight of each cattle was taken as covariate.

The following model was used:-

$$\mathbf{Y_{ijk}} = \mu + D_i + S_j + b (X_{ijk} - \alpha) + e_{ijk} \dots \dots \dots (1)$$

Where:-

Y_{ijk} = Response of animal due to effect of j^{th} finishing system, i^{th} district and k^{th} initial body weight

μ = Overall mean to all animals in the study area

D_i = Effect of i^{th} district

S_j = Effect of j^{th} finishing system

b = Coefficient of regression

(X_{ijk}) = Initial body weight of an individual animal

α = Mean of individual initial body weight in the experiment

e_{ijk} = Random effects peculiar to each animal in the experiment.

CHAPTER FOUR

4.0 RESULTS

4.1 General Observations

Mwanza region is located around Lake Victoria basin. It has seven districts which are Ilemela and Nyamagana Municipal councils, Kwimba, Magu, Misungwi, Sengerema and Ukerewe District Councils. According to the 2012 national census, Mwanza region had a population of 2,772,509. It is the sixth most densely populated region with 293 persons per square kilometre. Tribes located in this region are the Wasukuma, Wakerewe, Wakara and Wasinza, whereby the Wasukuma is the major tribe.

Mwanza region has bimodal rainfall, starting from mid-October to December for the short rains, and March to May for long rains. Figure 2 shows the average rainfall pattern in Ilemela and Magu districts. This rainfall pattern leads into seasonal availability of livestock feeds, whereby plenty of feeds are available from March to August and scarcity experienced from August to December.

The economic activities practiced by citizens in Mwanza are fisheries, which take the first lead, crop cultivation taking the second lead, mining and livestock taking the third lead. Maize, cassava and sweet potatoes constitute about 71% of all food crops grown in the region. Others include millet, sorghum, paddy and cassava. Cotton, paddy and maize are treated as cash crops. Crop production provides crop residues and industrial agricultural by products as livestock feeds.

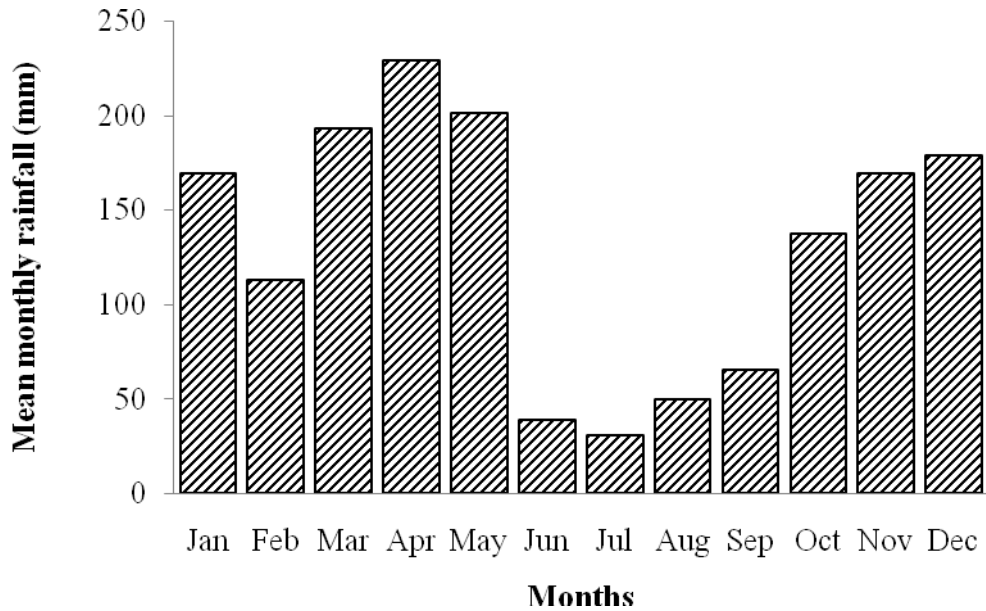


Figure 2: Average rainfall distribution in Ilemela and Magu districts (Year 1970 to 2000)

Mwanza region has large population of livestock. It has an approximately 2 million cattle, 771 000 goats, 265 000 sheep, 8 000 donkey and 164 000 pigs. Thus cattle are a leading livestock in number by species.

4.2 Socio-Economic Characteristics of Respondents

Results of socio-economic characteristics of the respondents are presented in Table 4. Majority of the respondents are males. The average age of respondents in Ilemela and Magu districts ranged from 41-60 years. The education level of respondents varied, although majority had primary education. Respondents with specialized training were found in Ilemela district only.

Table 4: Socio-economic characteristics of the respondents (%)

Variables	Magu (n= 80)	Ilemela (n= 40)
Sex		
Male	88.8	87.5
Female	11.2	12.5
Age		
1-20 years	1.20	0.00
21-40 years	26.20	17.50
41-60 years	50.00	50.00
61-80 years old	20.00	30.00
81-100 years	2.50	2.50
Education level		
None	15	27
Primary education (P1-P7)	85	65
Specialized training/college	0	7

4.3 Characteristics of Cattle Finishing Systems

It was revealed from the FGDs that most of the agro-pastoralists mainly relied on grazing their cattle and experienced low body weight gain. The high cost of concentrates made them not to feed the animals. It was further noted that, cattle under grazing alone were of poor condition during dry season while those under grazing with concentrate supplementation were of good body condition (Plates 1 and 2). Cattle finishing entrepreneurs bought cattle from the agro pastoralists and finished them with concentrate for 3 months.



Plate 1: Poor body condition of cattle at early days of fattening under grazing with concentrate supplementation in one of the finishing units in the study area



Plate 2: Improved body condition of the cattle after two months of concentrate supplementation in the study area

Results of cattle finishing systems, appropriate location and cattle breeds kept are presented in Table 5. All interviewed cattle finishing entrepreneurs in Magu district reported that, they were feeding their cattle on grazing with substantial concentrate supplementation while 82 % of the entrepreneurs in Ilemela district fed their cattle on grazing with concentrate supplementation. Feedlotting was done by few (18%) entrepreneurs in Ilemela district.

Table 5: Percent response on cattle finishing system, perception on location for cattle production and cattle breeds in the study areas

Variables	Agro pastoralists		Cattle finishing entrepreneurs	
	Ilemela (n= 40)	Magu (n= 80)	Ilemela (n= 28)	Magu (n= 2)
Finishing system				
Grazing alone	100.00	100.00	0.00	0.00
Grazing with concentrate supplementation	0.00	0.00	82.1	100.00
Feedlotting	0.00	0.00	17.90	0.00
Location for cattle production				
Urban	2.50	0.00	45.50	0.00
Rural	67.50	68.80	54.50	100.00
Unknown	30.00	31.20	0.00	0.00
Cattle breeds				
Tarime	45.00	100.0	78.60	100.0
Sukuma	40.00	0.00	17.90	0.00
Ankole	2.50	0.00	3.60	0.00
Crossbreed	12.50	0.00	0.00	0.00

Both agro-pastoralists and cattle finishing entrepreneurs perceive that, rural areas are appropriate location for cattle finishing. There were few cattle entrepreneurs in Ilemela district who showed interest of finishing cattle in urban areas. Tarime cattle were the most preferred breed kept by both agro pastoralists and cattle finishing entrepreneurs. The preference of Tarime cattle breed was due to its ability to

withstand harsh conditions like shortage of feeds and water. Other breeds were Ankole, Sukuma and their crossbreeds.

4.3.1 Herd sizes of cattle kept by respondents

Figures 3 and 4 present the herd sizes of cattle kept by agro pastoralists and cattle finishing entrepreneurs. Results showed that there was larger herd size in Magu than in Ilemela district. Majority of agro pastoralists in Ilemela district kept a herd size of 1 to 10 whereas in Magu district, the herd sizes ranged from 1 to 41 per household.

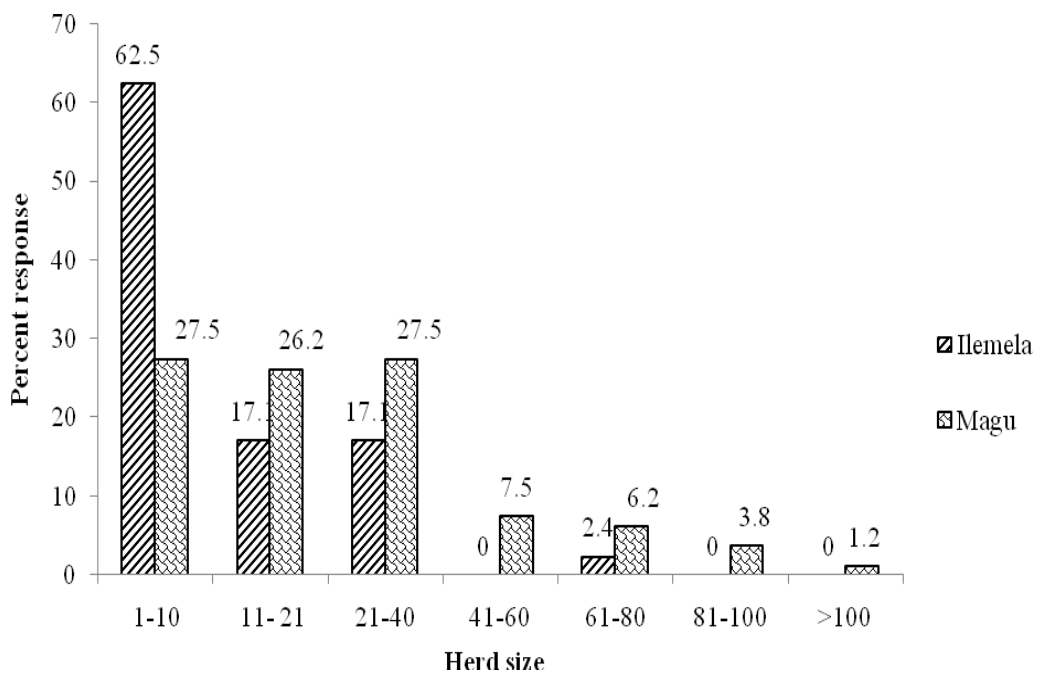


Figure 3: Percent response on the herd size of cattle kept by agro pastoralists

The cattle finishing entrepreneurs kept a herd size of 11 to 40 cattle per entrepreneur in Ilemela district and 21 to 80 cattle in Magu district (Fig. 4).

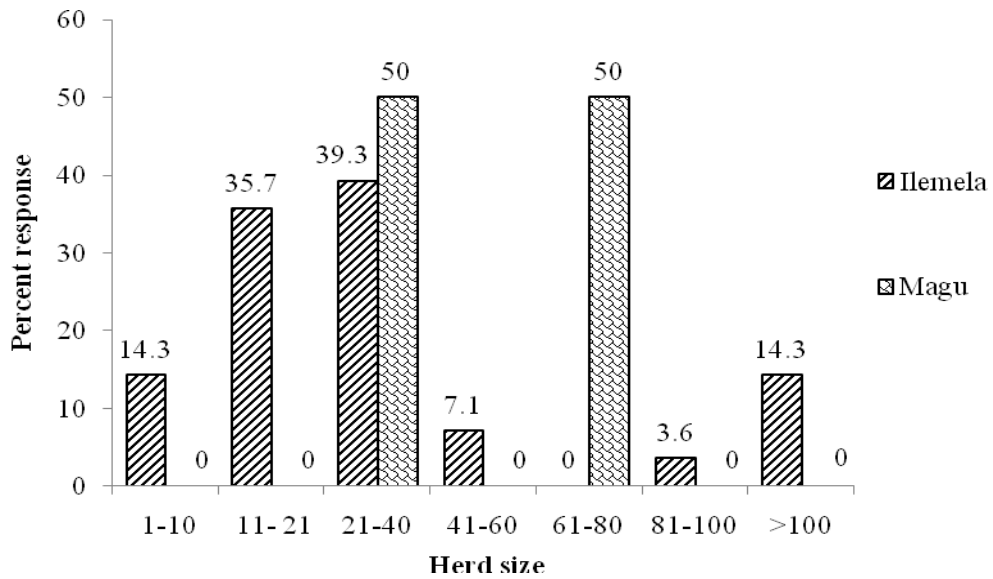


Figure 4: Percent response on the herd size of cattle kept by cattle finishing entrepreneurs

4.3.2 Feeding practices

Figure 5a presents grazing hours of cattle under grazing alone. Results showed that, cattle graze for longer time in Magu district than in Ilemela district. Most of the cattle under grazing alone were grazed for 8 to 12 hours. Agro pastoralists allowed their animals to go for grazing early in the morning and return back home in the late evening during dry season. Cattle were drinking water during grazing time. Also results showed that, cattle under grazing with concentrate supplementation in Magu and Ilemela districts grazed for 1 to 4 hours and 5 to 7 hours, respectively (Fig. 5b). After grazing cattle were returned to the finishing units for concentrate feeding and watering. Concentrates commonly used were cotton seed hulls, cotton seed cake, rice polishing and sunflower seed cake.

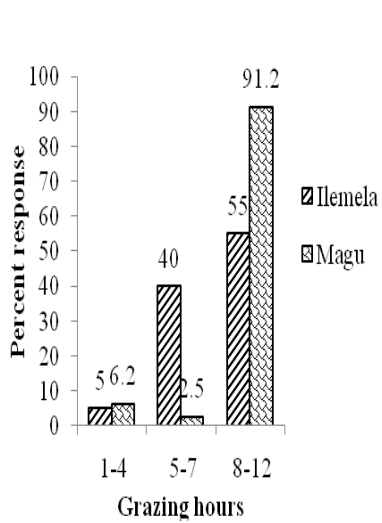


Figure 5a: Percent response on time used for grazing cattle under grazing alone

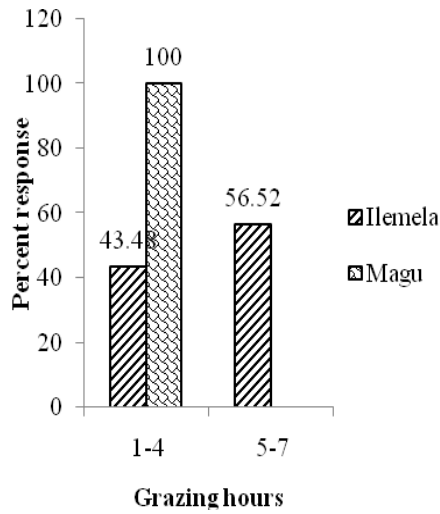


Figure 5b: Percent response on time used for grazing cattle under grazing with concentrate supplementation

4.3.3 Health management

Results of deworming and dipping are summarized in Table 6. Majority of agro pastoralists (85% in Ilemela and 78% in Magu district) and cattle finishing entrepreneurs (92% in Ilemela and 100% in Magu district) control the external and internal parasites in both finishing systems, but they differ in frequency of application of acaricides and anthelmintics. Cattle finishing entrepreneurs had regular application of acaricides and anthelmintics but agro pastoralists had irregular application.

The frequency of deworming cattle by agro pastoralists is presented in Fig. 6. Majority of agro pastoralists (52.9 % in Ilemela, 37.7 % in Magu district) deworm

Table 6: Percent response on practice of deworming and dipping of cattle by agro pastoralists and finishing entrepreneurs

Variables	Agro pastoralists		Cattle finishing entrepreneurs	
	Ilemela (n= 40)	Magu (n= 80)	Ilemela (n = 28)	Magu (n= 2)
Deworming				
Practiced	85.00	78.80	92.90	100.00
Not practiced	15.00	21.20	7.10	0.00
Dipping				
Practicing	97.50	88.80	100.00	100.00
Not practicing	2.50	11.20	0.00	0.00

their cattle when animals were on ill condition in both districts. Some agro pastoralists in both districts deworm their cattle once in three months.

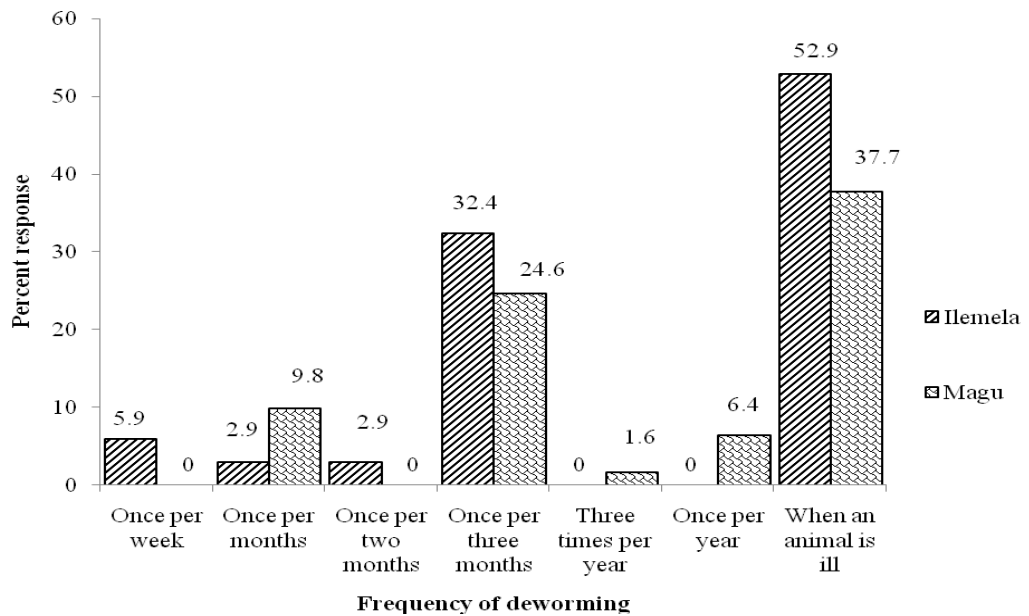


Figure 6: Percent response on the frequency of deworming cattle by agro pastoralists

The frequency of deworming by cattle finishing entrepreneurs is presented in Fig. 7. Most of cattle finishing entrepreneurs follow a specific routine frequency of drug application for worms and dipping for tick control. Majority of cattle finishing entrepreneurs had a regular routine dipping of their cattle. Cattle entrepreneurs in Ilemela and Magu districts deworm their cattle after every three months (77.8% and 100% respectively).

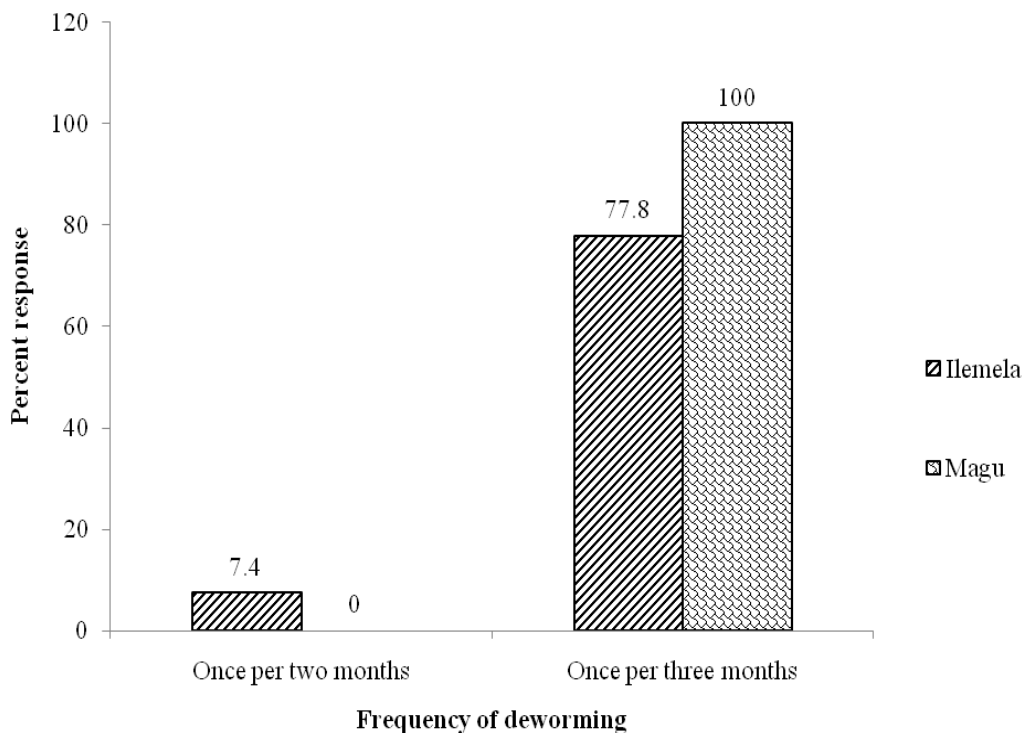


Figure 7: Percent response on the frequency of deworming cattle by cattle finishing entrepreneurs

Majority of agro pastoralists and cattle finishing entrepreneurs were dipping their cattle once per week (33.3% in Ilemela, 43.7 in Magu district) (Fig. 8) while some agro pastoralists were dipping their cattle twice per month in both Ilemela and

Magu districts. Half of the cattle finishing entrepreneurs in Magu dip their cattle once per week while the rest were dipping once in two weeks (Fig. 9).

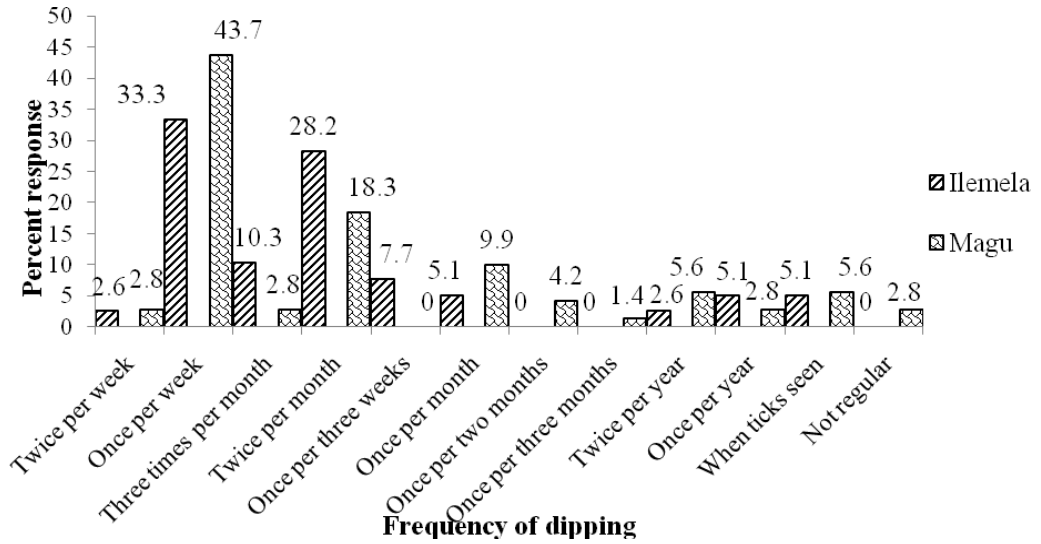


Figure 8: Percent response on the frequency of dipping cattle by agro-pastoralists

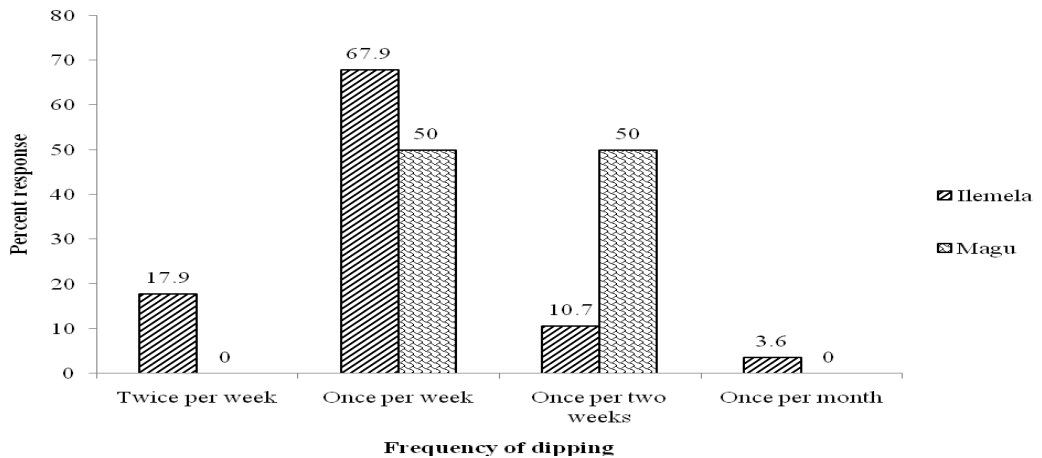


Figure 9: Percent response on the frequency of dipping cattle by cattle finishing entrepreneurs

4.4 Cattle Growth Performance

Most of agro pastoralists in both districts realized low growth rate of cattle while cattle finishing entrepreneurs realized high growth rate of cattle (Table 7).

Table 7: Response on cattle growth performance (%)

Variables	Agro pastoralists		Cattle finishing entrepreneurs	
	Ilemela (n= 40)	Magu (n= 80)	Ilemela (n= 28)	Magu (n= 2)
Perception on growth rate				
Low	33.40	73.0	4.30	0.00
Average	30.60	16.7	13.10	0.00
High	36.00	10.3	82.60	100.00

Majority of agro pastoralists in Ilemela district perceived that, cattle attain slaughter weight while they are four to five years (Table 8). In Magu district cattle attained slaughter weight when they reach four to seven years.

Table 8: Response on age at slaughter of cattle under agro pastoralists (%)

Age at slaughter	Ilemela (n= 40)	Magu (n= 80)
Two years	8.00	1.20
Three years	15.00	3.80
Four years	25.00	10.00
Five years	27.00	25.00
Six years	5.00	21.20
Seven years	0.00	20.00
>Seven years	20.00	18.80

Least square means of body weights at different measurement intervals in Ilemela and Magu districts are shown in Table 9. The average daily gain of animals in Ilemela district was higher ($P < 0.001$) than that in Magu district. The average daily gain of cattle under grazing with concentrate supplementation was higher than that

for grazing alone (Table 9). ANOVA table for the effect of district and feeding system on body weight gain is summarized on Appendix 4.

Table 9: Effect of District and Finishing system on body weight gain and average daily gain of cattle

Stage	District		SEM	P-value	Finishing system		SEM	P-value
	Ilemela (n= 60)	Magu (n=45)			GrazAlo (n= 60)	GrazSup (n= 45)		
Body weight in (kg)								
Week 2	250.78	249.61	1.79	0.0016	248.58	251.81	1.79	0.0001
Week 4	256.04	253.94	3.18	0.0014	251.85	258.13	3.18	0.0001
Week 6	262.29	258.18	3.51	0.0001	254.89	265.58	3.51	0.0001
Final wt (Week 8)	269.52	264.05	4.12	0.0001	258.15	275.42	4.12	0.0001
Overall gain	22.89	17.41	4.12	0.0001	11.51	28.78	4.12	0.0001
ADG	0.41	0.31	0.07	0.0001	0.21	0.51	0.07	0.0001

Note: kg = Kilogram, GrazAlo = Grazing Alone, GrazSup = Grazing with supplementation, P-value = probability value, SEM = Standard error of the mean, wt = weight, n = number of observations

4.5 Feed Resources and Chemical Composition of Feeds for Cattle Finishing

The common feed resources available in the study area are summarized in Fig. 10.

The common feed resources identified in the study area were natural forages, maize stover, rice straw, sweet potato vines, sorghum straw and chickpea plant residues.

Natural forages were the main source of feed for cattle in the study area. Cattle under grazing alone depend entirely on natural forages and crop residues after harvesting. The main crop residues available in both districts were maize stover, rice straws and sweet potato vines.

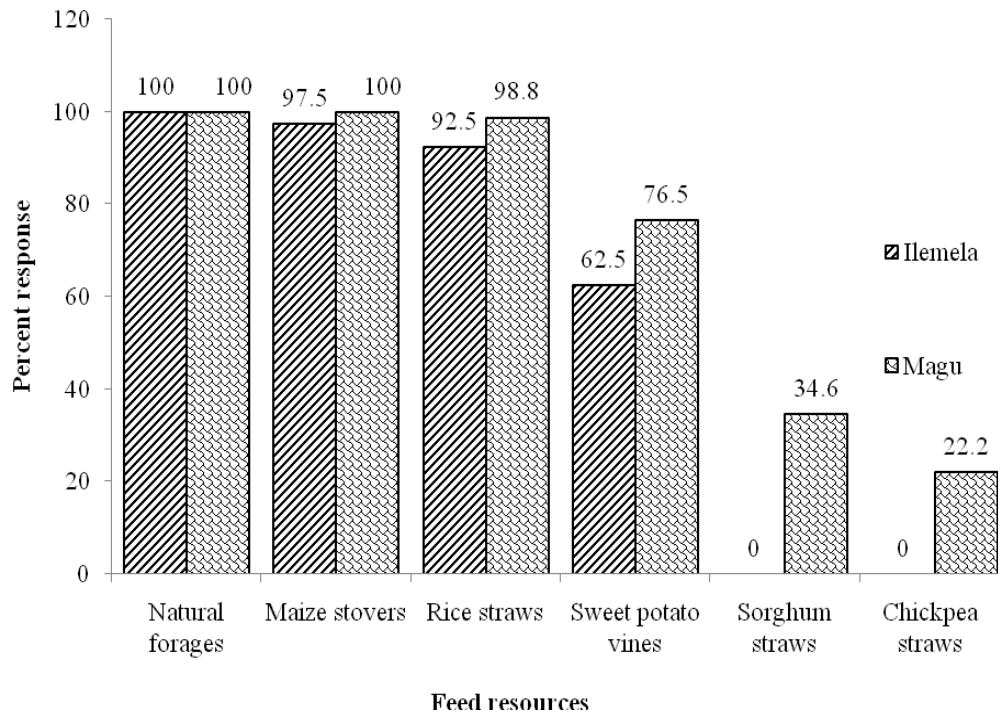


Figure 10: Percent response of livestock feed resources available in Ilemela and Magu districts

Supplementary feeds available in the study area were cotton seed cake, cotton seed hulls, rice polishing and sunflower seed cake (Fig. 11). Concentrates were brought from different sources such as cotton oil refining industries and rice dehulling machines. The respondents perceived that both CSH and CSC are equally available in both districts.

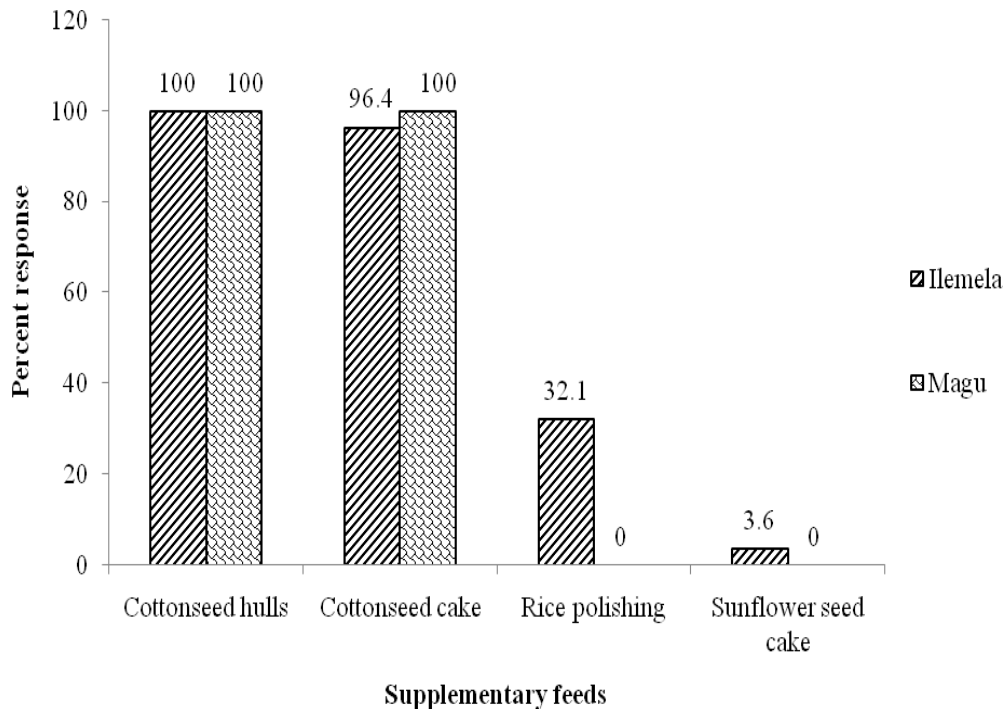


Figure 11: Percent response on supplementary feed resources for cattle finishing in Ilemela and Magu districts

4.5.1 Feed availability

Livestock feeds are adequately available during wet season and become scarce during dry season. The perception of respondents in Ilemela district on the average monthly distribution of forage availability in Ilemela district is shown in Fig. 12a. Natural forages and crop residues were available in Ilemela district from January to July. Different types of crop residues were available starting from February to July. In addition crop residuals were plenty between April and July. Forages and crop residues become scarce as from August to December. Although there were adequate forages during wet season, the respondents noted that feed availability for cattle was obstructed by crop fields.

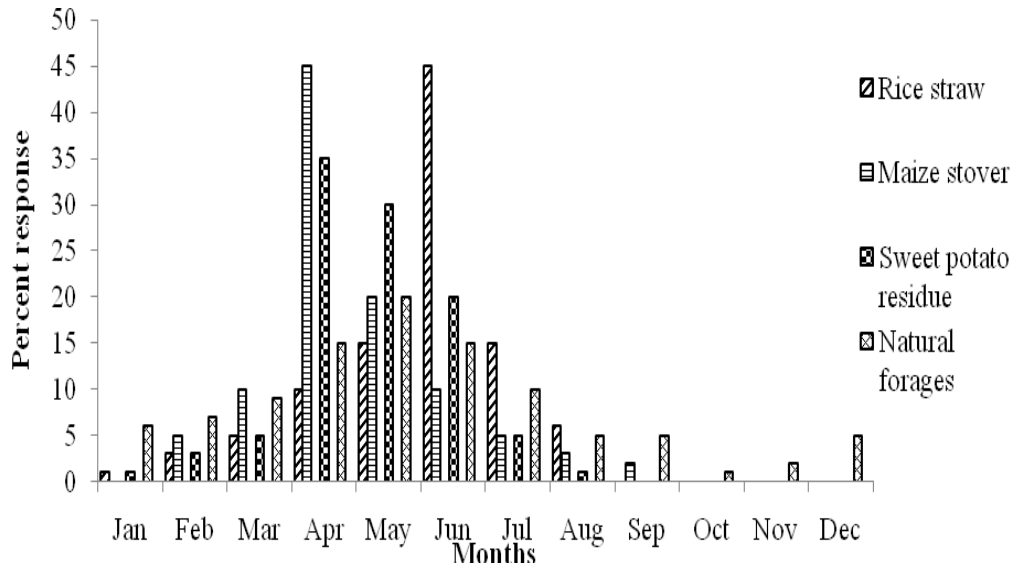


Figure 12a: Percent response on average monthly distribution on availability of forages in Ilemela district

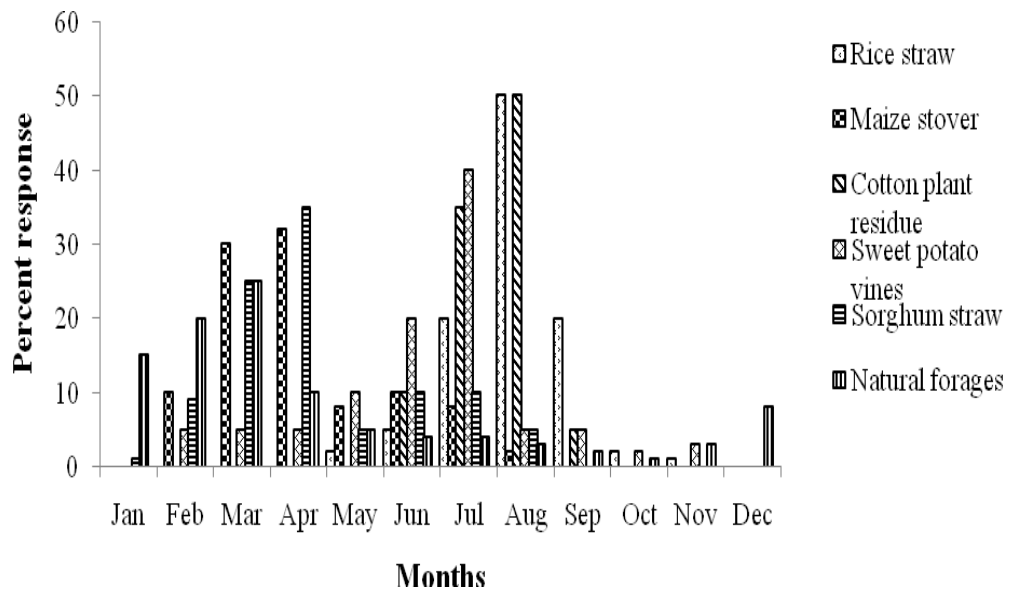


Figure 12b: Percent responses on average monthly distribution on availability of forages in Magu district

The average monthly distribution of forage availability as per respondents in Magu district is shown in Fig. 12b. Natural forages and crop residues were available in Magu district from January to August. Different types of crop residues were available starting from February to August. Crop residuals were plenty between March to August. The months with shortage of forages were from August to December, which is a period of dry season.

It was found that, supplementary feeds such as rice polishing, cotton seed hulls and cotton seed cake are available from June to December in Ilemela district (Fig. 13). Rice polishing is available after dehusking of paddy which is practiced in November to February. Cotton seed hulls and cotton seed cake are available from June to September.

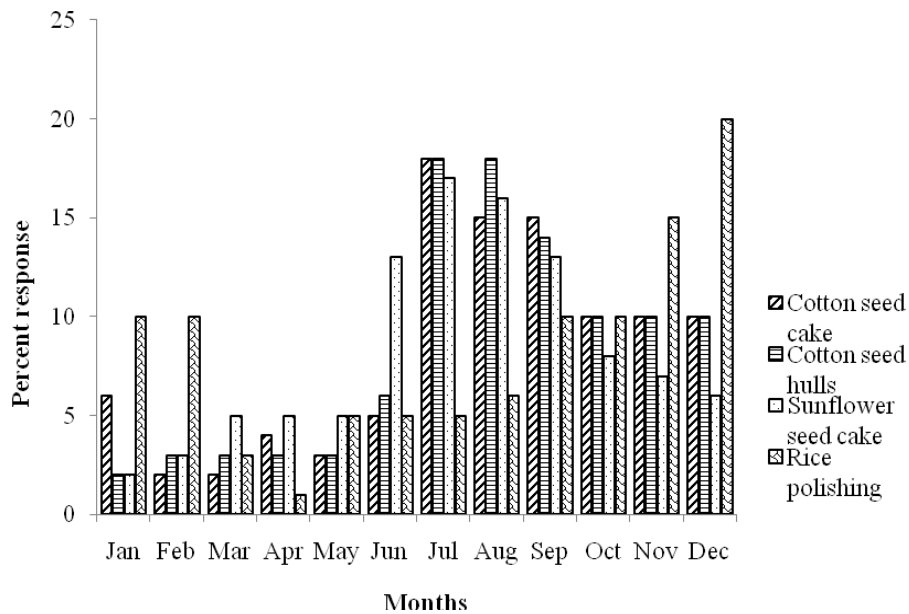


Figure 13: Percent response on average monthly distribution of availability of supplementary feed in Ilemela district

Crop industrial by products, such as cotton seed hulls, rice polishing, cotton seed cake and rice polishing were available in Magu district after harvesting from June to December (Fig. 14). Rice polishing was available after dehusking of paddy, which was largely practiced from November to February. Cotton seed hulls and cotton seed cake were plenty from June to September after harvesting of cotton.

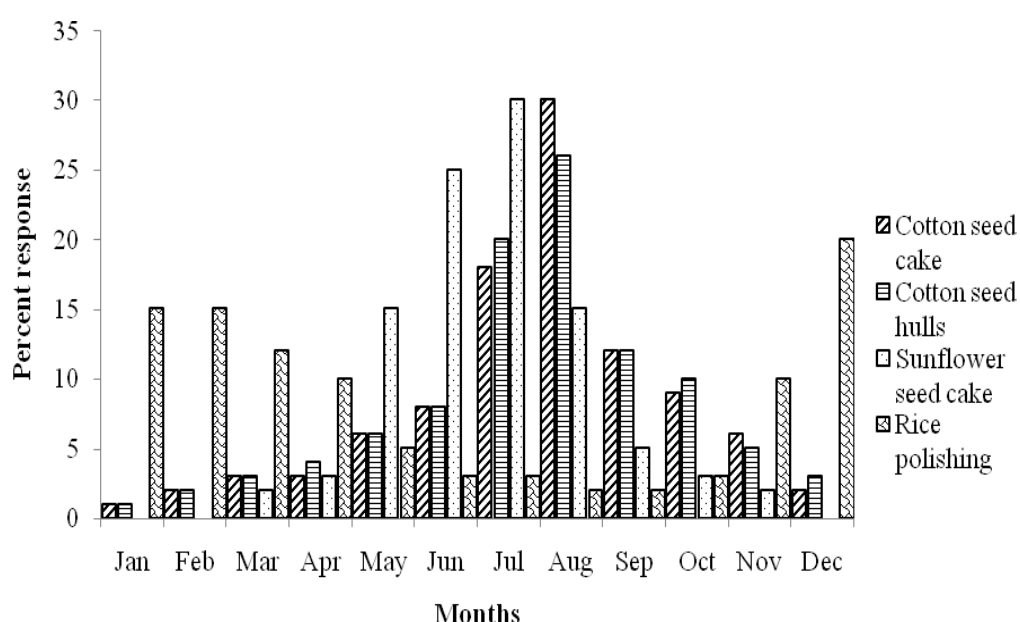


Figure 14: Percent response on average monthly distribution of availability of supplementary feeds in Magu district

Results of feed conservation practices and perception of agro pastoralists on concentrate supplementation are summarized in Table 10. Majority of agro pastoralists in both districts do not conserve feed for their animals to be used during shortage of feeds. Agro pastoralists in Ilemela district planed to supplement their cattle while majority of agro pastoralists in Magu district had no plan to supplement concentrate to their animals. Both agro pastoralists in Ilemela and Magu districts

perceived the importance of concentrate supplementation to their animals; however due to lack of awareness and funding failed to practice supplementation.

Table 10: Response on feed conservation and concentrate supplementation by agro pastoralists (%)

Variables	Ilemela (n= 40)	Magu (n= 80)
Feed conservation		
Practiced	2.50	25.00
Not practiced	97.50	75.00
Plan for supplementation		
There is a plan	57.50	15.00
No plan	42.50	85.00
Perception on concentrate supplementation		
It is important	90.00	95.00
Not important	10.00	5.00

4.5.2 Chemical composition (g/kg DM), energy (MJ/kg DM) and *in vitro* digestibility (g/kg DM) of pasture and supplementary feeds from the study area

The chemical composition of pasture from 4 villages in the study area is presented in Table 11. The pastures harvested from the different villages in the study area differed a little bit in chemical composition. Pasture from Bubinza had the highest DM content followed by pasture from Nyamhongolo, which was slightly similar to the one from Bulola. Pasture from Kitongo had the lowest DM content. The CP content was highest on the pasture from Nyamhongolo, followed by pasture from Kitongo and Bubinza. The lowest crude protein content was on pasture from Bulola village.

Table 11: Chemical composition (g/kg DM), energy (MJ/kg DM) and *in vitro* digestibility (g/kg DM) of pasture from the different villages in the study area

Nutrient composition	Nyamhongolo	Bulola	Kitongo	Bubinza
DM (g/kg DM)	385.6	382.9	350.7	413.5
CP (g/kg DM)	165.1	120.9	164.5	148.9
ADP (g/kg DM)	11.65	11.52	11.65	10.9
ADF (g/kg DM)	394.9	438.9	389.4	413.5
NDF (g/kg DM)	697.8	730.9	669.7	722.5
IVDMD (g/kg DM)	468	416.7	520.8	416.7
INOMD (g/kg DM)	549.6	480.4	584.5	480.2
ASH (g/kg DM)	120	90	140	120
ME (MJ/kg DM)	9.45	8.62	9.59	9.10

DM =Dry Matter, **CP**= Crude Protein, **ME**= Metabolizable Energy, **ADF** = Acid Detergent Fiber, **NDF** = Neutral Detergent Fiber, **IVDMD** = *In vitro* Dry Matter Digestibility, **INOMD** = *In vitro* Organic Matter Digestibility

The NDF content of pasture in Bulola was higher compared to other villages, followed by pasture from Bubinza. Pasture from Kitongo had the lowest NDF content which is almost similar to that pasture from Nyamhongolo. Pasture from Kitongo had higher *in vitro* digestibility than pasture from other villages. Pasture from all villages had slightly similar metabolizable energy content. Chemical composition of forages from all villages under study did not differ much.

The chemical composition of supplementary ingredients (concentrates) from the study area is presented in Table 12. Cotton seed cake (CSC) had the highest DM followed by sunflower seed cake (SSC) while cotton seed hulls (CSHs) lowest DM among the supplementary feed type. The crude protein ranged from 93.91 g/kg DM

to 363.9g/kg DM. Cotton seed cake had the highest CP followed by SSC and rice polishing (RP). Cotton seed hulls had the lowest CP content.

The values of EE were relatively low in CSHs compared to other supplementary feed types. Sunflower seed cake had the highest content of EE followed by CSC and RP. Cotton seed hulls had EE less than other feed types. The CF content was comparatively higher in CSHs followed by RP and SSC. Cotton seed hulls had the lowest CF compared to other feed types.

Table 12: Chemical composition (g/kg DM) and *in vitro* digestibility (g/kg DM) and energy content (MJ/kg DM) of supplementary feeds from the study area

Nutrient Composition	Supplementary feed			
	Cottonseed hulls	Cottonseed cake	Sunflower seed cake	Rice polishing
DM (g/kg DM)	912.3	934.6	934.3	920.9
CP (g/kg DM)	93.91	363.9	319.53	113.5
ADP (g/kg DM)	7.77	213.8	45.49	19.49
EE (g/kg DM)	51.0	81.0	130.0	76.0
CF (g/kg DM)	465.0	174.0	287.0	301.0
ADF (g/kg DM)	532.5	207.4	301.9	328.9
NDF (g/kg DM)	745.5	399.9	345.0	462.86
IVDMD (g/kg DM)	313.5	520.0	416.7	250
IVOMD (g/kg DM)	323.5	537.1	428.4	317.2
ASH (g/kg DM)	30	70	60	200
ME (MJ/kg DM)	3.46	10.30	8.80	7.35

DM =Dry Matter, **CP**= Crude Protein, **ME**= Metabolizable Energy, **ADF** = Acid Detergent Fiber, **NDF** = Neutral Detergent Fiber, **IVDMD** = *In vitro* Dry Matter Digestibility, **INOMD** = *In vitro* Organic Matter Digestibility

Cotton seed hulls had the highest NDF content followed by RP, CSC and least in SSC. Cotton seed cake had highest energy content than other feed types whereas CSHs had the lowest energy content. *In vitro* digestibility of CSC was higher than

other supplementary feeds followed by SSC and CSHs. RP had the lowest *in vitro* digestibility value.

4.6 Constraints Affecting Cattle Performance

The main constraints facing cattle under agro pastoralists are presented in Fig. 15. Different constraints were affecting cattle in different districts at varying extent, where as in Ilemela district were grazing land and theft, the major constraints in Magu district there were inadequate feeds, diseases, parasites and inadequate grazing land.

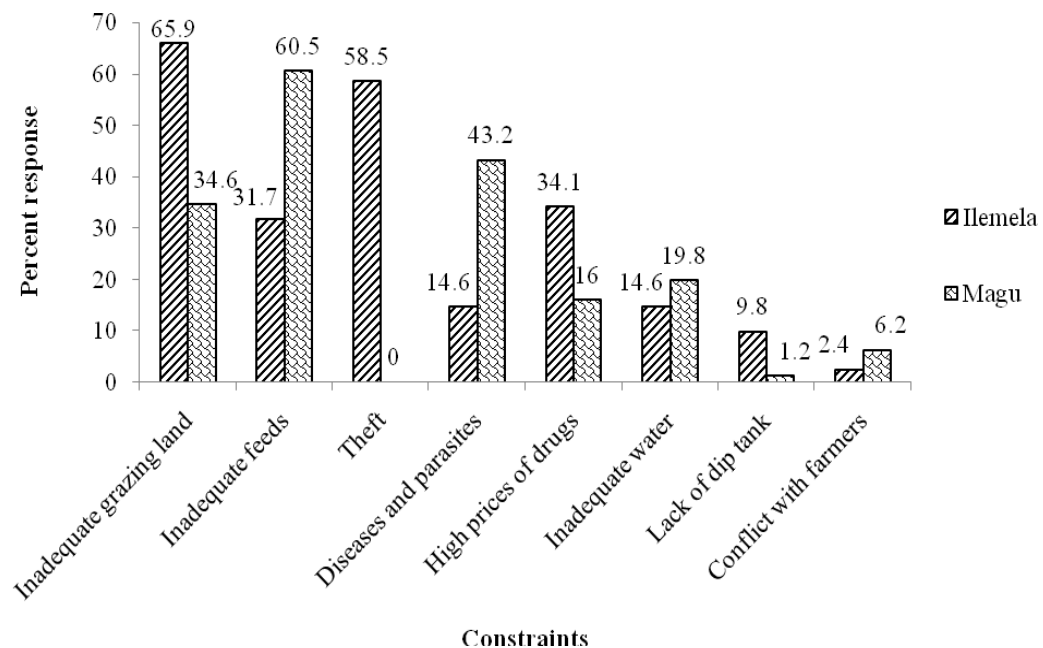


Figure 15: Percent response on the constraints facing agro pastoralists in Ilemela and Magu districts

The major constraints facing cattle finishing entrepreneurs in Ilemela district were high prices of drugs and inadequate grazing land while high prices of drugs and

shortage of water were reported by cattle finishing entrepreneurs in Magu district (Fig. 16). During focus group discussions (FGDs), fluctuation of price of concentrates was reported as one of the factors which affect cattle finishing in the study area.

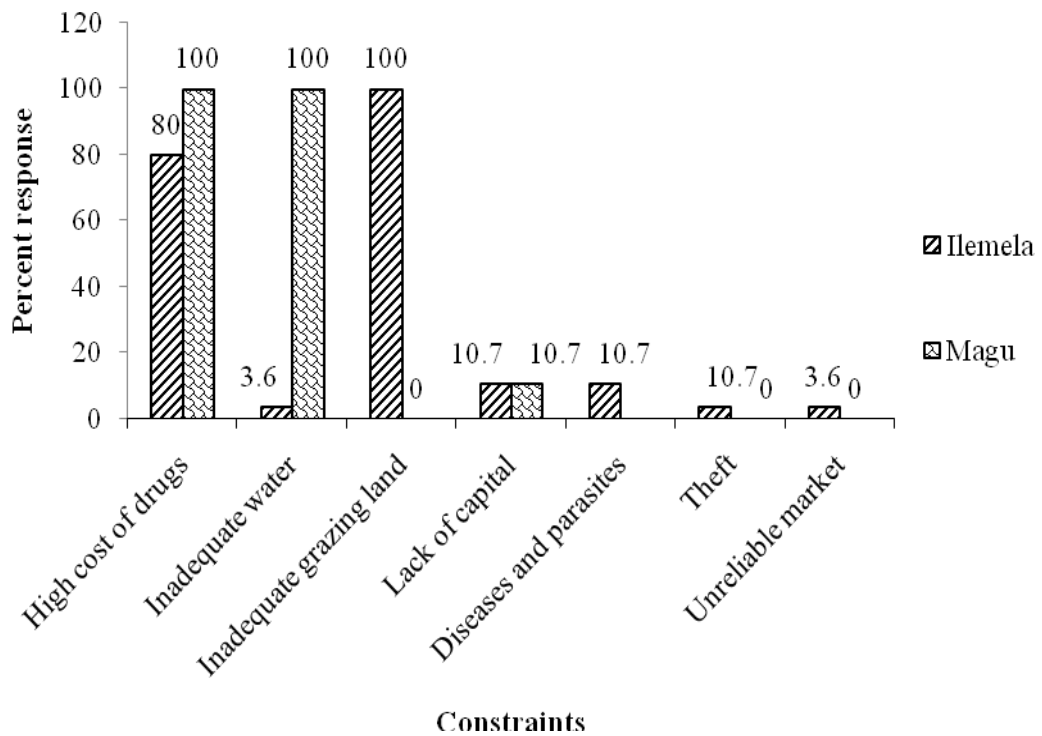


Figure 16: Percent response on the constraints facing cattle finishing entrepreneurs in Ilemela and Magu districts

4.7 Coping strategies during shortage of animal Feeds

The coping strategies of agro pastoralists in Ilemela district in feeding their cattle during shortage of feeds were prolonged grazing time, use of crop residues and shifting of cattle to the areas where feed is available (Fig. 17). On the other hand, agro pastoralists in Magu district use of crop residues, extending grazing time and

grazing their cattle around Lake Victoria and river Simiyu. Some agro pastoralists in Magu district shifted their animals during shortage of feeds to nearby districts and regions such as Muleba in Kagera region. The practice of feed conservation by agro pastoralists was found not be common in Magu district, however they only conserve little feed for oxen. Also animals were shifted to nearby districts and regions where forages are available. The use of standing hay “*Ngitiri*” in both districts was reported as one of the coping strategies during shortage of forages. Some areas with forages were selected and preserved/closed (*Ngitiri*) as from April to July and opened for grazing in the months of August to September. By laws have been set by local communities for prohibiting grazing animals in the preserved areas. Anybody who grazes his/her animals in the closed area before the time period set for opening is usually penalized. Drilling of deep wells and charcoal dams was reported by agro pastoralists and cattle finishing entrepreneurs during focus group discussions as a coping strategy on water scarcity during dry season.

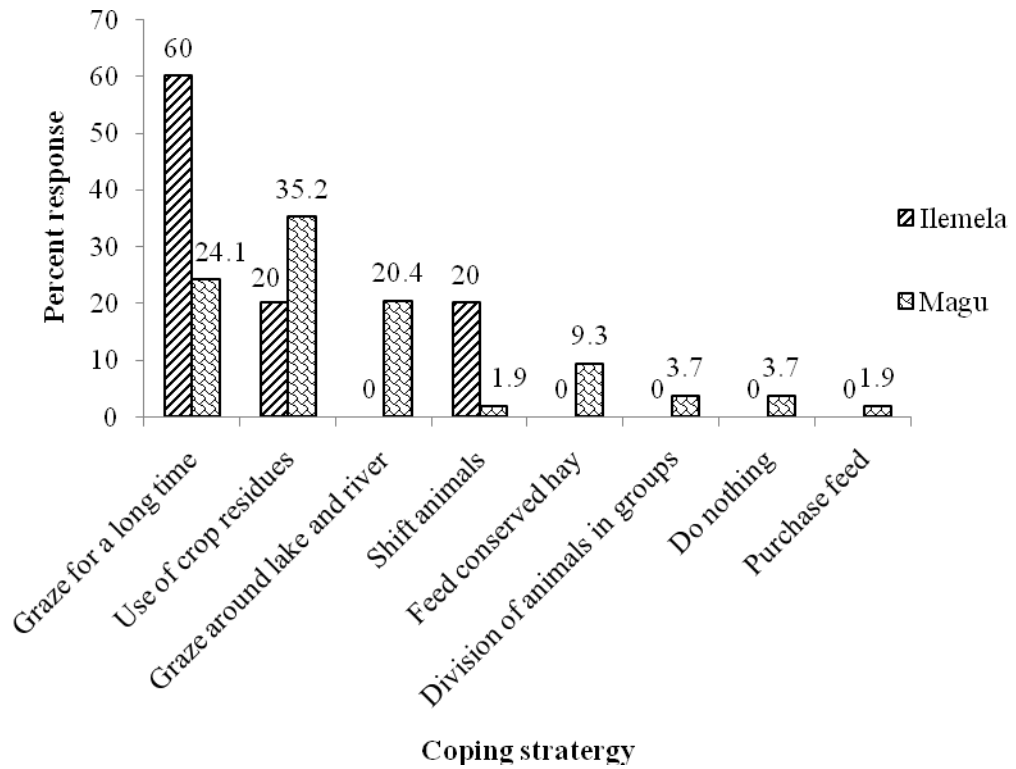


Figure 17: Percent response on the coping strategies of agro pastoralists on feeding cattle during dry season

CHAPTER FIVE

5.0 DISCUSSION

5.1 General Observation

This chapter presents a discussion of the findings made in this study. The discussion covers characterization of cattle finishing systems, growth performance of cattle under grazing alone and grazing with concentrate supplementation, feed resources availability for cattle production and constraints affecting cattle production.

5.2 Cattle Finishing Systems in the Study Area

The main cattle finishing systems observed in the study area were grazing alone practiced by all agro pastoralists and grazing with concentrate supplementation practiced by cattle finishing entrepreneurs. Feedlotting was practiced by few cattle finishing entrepreneurs. Most of agro pastoralists allowed animals to go for grazing early in the morning and return back in the late evening to their night boma. Cattle spent long time grazing due to inadequate feeds during dry season. Long grazing time of cattle under grazing alone is in agreement with the study by Bayer (1986) who reported that long grazing hours of cattle under grazing alone is attributed to inadequate and poor quality of feeds during dry season. Long grazing time observed could increase long walking distance searching for forages during dry season which result into the low body weight gain of cattle due to wastage of energy during walking. Brosh *et al.* (2010) reported that cows on grazing needed 89 to 103 KJ BW^{0.75} per day for walking and grazing compared to 42 to 47 KJ/kg BW^{0.75} per day required for standing. Long grazing time could also be attributed to the reduced

green parts of forages during dry season which cause animals to increase time for selection. It has been reported that even cattle on grazing native rangelands with a diverse population can select about what they eat (Mathis, 2003).

The observed high response on the preference of both cattle finishing systems to keep Tarime breed was locally attributed to its ability to adapt on areas with inadequate feeds and harsh environmental condition. Likewise, Ngowi *et al.* (2008) reported that, Tarime cattle breed was preferred by farmers due to its ability to walk long distances for grazing and digesting of poor quality forages as well as its higher resistance to endemic diseases. The current shortage of feeds and grazing lands led to selection of cattle breeds which can thrive under such conditions. The small herd size of cattle observed in Ilemela district compared to Magu district could be due to the severe shortage of grazing land reported in Ilemela district. Note that Ilemela district is found in the city of Mwanza, has low grazing land due to expansion of the city and increase in human population.

The observed low body weight of cattle under grazing alone could be contributed by inadequate feeds and poor management in controlling internal and external parasites, such as worms and ticks respectively. This signifies the need for concentrate supplementation and regular parasites control. It was observed that, cattle raised by agro pastoralists under grazing alone can attain slaughter weight when they are more than four years of age. This result is supported by UNIDO (2012) who reported that cattle raised under traditional sector in Tanzania on grazing alone attain optimum slaughter weight at 5 and 6 years of age. In addition,

Mlote *et al.* (2012) noted that mature animals of age ranging between 4 to 10 years were commonly bought by cattle finishing entrepreneurs from pastoralists and agro pastoralists in Mwanza and Shinyanga regions. Long time spent by cattle to attain slaughter weight could be attributed to seasonal variability of feeds in both quantity and quality. During the dry season cattle loss weight and prolong time for cattle to attain slaughter weight. Failure of agro pastoralist to supplement concentrates and conserve livestock feeds could be the cause for the observed low growth performance of cattle due to limited nutrient intake. Asizua (2010) reported that low productivity of animals is associated with the limited nutrient supply. The observed long grazing time of cattle under grazing alone in Magu district was due to shortage of forages during dry season.

The observed few grazing hours by cattle under grazing with concentrate supplementation signifies the need for concentrate supplementation. Cattle under grazing with concentrate supplementation were grazed for few hours because they were fed concentrates after grazing. Short grazing hours reduce distances covered while searching for forages and water thus animals retain more energy for growth. Energy retained due to reduced walking activity has been reported to influence good performance of animals (Asizua, 2010). The observed and perceived high growth rate of cattle under grazing with concentrate supplementation could be attributed to reduced walking activity, high protein and energy of the supplements. In addition good management on regular control of ticks and worms of cattle practiced by cattle finishing entrepreneurs was the reason for high growth rate of cattle under grazing with concentrate supplementation. High performance of cattle under concentration

supplementation was also observed by Mpairwe *et al.* (2003) and Asizua (2010) who found that, Ankole cattle on grazing alone gained only 0.194 kg/day compared to 0.350 kg/day of animals supplemented with high energy and protein diets. The observed ADG of cattle supplemented with concentrate of 0.51 kg in this study was within a range of 0.43 kg to 0.69 kg found by Dung *et al.* (2013) in Vietnam smallholder farmers. The good performance of cattle under grazing with concentrate supplementation is contributed by the high energy and protein in concentrates. The observed low ADG (0.21 kg) of cattle under grazing alone practiced by agro pastoralists compared to those cattle under grazing with concentrate supplementation signify the importance of concentrate supplementation and intensification on animals before slaughter. Therefore, the daily weight gain of cattle under grazing with concentrate supplementation double the weight gain of cattle under grazing alone implying that, cattle supplemented with concentrates under good management during dry season can perform as twice as those under grazing alone. Similar results were observed by Asizua (2010) who reported that, growth rate of Ankole cattle can gain more than double when supplemented with concentrates. Thus concentrate supplementation in cattle during dry season is very important to increase their growth rate.

The observed high average daily gain by cattle in Ilemela than Magu districts could be due to differences in the availability of forages, management practices and vegetation type in the two districts. Shortage of feeds and large cattle herd size in Magu district compared to Ilemela district could be the reason for the observed low average daily gain of cattle compared to those in Ilemela district. In addition,

Ilemela district being within the city area, it is easier to access veterinary and animal feed supplies than Magu district. In addition, people in Ilemela district can get easy access to trainings on animal production compared to those in Magu district. Thus, animals in Ilemela district could receive better management than those in Magu district.

5.3 Feed Availability and Nutritional Values

The observed availability of feeds in the study area depends on the season of the year, whereby during wet season feeds were adequately available and became scarce during dry season. The results were in agreement with the findings by Tolera and Abebe (2007) who reported that there is seasonal variation of livestock feeds whereas, during wet season there are adequate feeds and depleted during dry season. Shortage of forages and crop residues was experienced during dry season which commence from July to mid-October. Feeds were available from January to July which falls in immediately after heavy rains. The same observation was noted by Abusuwar and Ahmed (2010) that there are plenty of forages during and immediately after rainy season in many semi – arid rangelands in the tropics. The main source of feeds for cattle production under agro pastoralists are natural forages and crop residues which are available all over the year but become scarce during dry season. Similar observation was reported by Assefa *et al.* (2013) that natural pasture and crop residues are the major feeds sources for animals. These feed sources become scarce during crop cultivation and dry season.

The highest CP content of forages was from Nyamhongolo village while the lowest CP was on pasture from Bulola village. The high CP content of pastures observed was attributed to short rains that commenced in the mid October during the study. There was little variation of CP content of forages collected from the villages of the study area. The variations of CP content could be due to different species composition of the collected forages. Variation of CP content due to species differences was also reported by McDonald *et al.* (2002). It has also been reported that, variation in protein content of forages depends on forage type (Doto *et al.*, 2004 and Nkenwa, 2009). Legumes may contain CP range from 150 to 230 g/kg DM whereas typical grasses contain 80 to 180 gCP/kg DM (Doto *et al.*, 2004). Variation of CP content of forages might also be due to differences in soil characteristics, such as soil fertility, soil structure and texture. The energy content of forages found in this study ranged from 8.62 to 9.59 ME MJ/kg DM. The difference of ME of forages in the villages under study could be due to differences in vegetation where forages were clipped. The observed energy of forages from the study area is less than the energy requirement for cattle. The energy observed is less than the recommended energy for cattle finishing which range from 12.5 to 13.6 MJ ME/kg under East and Central Africa conditions (Topps and Oliver, 1993; Mwilawa, 2012). Thus, the energy of forages from the study areas cannot meet energy requirement for cattle, hence need concentrate supplementation to supply more energy. The observed CP content of CSHs of 93.91g/kg DM was higher than that reported by Mertens (1994) and Mawona (2010) which were 44 g/kg DM and 60.6 g/kg DM, respectively. However the CP was less than the values reported by Chamatata (1995) which was 162 g/kg DM. The differences in CP content of CSHs

could be contributed to difference in year, ginning process, climatic and soil condition under which the cotton was grown. The CP of CSHs found in this study was less than the required CP for cattle finishing which is 135 g/kg DM to 171 (Weisbjerg *et al.*, 2009). Also Brown *et al.* (2008) reported protein requirement for cattle finishing to be 120g/kg DM to 150g/kg DM which is within the range reported by Weisbjerg *et al.* (2009). Thus CSHs should be mixed with feeds of high CP content for example CSC to improve its CP content. The NDF content of CSHs found in this study was 745.5 g/kg DM, slightly lower than that found by Mawona (2010) which was 809 g/kg DM but as twice higher than that reported by Torrent *et al.* (1994) of 319 g/kg DM. High NDF content could be caused by high content of lint in the seed hulls which is an indication of poor removal of lints. The higher NDF content of CSHs might lower its digestibility.

The *in vitro* digestibility of CSHs observed in this study (313.5 g/kg DM) was slightly lower than 473 g/kg DM found by Mawona (2010). The low digestibility value of CSHs might have been caused by the high cell wall contents of the CSHs. The observed high NDF content of CSHs could contribute to its low digestibility. Cotton seed hulls fed alone have little influence on cattle growth performance of animals but can be used as roughage sources. Utilization of poor roughages, such as CSHs can be improved by supplementation of feeds with good protein and energy level, which will improve intake and digestibility (Gadberry *et al.*, 2009).

The observed CP (363.9 g/kg DM) of CSC in this study was higher than 242, 268 and 285 g/kg DM, values reported by Mawona (2010), Machibula (2000) and

Urassa (2012) respectively. The differences in CP content could be caused by the soil type, year when the cotton was grown, source of the product, presence of impurities or the way it was processed, whether from decorticated or undecorticated cotton seeds. Undecorticated cotton seed cake has low CP than decorticated seed cake. The higher CP content of CSC places it in a position as a good protein source for cattle finishing during dry season.

The level of NDF (399.9 g/kg DM) observed on CSC was slightly similar to that (400 g/kg DM) reported by Coppock and Wilkis (1991) but lower than (488 g/kg DM) reported by Machibula (2000). The variation on NDF of CSC can be caused by the soil type, climatic condition, and prior processes on the seeds before oil extraction. The observed CF of CSC (174 g/kg DM) from the study area was slightly higher than the values reported by Kakengi (1998), which was 142 g/kg DM. The difference of CF content from the other author could be due to differences in the sources of CSC and efficiency of cotton seed processing for oil extraction. The good *in vitro* digestibility of CSC indicates its good quality concentrate source for cattle finishing. In addition the high energy level of 10.30 ME MJ/kg DM in CSC found in the present study was almost similar to 10.7 ME MJ/kg reported by Mawona (2010), which makes it as a good concentrate source for supplementing cattle.

Crude protein (CP) content in the rice polishing (RP) was 113.5g/kg DM which is lower than that reported by Ambreen (2006) and Urassa (2012) of 130 g/kg DM and 115 g/kg DM, respectively. This variation could be caused by the processing

condition and the type of rice milling machine used in Mwanza, which could not be efficient in separating the polish and husks. The observed NDF level in RP of 463 g/kg DM was lower than that reported by Mawona (2010), which was 586 g/kg DM. In addition, higher levels of CF (301 g/kg DM) was observed than that reported by Ambreen (2006), Urassa (2012) and Hossain *et al.* (2012), which were 151 g/kg DM, 206 g/kg DM and 252 g/kg DM, respectively. The higher level of CF in RP could be contributed by improper separation of bran from rice husks. Differences in CF content in RP from other authors could be due to differences in the efficiency of rice milling machines and variety of paddy. The differences of chemical composition in RP could be due to different varieties of paddy reported by Ambreen *et al.* (2006). The observed ME of RP in the present study (7.35 MJ ME/kg DM) was within the range of 6.7 MJ ME/kg DM to 11.17 MJ ME/kg DM reported by Tahir *et al.* (2002). The observed ME of RP in the present study is less than the recommended energy requirement of cattle finishing, which range from 12.5 to 13.6 MJ ME/kg under East and Central Africa conditions (Topps and Oliver, 1993; Mwilawa, 2012). Rice polishing alone from the present study cannot meet energy requirement of cattle. Thus, to meet the required energy for cattle finishing RP should be mixed with high energy dense concentrate.

The crude protein (CP) content in sunflower seed cake (SSC) from this study was higher than that reported by Shigulu (2012) of 220.3 g/kg DM. The high CP content of SSC is a potential for microbial digestion in the rumen of ruminants. The observed low NDF content of SSC compared to the other supplements attributed to its high *in vitro* digestibility. The observed crude fibre (CF) of SSC in the study is

lower than values of 381.2 g/kg DM reported by Shigulu (2012). Due to the high level of CP of 319.3 g/kg DM and low level of NDF of 345 g/kg DM, SSC can be used as a good supplementary feed in cattle finishing. It can be concluded that, CSC is a good source of energy and protein for cattle finishing during dry season.

The anti-nutritional factor, gossypol, present in CSC, has low side effect in ruminants. Sunflower seed cake has good potential as a protein source for cattle finishing. Cotton seed hulls (CSHs) have low energy and protein but can be utilized well by ruminants as an alternative source of roughages during shortage of forages. When CSHs is mixed with high energy and protein source feeds it can be used as a good feed source for cattle finishing during dry season. Rice polishing (RP) also can be used as a good source of energy although it is limited by storage shelf life as it undergoes rancid. However, it should be promoted as energy source to finishing cattle.

5.4 Constraints and Coping Strategies

The shortage of grazing lands observed in Ilemela could be due to urbanization, expansion of crop cultivation and increase in human population because it is located in Mwanza city. Shortage of grazing lands due to urbanization was also observed by Lwasa (2004) and Katongole *et al.* (2012). Open access are being exchanged for infrastructural development. The observation is also in agreement with MLFD (2011) who reported that, increase of human population and livestock has lead to shortage of grazing lands. MLFD (2011) reported that, the increase in human population has caused demand for more land for settlement and cropping. Similar

observation of scarcity of grazing land was reported in tropics by Lanyasunya *et al.* (2005). Shortage of grazing lands in the study area has led into shortage of feeds for cattle which has negative impact on the growth performance of cattle. Proper implementation of laws and regulation on land use plan could be a solution of shortage of grazing lands. Theft was observed as among the constraints which trouble agro pastoralists and cattle finishing entrepreneurs in Ilemela district but was not reported in Magu district. Cattle were stolen and slaughtered in the night boma (local enclosure for cattle) or nearby and brought meat to the meat selling shops. This has troubled many agro pastoralists in Ilemela district in such a way that, they were not willing to keep cattle any more. Cases of livestock theft which hinder cattle production were also reported by Nyariki *et al.* (2009) in Masai- Mara, Kenya. To solve the problem of theft agro pastoralists were keeping dogs and hiring security guards for security. Raising dogs and hiring security guards increased cost of production as the dogs need food and the security guards are paid wages.

The observed inadequate feed resources as was reported by agro pastoralists in both districts was contributed by prevailing drought condition and shortage of grazing lands due to expansion of crop production and increase in human population in the study area. Urbanization and increase in human population attributed to the shortage of grazing land in Ilemela district whereas expansion of crop cultivation was observed to lead to the shrinkage of grazing land in Magu district. Shortage of feeds due to shortage of grazing land in the study area is in agreement with the findings reported by Assefa *et al.* (2013) who reported shortage of feeds was caused by decreased grazing land. In addition, shortage of livestock feeds due to shortage

of grazing land was also observed by Tebeje (2012) in Ethiopia. Shortage of livestock feeds due to expansion of crop production and increase in human population cause shrinkage of grazing lands which lead into shortage of livestock feeds was also observed by Komwihangilo *et al.* (2009) in the central parts of Tanzania. The findings were also in accordance with the observation made by Tolera and Abebe (2007) that, expansion of crop cultivation has led to decreased grazing lands which ultimately caused shortage of feeds for animals. Similar findings of shortage of grazing land due to expansion of crop cultivation were reported by Selemani *et al.* (2012) in Shinyanga region. The shortage of livestock feeds in Magu district was also attributed to the recurrent drought condition, prolonged dry season and uneven distribution of rainfall which affects crop production and re-growth potential. Shortage of livestock feeds in the study area consequently led to the long grazing time of animals. Shortage of grazing land and feeds which affect cattle production was also observed by Degu (2012) in the Southern region of Ethiopia.

The observed conflicts between agro pastoralists and crop producers in the study area were probably attributed to the shortage of grazing lands. Expansion of land for crop production and poor land use plan has contributed into conflicts between small holder farmers and livestock keepers. It has been reported that, conflicts between farmers and pastoralists are due to poor land use plan and poor approaches of resolving the conflicts. For instance REPOA (2003) observed that, conflicts between farmers and pastoralists in Kilosa were caused by poor land use plan and the unlawful permission of pastoralists and farmers from other districts and regions

to invade the area. The observed challenges of diseases and parasites affecting cattle production in Ilemela and Magu districts is in agreement with findings of Onono *et al.* (2013), who reported the incidence of diseases as a constraint to cattle production in some parts of Kenya. Diseases reduce growth rate and cause pre weaning mortality rate in calves (Onono *et al.*, 2013). The observed most economic important diseases in the study area, are anthrax, foot and mouth disease (FMD). The common parasites were ticks and worms. Diseases and parasites have significant effect on health and productivity of animals as it was also reported by Tolera and Abebe (2007) in Southern Ethiopia. Thus, control of diseases and parasites is very important for increasing animal production.

Water shortage was observed as among the challenges which affect cattle production in Magu district. Scarcity of water as constraint for cattle production was also reported by Onono *et al.* (2013) in some parts of Kenya. Most of the agro pastoralists and cattle finishing entrepreneurs in Magu district depended on sources of water for their cattle in Lake Victoria, river Simiyu and river Ng'aya.

The observed high prices of drugs and price fluctuation of feeds for cattle finishing were obstacles on cattle finishing under grazing with concentrate supplementation in both districts. Prices of feeds for cattle finishing such as cotton seed hulls, cotton seed cake and rice polishing rose up when there was inadequate rainfall. Long grazing time was observed as a coping strategy during shortage of livestock feeds in Magu district, therefore animals have to spend more time grazing to satisfy their needs. Also cattle were grazed on the crop fields to consume crop residues as a

coping mechanism during shortage of forages. Feeding of cattle to crop fields was done after harvesting which was also observed by Komwihangilo *et al.* (2009) in the central zone of Tanzania.

Few agro pastoralists in Magu district were conserving rice straws to feed oxen during shortage of feeds. Conservation of livestock feeds by agro pastoralists and cattle finishing entrepreneurs for finishing cattle was not common in the study area. The observation is in agreement with Smith (1993) who reported that large quantity of cereal straws in tropics is left in the fields for grazing without being harvested, treated and stored for future use. When crop residues are left in the fields they are deteriorating and large amount are usually trampled by animals during grazing. The observed shifting of animals during shortage of feeds in Ilemela district as a coping strategy during shortage of livestock feeds was due to less grazing lands. Shortage of grazing land had led to shifting of agro pastoralists to nearby districts such as Magu and Misungwi for grazing lands and livestock feeds, similar results were observed by Belay and Sugulle (2012) in Gabiley region, Somalia. Shifting of agro pastoralists observed in Magu district to nearby districts and regions such as Muleba in Kagera was attributed to drought condition which reduces livestock feeds. Shifting of animals to areas where there are plenty of grazing lands and possibly more pastures was also observed by Komwihangilo *et al.* (2009) in the central parts of Tanzania. Similar observation of shifting animals to areas with adequate feeds was reported by Belay and Sugulle (2011). Grazing and drinking water along Lake Victoria and river Simiyu was observed in Magu district as one of coping strategies during shortage of feeds and water. Grazing along Lake Victoria and river Simiyu

has degradation effect on those areas. Similar observation was reported by Bwire *et al.* (2011). Although it was prohibited by the government to bring animals along the Lake Victoria and river Simiyu for water, the respondents said that, agro pastoralists and cattle finishing entrepreneurs are bringing animals to drink water in those water sources. In addition, drilling of charcoal dams and wells in seasonal rivers were observed in the study area to cope with the situation of water shortage. The observed conservation of animal feeds in special areas by agro pastoralists known as *Ngitiri* to be used during dry season was in agreement with Selemani *et al.* (2012) who reported that traditional forage conservation (*Ngitiri*) was used during dry season in Shinyanga region. *Ngitiri* is an *in situ Sukuma* traditional vegetation conservation technology to promote regeneration of vegetations to provide fodder for animals during shortage of feeds (Brandstrom, 1985; Rubanza *et al.*, 2005).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

- (i) Cattle on grazing alone, which is common practice with agro pastoralists, are characterized by poor growth performance attributed to inadequate supply of nutrients especially during dry season.
- (ii) Supplementing cattle during dry season with available concentrates in the area improved body condition of the fattened animals. Cattle finishing entrepreneurs are realizing this opportunity in their business.
- (iii) The strategy of using available concentrates would depend on the seasonal availability of good quality forages and crop residues.
- (iv) Shortage of feeds is constrained by inadequate grazing lands which could be alleviated through intensification of cattle and supplementing concentrate during dry season.

6.2 Recommendations

- (i) To improve cattle growth performance during dry season, agro pastoralists should employ the techniques of forage conservation and use of the available concentrates. The available natural forages and crop residues such as rice straws, maize stover and potato vines could be

collected during the periods of plenty and conserved to be used during the times of feed shortages.

- (ii) Further assessment on the quantity and quality of the available forages and crop residues is needed to develop a year round feeding strategy for cattle production in the study area.
- (iii) Further research is needed on the appropriate techniques for feed conservation and effect of the available feed resources on the economic performance of the animals.

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APPENDICES

Appendix 1: Questionnaire for pastoralists and cattle finishing entrepreneurs

NOTES TO ENUMERATORS: *Start the interview by introducing yourself and the aim of the interview as well as how the results of interviews will be used. Where the respondent wishes to be ensured about the confidentiality of the interview process, please do so.*

IDENTIFICATION PARTICULARS, STAFF & SURVEY TIME DETAILS

1. COUNTRY: 1)Tanzania				
2. REGION: 1) Mwanza				
3. DISTRICT: 1) Ilemela 2) Magu				
4. DIVISION: 1)Ilemela; 2)Ndagaro; 3 Itumbili				
5. WARD:1)Buswelu; 2) Bugogwa; 3) Shishani; 4) Nkungulu; 5) Sukuma; 6) Lubugu				
6. VILLAGE:1) Nyamhongolo; 2) Buswelu/Bulola; 3) Shishani; 4) Kabila; 5) Kitongo; 6)				
7. HOUSEHOLD CATEGORY (1=Pastoralists, 2 = Cattle fattening entrepreneurs)				
8. HOUSEHOLD CODE/NAME:				
9. NUMBER OF YEARS LIVED IN THE VILLAGE:				
10. SEX OF HEAD OF HOUSEHOLD:		1) MALE 2)FEMALE		
11. AGE				
12. Education				

1. Common feeding system

		Fattening system		
Seasonal feeding	Feedlotting (complete concentrate feeding)	Grazing alone	Grazing + supplementation	Stall feeding alone (roughages + concentrates)
Season 1 Number of farmers using				
Season 2 Number of farmers using				
Season 3 Number of farmers using				

2. Land retained for cattle production

Acreage owned: 1=0.5-1, 2=1-2,3= 2-4,4= 4-6,5=6-10, 6=any other specify	Is the land satisfying the need? 1=Yes,2=No	Plan for expanding the land:- 1=purchasing, 2 = renting, 3 = any other specify	Where do the land for beef cattle finishing do you prefer to be?: Urban =1 Rural area= 2	Why beef cattle finishing in the area of your choice?

Livestock inventory and herd structure

3. What cattle breed do you keep?

Breed	Source
1 = Ankole	
2 = Zebu	
3 = Boran	
4 = Others	

4. What is the herd structure of your livestock? (Give numbers in each category for cattle)

Total	Mature cattle				Young cattle			
	Breeding females	Breeding males	Non Breeding males	Non Breeding females	Heifers	Bulls	Heifer calves	Bull calves

5. Beef cattle feeds and feeding

What are the feed resources available in your area	Do the grassland satisfy the need ?, 1 = satisfy the need, 2 = Not satisfied the need	Season with inadequate feed sources. Provide reasons for your choice 1 = dry season 2 = wet season	Do you conserve livestock feeds? 1 = Yes, 2 = No. If Yes in which form If no provide reason

6. Rank supplementary feeds according to use, 1 = most used, 2 = moderate used, 3 = least used

Type of concentrate	Rank			Quantity per animal per day (tin, sadolin, kg, gram, any other unit)
	1	2	3	
Maize bran				
Cotton seed cake				
Cotton seed hulls				
Rice polish				
Rice bran				
Sunflower seed cake				
Molasses				
Others (Specify...)				

7. Concentrate feeding

Do you supplement/ use concentrates to your cattle? 1=Yes, 2=No	If no supplementation why?	Source of concentrates, 1 = purchasing, 2 = from my own farm, 3= others specify.....	Do concentrates adequate available 1 = Yes, 2 = No	Do the unit owner formulate feeds 1 =Yes, 2 = No	If the owner formulate feeds he/she should indicate ratios of ingredients in (gallons, tin, kg etc)

8. What is the price per kg/tin/sac of concentrate? Fill in the table below

Type of feed	Source(s)	Kg/Sac/Tin	Price
1			
2			
3			
4			

9. Do you have any plan to supplement your animals with concentrate? 1 = Yes []
2 = No []

10. Do you think is important to feed animals concentrates? 1 = Yes = [] 2 = No []

11. If Yes, give

reasons.....

12. If no, give reasons.....

13 What quality criteria are considered in selection of concentrates? 1 = Colour

observation 2 = texture, 3 = Smelling, 4 = analysis, 5 = any other

specify.....

14. What do you normally do (coping strategy) when there is a shortage of feed on your farm? 1 = Purchase feeds

2 = Sale some animals 3 = Shift animals to the other areas with feeds, 4 = do

nothing 5 = others specify. [].....

13 Reproductive and production performance (to be asked to the pastoralists)

What is the source of replacement stock? 1 = Buy from the market, 2= Exchange 3 = others specify....	How do you control inbreeding? 1 =Buy bull from far markets, 2 = Exchange bulls 3= Bull rotation 4= others, specify.....	At what age do your cows produce their first calf? 1= In less than two years old , 2 = When two years old, 3= When over two years old	How often do your cows calve down? 1 = Every year, 2 = every two years, 3 = after more than two years	How long will it take for cattle to reach slaughter weight? 1 =Six months, 2= One year, 3= two years, 4 = three years, 5 =four years, 6 = others, specify.....

15. What is the growth rate of your cattle 1 = very low, 2 = low. 3 = average 4 = high, 5 = very high

16 Give reasons for your answer.....

17 Cattle inventory and herd structure

To ask the respondents on animal sources, breeds and adequacy of animals.

What are the breeds of your animals? 1 = Boran, 2 = Zebu, 3 = Ankole, 4 = Boran + Zebu, 5 = Zebu + Ankole 6 = others specify.....	Are you getting enough cattle for your unit 1=Yes, 2= No. If no what is the solution?	What breed do you prefer to purchase? Why so? (RANK)

18. Do you get access to veterinary and extension services 1 =Yes [] 2 = No []

19 If no

why?.....

..

20. What are the main problems you face in your cattle production? Mention them.

Problems/constraints	Solution (How to overcome the problem)

21 Do you deworm your cattle (1) Yes (...) No (...)

If yes what is the frequency do you deworm your cattle?.....

22 Do you dip your cattle? Yes (.....) No (.....)

If yes what is the frequency?.....

THANK YOU FOR YOUR COOPERATION

3 How much do the various feeds contribute to the diet of the animal throughout a year? Proportion of nutrition derived from different sources.

Type of feed	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Crop residues (a) cereals: e.g. rice straw, maize stover)												
(b) Legume crop residues												
c) Banana pseudo stems, tubers, etc												
Green forage (e.g. grass, weeds, fodder crops)												
Grazing on community land												
Grazing on grass cropland												
Conserved feeds												
Concentrates (List)												
Minerals + Premixes												
	10	10	10	10	10	10	10	10	10	10	10	10

4 Feed problems and potential solutions

Feed resource type	Problem/ constraint	Solution/ Opportunity	
		Technological	Institutional/ organizational
Grazing			
Cotton hulls, sfsc, ricepolish,csc			
Minerals			
Conserved feeds (Hay, Silage)			
Crop residues (stover, straw, bean hawls etc)			

- 5 What criteria do you use on selection of cattle in the market?
- 6 How long do you fatten your cattle?
- 7 What determine the fattening period?
- 8 What criteria do you use to know your cattle is ready for selling?
- 9 Do you control endoparasites and ectoparasites? If yes how?

THANK FOR YOUR COOPERATION

- 3 How much do the various feeds contribute to the diet of the animal throughout a year? Proportion of nutrition derived from different sources.

Type of feed	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Crop residues (a) cereals: e.g. rice straw, maize stover)												
(b) Legume crop residues												
c) Banana pseudo stems, tubers, etc												
Green forage (e.g. grass, weeds, fodder crops)												
Grazing on community land												
Grazing on grass cropland												
Conserved feeds												
Concentrates (List)												
Minerals + Premixes												
	10	10	10	10	10	10	10	10	10	10	10	10

- 4 Feed problems and potential solutions

Feed resource type	Problem/ constraint	Solution/ Opportunity	
		Technological	Institutional/ organizational
Grazing			
Cotton hulls, Sunflower seed cake, rice polish, csc			
Minerals			
Conserved feeds (Hay, Silage)			
Crop residues (stover, straw, bean haws etc)			

- 5 What criteria do you use on selection of cattle in the market?
- 6 How long do you finish your cattle?
- 7 What determine the finishing period?
- 8 What criteria do you use to know your cattle is ready for selling?
- 9 Do you control endoparasites and ectoparasites? If yes how?...

THANK FOR YOUR COOPERATION

**Appendix 4: ANOVA for different body weight in different weeks during
body weight measurements**

Dependent Variable: Body weight of cattle at week 2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Distri	1	33.9404	33.9404	10.56	0.0016
FeeSys	1	192.6491	192.6491	59.96	<.0001
Inwt kg	1	206930.0481	206930.0481	64401.6	<.0001
Error	101	324.5253	3.2131		
Corrected Total	104	293120.7619			
	R-Square	Coeff Var	Root MSE	Wt2kg Mean	
	0.998893	0.716871	1.792518	250.0476	

Dependent Variable: Body weight of cattle at week 4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Distri	1	109.8155	109.8155	10.84	0.0014
FeeSys	1	724.1582	724.1582	71.49	<.0001
Inwt kg	1	209513.3762	209513.3762	20682.7	<.0001
Error	101	1023.1171	10.1299		
Corrected Total	104	307218.2476			
	R-Square	Coeff Var	Root MSE	Wt4kg Mean	
	0.996670	1.249629	3.182746	254.6952	

Dependent Variable: Body weight of cattle at Week 6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Distri	1	422.8025	422.8025	34.17	<.0001
FeeSys	1	2098.4143	2098.4143	169.59	<.0001
Inwt kg	1	208785.2428	208785.2428	16873.7	<.0001
Error	101	1249.7172	12.3734		
Corrected Total	104	322072.5143			
	R-Square	Coeff Var	Root MSE	Wt6 kg Mean	
	0.996120	1.354110	3.517590	259.7714	

Dependent Variable: Body weight of cattle at Week 8

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Distri	1	749.7252	749.7252	44.26	<.0001
FeeSys	1	5477.9640	5477.9640	323.41	<.0001
Inwt kg	1	209748.7116	209748.7116	12383.4	<.0001
Error	101	1710.7284	16.9379		
Corrected Total	104	348461.6571			

R-Square Coeff Var Root MSE wt wk 8 kg Mean
0.995091 1.547539 4.115569 265.9429

Dependent Variable: Average daily gain (ADG) in kg

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Distri	1	0.24616265	0.24616265	44.99	<.0001
FeeSys	1	1.74163455	1.74163455	318.33	<.0001
Inwt kg	1	0.00671816	0.00671816	1.23	0.2704
Error	101	0.55259117	0.00547120		
Corrected Total	104	3.67640571			

R-Square Coeff Var Root MSE AVDGkg Mean
0.849693 21.46654 0.073968 0.344571