FARMERS PERCEPTION OF THE SMALL EAST AFRICA ZEBU x TYROLEAN GREY CATTLE CROSSES PERFORMANCE IN UGANDA

BY

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DECLARATION

I, Acila Goretti (Sr.) do hereby declare that this thesis is my original work and has never been submitted to any institution of higher learning for an academic award.

Signed…….

Date.....

APPROVAL

This is to certify that this work was carried out under our supervision as University supervisors.

Signed ……**Date** ……

Assoc Prof. Habib Kato

Signed…… …….. **Date** ……..…

Dr. Helen Nalumu Nakimbugwe

DEDICATION

In appreciation, I dedicate this thesis to my late parents V.G Okello and Martha Wanyenze. In a special way, I wish to register my sincere thanks and gratitude for the parental roles you played to shape my perspective about life and education. You cherished education so much. I wish you had stayed to witness the fruits of your investment.

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LIST OF ACRONYMS AND ABBREVIATIONS

AEZ	Agro-ecological zones
AI	Artificial Insemination
AnGR	Animal Genetic Resources
FAO	Food and Agricultural Organisation of the United Nations
Fig	Figure
HG	Heart Girth
KYU	Kyambogo University
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
NAGRC&DB	National Animal Genetic Resources Centre and Databank in Uganda
NaLIRRI	National Livestock Resources Research Institute
NSC	Number of services per conception
ÖNGENE	ÖsterreichischeNationalvereinigungfürGenreserven.
PMA	Plan for Modernization of Agriculture
UBOS	Uganda Bureau of Statistics
UN	United Nations
SEAZ	Small East African Zebu
SPSS	Statistical Package for social sciences
TG	Tyrolean Grey
TGX	Tyrolean Grey cattle crosses
WB	World Bank

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ABSTRACT

The study aimed to determine the performance of the Small East African Zebu (SEAZ) and the Tyrolean Grey cattle crosses (TGX) in the selected cattle corridor districts (Kole, Nakapiripirit, and Kayunga of Uganda. SEAZ is an indigenous breed in Uganda, while the TG breed is indigenous to the alpine region of Austria and was introduced in the country through use of semen in 2009. Heart girth data collected for over three years at Lusenke Stock Farm (National Animal Genetic Resources Centre and Databank – NAGRC&DB) was used in the study. This study used cross-sectional survey design embracing qualitative and quantitative approaches. Data was obtained by use of structured questionnaires, focus group discussion, and Individual In-depth interview for farmers, AI technicians, farm managers and extension workers. The study revealed that, traits such as; better draft power (χ^2=6.943, p<0.01) and resistance to parasites and diseases (χ^2=4.477, p<0.05) were significantly associated with the SEAZ. On the other hand, docility (χ^2=4.847, p<0.05), better milker (χ^2=13.976, p<0.001), good mothering ability (χ^2=10.174, p<0.001), fast growth (χ^2=11.242, p<0.001) and hard hooves to withstand muddy places better (χ^2=4.498, p<0.05), were significantly associated with the TGX. The study established that, the TGX were majorly and significantly constrained by parasites and diseases (χ^2=7.967, p<0.05), shortage of feeds and grazing land (χ^2=5.946, p<0.05), shortage of water (χ^2=5.883, p<0.05), high prices of veterinary drugs (χ^2=4.943, p<0.05), theft (χ^2=5.385, p<0.05), and lack of AI services (χ^2=13.507, p<0.001).Free range system was reported by the majority (81.6%). Pond/dam was the main water source reported by majority in the study (44.2%). Natural mating was the common breeding system used (45%). Greater proportion of the respondents (90.3%) reported problem of ticks in their farms. (52.5%) of the respondents reported no adaptation problem with TGX. Majority of the respondents reported AI technician as the major source of information about the cross breeding programme (56.7%). TGX was preferred by the majority of the respondents (78.8%).The study revealed that, there was a difference in the heart girth of the SEAZ and TGX (t=2.857, p<0.01). Based on the results of the study, the TGX showed better performance as compared to the SEAZ. At farm level, it is desirable for farmers to start keeping breeding records so that they can plan and control breeding for the future. The study recommends continued importation of TGX into Uganda to boost milk and meat production.

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Globally, there is a rapid human population growth rate, increased urbanization and increasing consumer preferences and demand in most parts of the developing world and therefore putting a serious threat to food security. Globally, in the last 25 years, per capita food demand of all Animal Source Food increased by more than 40 kg/person/year (FAOSTAT, 2018). Smallholder farming systems have been perceived as less likely to satisfy the escalating demand for foods of animal origin (MAAIF, 2013). With world population expected to reach 9.8 billion in 2050, demand for foods of animal origin is projected to continue increasing (Alexandratos and Bruinsma, 2012; UN, 2017). This presents significant market opportunities for livestock products. Livestock and livestock production serve multiple functions in millions of peoples' livelihoods. Worldwide, the livestock sector supports about 1.3 billion producers and retailers and contributes 40–50% of agricultural GDP (Herrero et al.; 2016).

Population growth in sub-Saharan Africa is among the fastest in the world, with growth rates estimated at approximately 2.5% per annum (UN, 2013a; World Bank, 2013a). However, increase in the production of livestock products is not keeping pace with the growth of the human population and sub-Saharan Africa has the lowest per capita consumption levels of livestock products in the world, (Cardoso, 2012). Livestock plays an important role in much of rural Africa where an estimated 50% of the population lives in poverty (World Bank, 2013).

Uganda is a low-income country with a population of 40 million (UN, 2018) and a GDP per capita of USD 607 per year. According to (UN, 2013b), if the trend of population increase continues, Uganda’s population will exceed 100 million by the year 2050. Agriculture is a critical sector of the economy,

contributing about 24.6 percent to GDP and 71 percent to employment (World Bank, 2019). Fifty-eight percent of households depend on livestock for their livelihoods. Most of them are subsistence-oriented smallholders (MAAIF, 2018 & UBOS, 2018).The total supply of animal source foods in Uganda, including that of net trade, translates in a per capita consumption of about 14 kg of meat, 36 liters of milk, per year (FAO, 2019a). The country has 14.2 million cattle, of which 13.3 million are indigenous or native breeds; 1.4 million households own at least one cattle (MAAIF, 2018 & UBOS, 2018). Out of the national herd, 11.9 million cattle are raised for meat. The cattle sector contributes to over 40 percent to the value of livestock production and to about 7 percent to the value of agricultural production (UBOS, 2017). Most cattle are in the 'Cattle Corridor', which extends diagonally across Uganda from the pastoralist Ankole area in the Southwest to the Karamoja region in the Northeast (Egeru et al., 2014). Regular climatic shocks affect Uganda, mainly associated to low rainfall and dry spells. Uganda, and particularly the Karamoja region in the northeast, is considered highest risks exposure to climate extremes (FAO et al., 2018).

Cattle are Uganda's most important livestock species because of their production and role in people's culture. Smallholder farming systems have been perceived as less likely to satisfy the demand for foods of animal origin set to dramatically increase (MAAIF, 2013). Exotic and improved breeds are usually imported from Kenya, South Africa and Europe (Mpairewe et al., 2015). Presently, local farmers' choices greatly influence patterns of genetic variation which has not yet been fully studied, similar to the morphometric variation lately documented (Kabi et al., 2015).

In 2009, through the intercession of Prof. Johann Sölkner, the head of the Animal Breeding Group at the University of Natural Resources and Life Sciences, Vienna, Austria – Bodenkultur (BOKU), the

Tyrolean Grey Cattle Breeders' Association donated 1000 doses of Tyrolean Grey cattle semen to the National Animal Genetic Resources Centre and Databank in Uganda (NAGRC&DB). NAGRC&DB is a government agency mandated to spearhead livestock breeding in the country. Since Prof. Solkner has for many years been involved in animal breeding developmental work in the tropics and is well conversant with the attributes of Tyrolean Grey cattle, he recommended its use on the Small East African Zebu cattle (SEAZ).Tyrolean Grey cattle semen was first used on SEAZ cattle that are kept at Lusenke Stock Farm, Kayunga District (Central Uganda) and among farmers in the neighborhoods of the farm. This farm, owned by NAGRC&DB, is at the forefront of conserving SEAZ.

In an effort to establish the performance of Tyrolean Grey cattle, weekly heart girth measurements of Small East African Zebu and their crosses with Tyrolean Grey cattle (SEAZ and TGX) took place at the farm between the years 2011untill 2013. Records from the farm show a total of 178 animals having been involved in this exercise. The National Livestock Resources Research Institute (NaLIRRI) an Institution under the National Agriculture Research Organisation (NARO) later embraced the use of Tyrolean Grey cattle semen on SEAZ in Karamoja region (northern Uganda). FAO under its two year project Integrated Dairy Development Pilot project in the middle north cattle corridor of Uganda also used TG semen in Kole and Nakapiripirit districts. Gayaza High School farm in Wakiso district also has some crosses of SEAZ and TGX. Further donation of 1000 Tyrolean Grey cattle semen straws to NaLIRRI and NAGRC&DB by the Tyrolean Grey Cattle Breeders' Association followed in 2015. The Tyrolean Grey cattle are a dual purpose breed that originates in Tyrol, Austria and is used in typical mountain farming under rough conditions. The Tyrolean Grey cattle are a small bodied endangered cattle breed with a population size consisting of 3785 breeding animals as of 2013 (ÖNGENE, 2014) and ranked lowest among temperate breeds in terms of milk yield and meat

production. However, since it is kept under rough conditions (low input and pasture based), it is well adapted for survival in marginal environments.

The Small East African Zebu is also a dual purpose breed found mainly in the Eastern and Northern parts of Uganda. It is a dual purpose breed which has a lower yield of milk but of higher butter fat and on average have a high milk protein content of (3.75%), (Hiemstra, 2015). These cattle breeds are dual purpose which means that they are kept for both meat and milk production (Peniche-Gonzalez et al., 2014).

Artificial insemination and embryo transfer have been used at various stages as tools to support the introduction of exotic germplasm especially in cattle since 1960 (Galukande et al., 2013). AI of indigenous cattle with exotic semen started in 1959 coupled with the importation of dairy stock, for example, Friesian, Jersey, Guernsey and Ayrshire which began during a similar period (NAGRC&DB, 2005). Uganda, smallholder cattle farmers have been encouraged to replace their indigenous cattle with high yielding exotic breeds (Balikowa, 2011). This is a widespread consequence of the need to increase productivity, although it is latently accompanied with narrowing of within-breed genetic variation (Kantanen et al., 2015). The Animal Breeding Center (ABC) charged with the duty of offering cattle rearing types of assistance was set up in the year 1960. From that point, a trial program to research the performance of indigenous cattle and their crosses with exotic dairy breeds started (Ococh, 2013; MAAIF, 2016; Engidawork, 2018).

Currently, intensive cattle management policies are being popularized for increased productivity and prospective poverty alleviation (MAAIF, 2013). Udo et al, (2011), however noted that the less

financially privileged farm households may exhibit less interest in investing their scarce resources and efforts in more intensive livestock systems. Consequently, highly specialized traits in domestic animal breeds often became obsolete in emerging, high-input-based farming systems leading to a progressive replacement of traditional multipurpose breeds with high-yielding breeds, (Zander et al.; 2013). As a way of increasing agricultural productivity, the government of Uganda ensured continued investment in technology improvement through research for improved breeds (Uganda Vision, 2040). According to Uganda's National Animal Breeding Policy (1997), strategic crossbreeding of local animals with improved breeds of temperate origin or tropicalised breed was one of the methods recommended for improving the productivity of the national herd since 2009. According to the Animal Breeding Act (2001) for any breed that is not listed in the Act as allowed into the country, the importer of a new breed is required to carry out some sort of study to establish the performance of the breed before permission is given for its nationwide use. Generally, indigenous livestock breeds of developing countries are scantily documented and under exploited (Philipsson et al., 2006).

1.2 Statement of the problem

The Zebu breed like other breeds in the tropics is characterized by low-productivity and low growth rates but highly adapted to harsh environmental conditions (Wurzinger et al, 2014). The *Bostaurus* (Exotic) breeds that are predominantly found in temperate countries, have a high production potential, but poor adaptation to tropical hash environment (Roschinsky et al., 2015).The poor results of massive imports of mostly female pure Holstein-Friesian stock, from Europe to East Africa in the 1960 sand more recently in the late 1980 sand 90s were due to their poor adaptation to local conditions. Despite the scientific criticism of indiscriminate crossbreeding, many farmers in favorable environments with market opportunities in place often go for this option that combines the hardiness of indigenous cattle with the production capacity of *Bostaurus* animals (Wurzinger et al, 2014). However, suitability of

these crosses to various production environments is largely unknown therefore; this study determined the performance of the Small East African Zebu and Tyrolean Grey cattle crosses in Uganda. On the other hand, when local conditions allow its proper implementation, crossbreeding has induced substantial increases in animal performance, as well as farmer income (Roschinsky et al., 2015). With the increased demand for livestock products and the need to bridge productivity gaps in developing countries, crossbreeding of locally adapted breeds with imported exotic breeds although poorly planned have been widely adopted yielding animals with unknown breed composition, (Weerasinghe et al.; 2013).

1.3 General objective

To determine the performance of the Small East African Zebu and Tyrolean Grey cattle crosses in Uganda.

1.4 Specific objectives of the study

i. To map the current distribution of the Small East Africa Zebu and Tyrolean Grey cattle crosses in Uganda.
ii. To determine the effect of demographic factors on the distribution of Small East Africa Zebu and Tyrolean Grey cattle crosses in Uganda.
iii. To assess farmers perception of the performance of the Small East Africa Zebu vis-à-vis Tyrolean Grey cattle crosses.
iv. To determine the heart girth according to age between Small East Africa Zebu and Tyrolean Grey cattle crosses.

1.5 Research Questions

Question 1: Is there effect of demographic factors on the distribution of SEAZ x TGX?

Question 2: Is there a difference in farmer's perception as regards the preferred traits of SEAZ and TGX?

Question 3: Is there a difference in heart girth according to age between SEAZ and TGX?

1.6 Limitations

In the course of the study some challenges were encountered, such as wide coverage for data collection, time for gathering sufficient data was limiting, the risks of losing animals under study through theft, farmers financial needs where some farmers sold off the animals under study and some farmers hid their animals for fear that the researcher was going to take their animals.

1.7 Delimitations

The study was carried out on selected farmers' holdings in three production systems in Uganda: the pastoral system in the district of Nakapiripirit and the agro-pastoral system is practiced in the district of Kole. The study required the consent and support from the leaders and extension staff.

1.8 Significance of the study

I. The results of this study will improve extension staff knowledge on the performance of the SEAZ and TGX in Uganda.

II. The findings of this study will provide guidance for the policy makers in allocating resources to support scaling out the TGX in Uganda.

III. These finding will be useful to the extension agents when guiding farmers on management of the SEAZ and TGX.

IV. The study provides a baseline on which future research can be based.

1.9 Justification of the study

Indigenous livestock, although adapted to the local environments, are poor milk and meat producers compared to the commercial breeds raised in the extensive system (Renaudeau et al., 2012; Tsegaye et al., 2014; Dossa and Vanvanhossou, 2016). In particular, the rapid increase in human and livestock populations is putting high pressure on rangeland, (FAO, 2013).

1.10 The Scope of the Study

The study was carried out in three production systems in Uganda: the pastoral system in the district of Nakapiripirit, and the agro-pastoral production system in the district of Kole.

1.11 Conceptual framework

The conceptual framework used is shown in the schematic representation below:

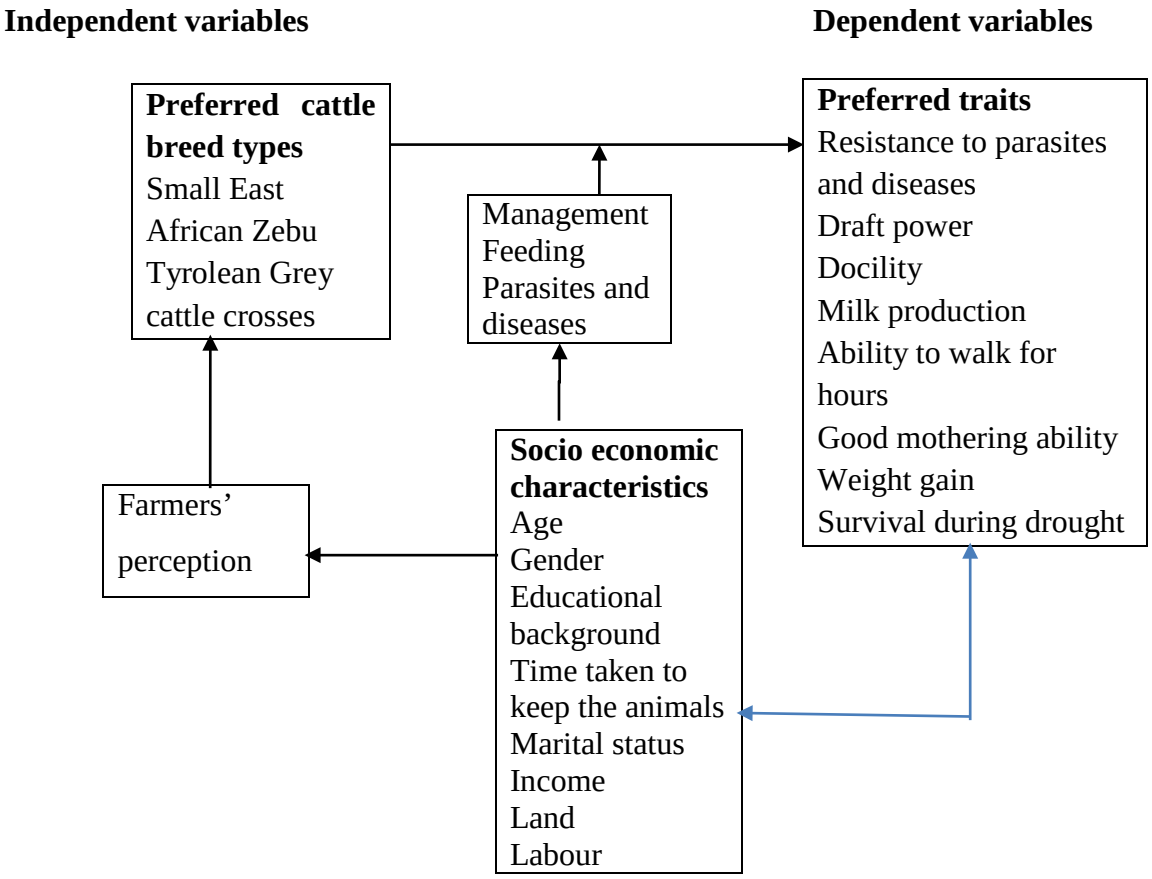

Figure 1: Conceptual framework

CHAPTER TWO: LITERATURE REVIEW

2.1 Cattle Production in Uganda

In Uganda, livestock is an important subsector in agriculture with around 90% of the national cattle herd kept under pastoral and mixed smallholder farms (UIA, 2016). The greatest concentration of animals is found in the "cattle corridor", extends from South-Western to North Eastern Uganda (UIA, 2016). The pastoral system is dominant in the North Eastern sub-region (Kotido, Moroto, Soroti and Kumi districts) and in the South West sub-region (Ntungamo, Mbarara, Masaka, Sembabule and Rakai districts), and in Central Uganda districts (Luwero and Kiboga districts) (Mwebaze et al., 2011). Felius et al. (2014) have noted that the natural distribution of *B. taurus* and *indicus* is successfully restricted to regions with similar climatic conditions to those of the earlier domestication centres in the Fertile Crescent region of Southwest Asia. However, beginning in the middle of the twentieth century, socioeconomic preferences for large highly productive dairy, beef and dual-purpose breeds have led to extinction and increased vulnerability of more than 200 locally-adapted landrace or native cattle breeds (Food and Agriculture Organization, 2015). Only those animals that adapted best to the environment, husbandry conditions, and the demands of their holders survived (Jaritz, 2014).

2.2 Cattle production systems in Uganda

There are four cattle production systems in Uganda: the commercial ranching, pastoral, agro-pastoral and semi-intensive production systems. Commercial ranching accounts for less than 10% of the national herd (UIA, 2016). Cattle are kept in confined fences and paddocks (ACET, 2014) and fed with natural or improved pastures. Farmers in this system keep large herds (between 500-3000 per holding). Exotic and improved breeds are usually imported from Kenya, South Africa and Europe (Mpairwe et al.; 2015). This production system is prevalent in the southwest and in the central region. Herds are largely (98%) composed of local breeds (Mwebaze et al., 2011). This system is dominant

in the Northeastern sub-region. According to (UBOS, 2014), agro-pastoralists are in the Eastern, Central, Western, North and West Nile Sub-regions. Semi-intensive Farmers keep cattle, mainly cross-bred, in kraals, paddocks and cattle barns/stalls and feed them with high-quality feed (ACET, 2014). This system is mainly found in Central and the Southwest sub-regions (FAO, 2019).

2.3 The need for improvement of indigenous cattle

Today's livestock production has changed from a resource-driven activity bound to local conditions and environments to one driven by demand, which is typically separate from local geographical or other constraints (FAO,2011). In Uganda, smallholder cattle farmers have been encouraged to replace their indigenous cattle with high yielding exotic breeds (Balikowa, 2011). This is a widespread consequence of the need to increase productivity, although it is latently accompanied with narrowing of within-breed genetic variation (Kantanen et al., 2015). Murage and Ilatsia *et al*., (2011) observed that farmers who kept purebred dairy cattle would more likely opt for improved technology. Experiences of the dairy farmers on dairy farming, education status and participation of the dairy farmers in various dairy farming related organizations also had positive and significant relationship with adoption of the improved dairy husbandry practices (Fita *et al*., 2012). The more educated a household head is, the more he/she is likely to acquire, understand, obtain, disseminate new technologies within a shorter time and more efficient when allocating resources compared to a household head with fewer years of education (Kafle and Shah 2012; Ebojei *et al*. 2012). According to Lemma (2017), education levels of household heads have impacts on potential of milk production. However, the herd sizes kept differ within small-scale dairy production system, ranging from two to four cows, three to ten cows in small-scale dairy and meat, and lastly 150 cows under the large-scale dairy and meat system (Duguma, 2012).

2.4 Preferred traits of the tropicalised cattle and temperate cattle crosses

Many farmers who keep dual-purpose breed are pleased with the good resistance of their herd and the low treatment costs (Hiemstra, 2015). Several studies have indicated that indigenous cattle can endure and be sustainably productive in the presence of disease challenges, a phenomenon referred to as tolerance or resilience to disease and endemic stability to infection (Bishop, 2012). The continuous exposure to endemic diseases such as tick-borne diseases among indigenous cattle populations has led to the development of tick-borne disease tolerant traits (Jonsson et al., 2012). Improved dairy cattle are more vulnerable to local diseases and parasites particularly tick-borne diseases, internal helminths and trypanosomiasis (Magona, Walubengo and Kabi, 2011), whose effective control requires substantial investments. Besides getting a better price for old dairy cows, farmers receive also a higher price for the bull calves when sold to a fattener because they grow faster (Geuder et al., 2012). Although indigenous cattle have been faulted for low productivity and reproductive performances, they still remain popular in Uganda because of their adaptive traits to the local underprivileged conditions (Balikowa, 2011). Therefore important traits such as adaptation to local environment and utilization of available feed resources are important in meeting the health and welfare needs of the animals and therefore their productivity (Odhong et al. 2015). Horn shaping and spacing are also critical traits in enabling cattle to graze in thickets and difficult terrain (Kugonza et al., 2012b).The specific features of the SEAZ such as size and shape of horns, multiple colourations, body size are carefully selected for by kraal leaders through utilization of specific sires and dams, (Nalule, 2010). Docility as a dairy cow trait, allows for ease in handling and, by extension, ease in milking (Gergovska et al 2014). Currently, intensive cattle management policies are being popularized for increased productivity and prospective poverty alleviation (MAAIF, 2013).

2.5 Constraints in rearing of the Small East Africa Zebu and Tyrolean Grey cattle crosses

Pastoral communities select breeding cattle with attributes to withstand challenges created by landscapes and this is common in the semi-arid region of Karamoja where cattle have to trek long distances in search of pastures and water (Nalule, 2010). This in turn is creating high demand for increasing productivity in pastoral communities. Udo et al. (2011) noted that the less financially privileged farm households may exhibit less interest in investing their scarce resources and efforts in more intensive livestock systems. Since the productive and reproductive potentials of the Zebu cattle are relatively low, crossbreeding with B.*taurus* ensures high improvement in the productive and reproductive performance of the Zebu. Consequently, highly valued traits in domestic animal breeds often become obsolete in emerging high-input-based breeds, leading to a progressive replacement of traditional multipurpose breeds with high-yielding breeds, (Zander et al.; 2013). Other important traits such as adaptation to local environment and utilization of available feed resources are important in meeting the health and welfare needs of the animals (Odhong et al. 2015). Selective breeding for increased productivity in tropical countries such as Uganda must be accompanied with agro-ecological fitness to counter metabolic, unsustainable feed resources and endemic diseases challenges (Eisler et al.; 2014). This might be an indication that farmers are constrained in their choice of breeding service (Mugisha et al. 2014). Indigenous cattle are managed by open grazing on communal rangelands, involving mobility in search of pastures and water in resource-scarce and highly variable marginal areas to enable human habitation and subsistence (Kratli et al.; 2013). Roschinsky *et al.* (2012), recommend introduction of rotational grazing to allow more efficient pasture utilisation.

2.6 Heart girth measurements of Small East Africa Zebu and Tyrolean Grey cattle crosses according to age and sex

Body weight is closely related to body measurements, with heart girth generally accepted as the most satisfactory single predictor of live weight in cattle (Lesosky et al., 2012; Lukuyu et al., 2016). Livestock live weights can be estimated indirectly through allometric relationships, where live weight is predicted from morphological measurements taken at specific locations of the body (Kugonza et al 2011). The measurements were found to be useful in predicting weight of indigenous cattle such as the short-horn zebu cattle of Tanzania (Kashoma et al., 2011; Musa et al.; 2011). Heart girth is the circumferential measure taken, around the chest just behind the front legs and withers (Kashoma et al, 2011; Musa et al, 2011). Heart girth is often used to predict live weight in cattle. Heart girth (HG) has been shown to be useful predictor of cattle live weight (Lukuyu et al., 2016). Among the morphological measurements commonly used, heart (chest) girth is the most strongly correlated with live weight in cattle (Kashoma et al.; 2011; Kugonza et al 2011.; Katongole et al.; 2013; Rashid et al.; 2013). However, accurate estimation of heart girth is required for a number of purposes including determining appropriate feeding level and nutritional condition of animals, growth rate, sale prices, correct drug dosage, and responses to genetic selection (Lesosky et al 2013, Lukuyu et al 2016). According to Lukuyu et al., (2016) variability in the heart girth measurements may arise due to positioning and tension of the tape on the body of the animal. Several authors have found a strong relationship between animals' LW and their linear measurements and then developed LW prediction models using body measurements (Lesosky et al., 2013; Lukuyu et al., 2016).The high underestimation of LW by farmers raises concerns of widespread under-dosing of cattle with veterinary drugs, a major route to drug resistance (Dijk et al.; 2015).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Current distribution of the Small East Africa Zebu and Tyrolean Grey cattle crosses in Uganda

The distribution of the SEAZ and TGX in Uganda was mapped using Geographical positioning systems and detailed descriptions of the locations of the farms, latitude, longitude and altitude were captured. The coordinates for SEAZ and TGX distribution were obtained and organized in Microsoft Excel to create a CSV (Comma Separated Values) file which was then imported into Arc GIS (Arc Map 10.6.1), which is a common GIS software which when combined with hardware, data, people, procedure and institutional arrangements can allow users to create, manipulate, analyze, visualize and disseminate geospatial data for decision making. Thereafter, a shape file for SEAZ and TGX distribution was created from the CSV file and was overlaid with the Districts shape file to generate the final SEAZ and TGX distribution map in Uganda.

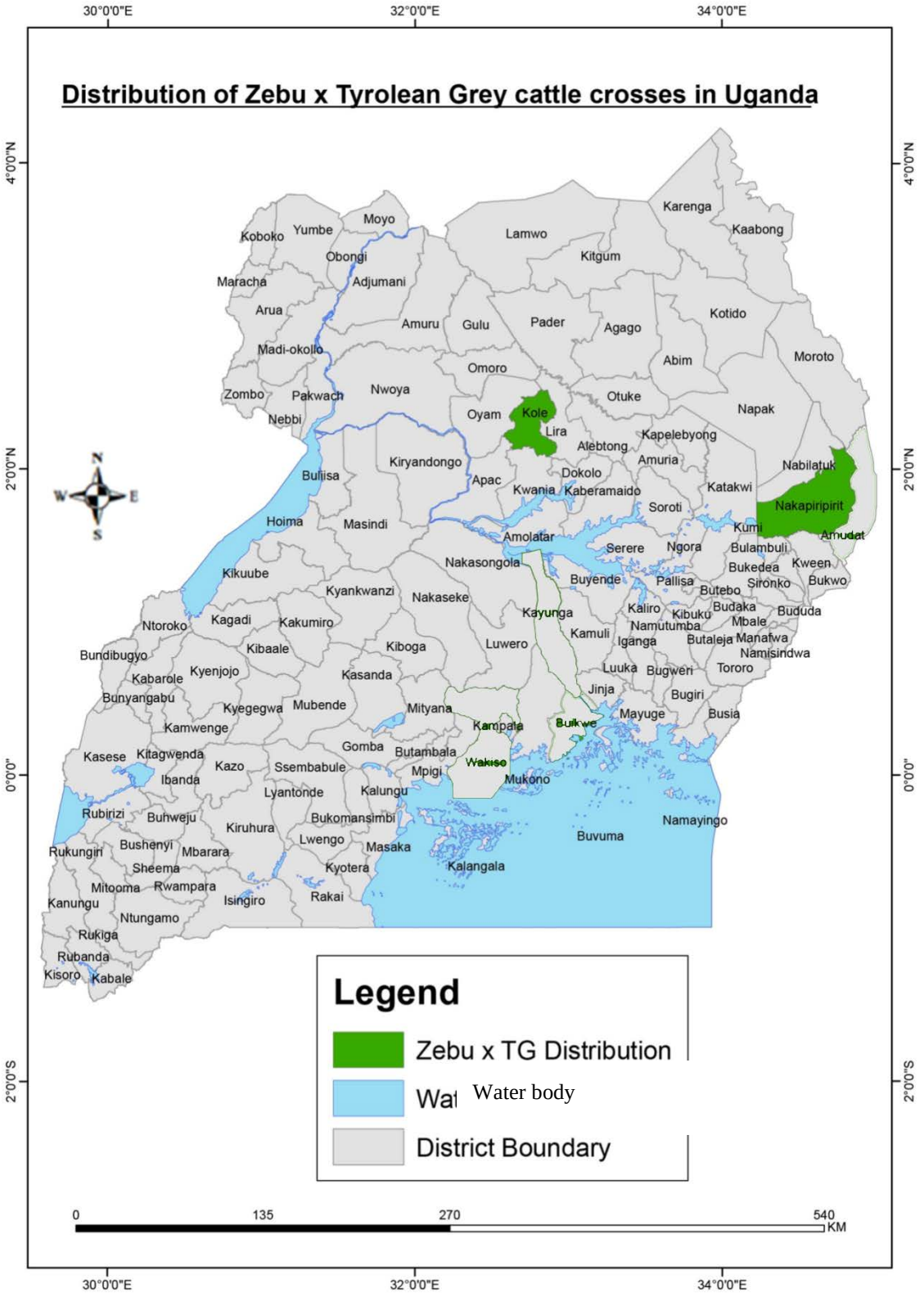

Figure 2: Map of Uganda showing the Study area

3.1.1 Nakapiripirit District

The pastoral system is practiced in the district of Nakapiripirit. Nakapiripirit is one of the districts in the Karamoja sub-region of Eastern region in Uganda. It is bordered by Moroto district in the North, Sironko and Kapchorwa in the South, Katakwi and Kumi in the west, and Amudat district in the east. The relief of Nakapiripirit district is generally represented by a fairly flat plain throughout the district with a highest pick found on mountain Kadam towards the southern part in Chekwii. The coordinates of Akuyam parish are Longitude 34.7216^{o} E Latitude 1.8503^{o} N. It lies at an altitude of between 1,356-1,524m above sea level in a semi-arid 30C per annum. Vegetation includes isolated thorny trees and shrubs. The Karamoja sub-region has one of the most fertile soils in Uganda but it has one rainy season. Crop production in Karamoja is rain-fed.

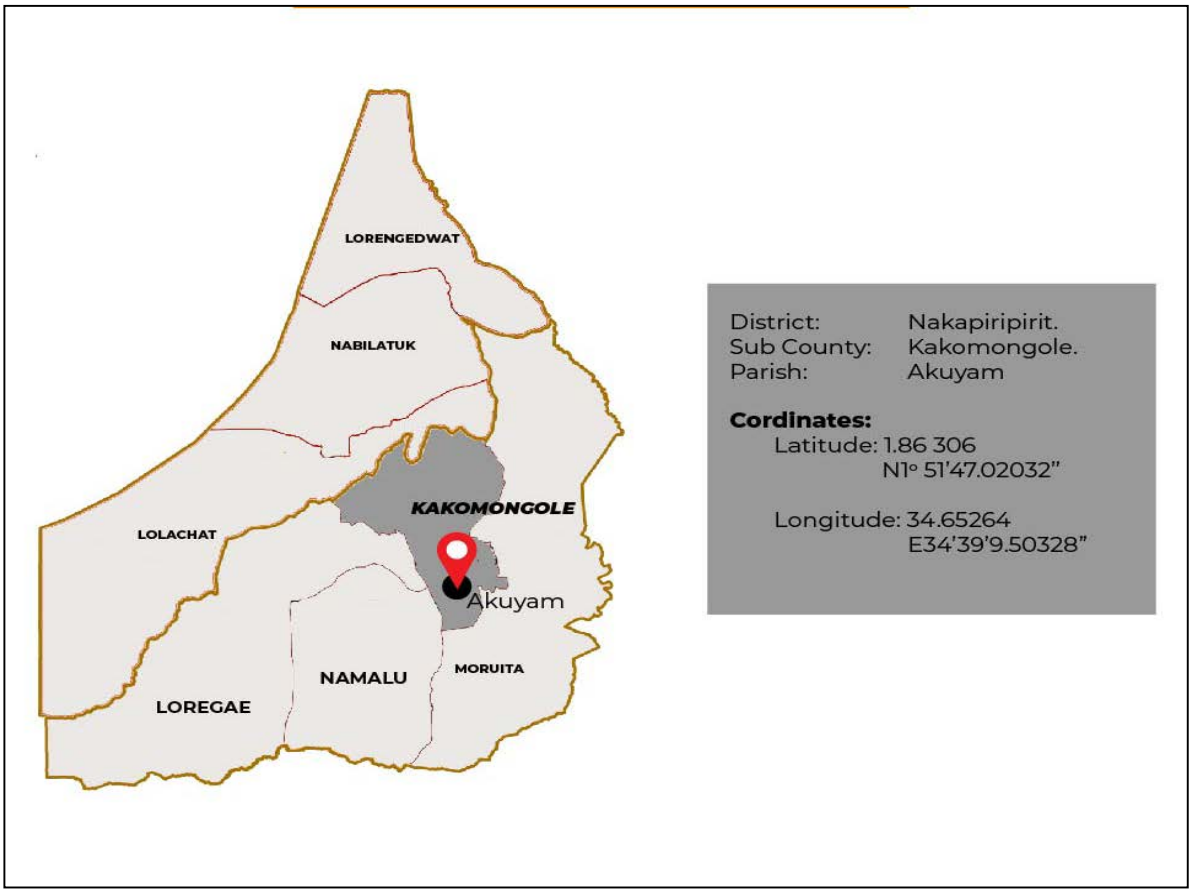

Figure 3: Map of Nakapiripirit showing the study area

Focus group discussion

Nakapiripirit

Individual in-depth interview

With farmers in Nakapiripirit

SEAZ x TGX

3.1.2 Kole District`

The agro-pastoral system is practiced in the district of Kole. Kole district is bordered by Lira district to the east, Apac district to the south and Oyam district to the west and north. The study areas have the following coordinates, Abeli at Longitude 32.6307E 32°38'3.458", Latitude 2.19564 N 2° 11'44.6316. It lies at an altitude 1061.8m above sea level and Agege at Longitude 32.7839 E 32°47"1.986", Latitude 2.21902 N 2° 13'8448. It lies at an altitude of 1056.58m above sea level. It is known that the soils in the Kole area especially those in the flood plain are heavy clay in texture and acidic in reaction. The presence of organic peat layer in the sub-surface of the soil profile has made soils extremely acidic. The pH ranges from 2.6 to 6.3. The rainfall pattern is bimodal and is typically convectional but the level is changing with the current global climatic change. Isolated riverine forest type vegetation is found a long Okole & Arocha wetlands dominated by wetlands plants.

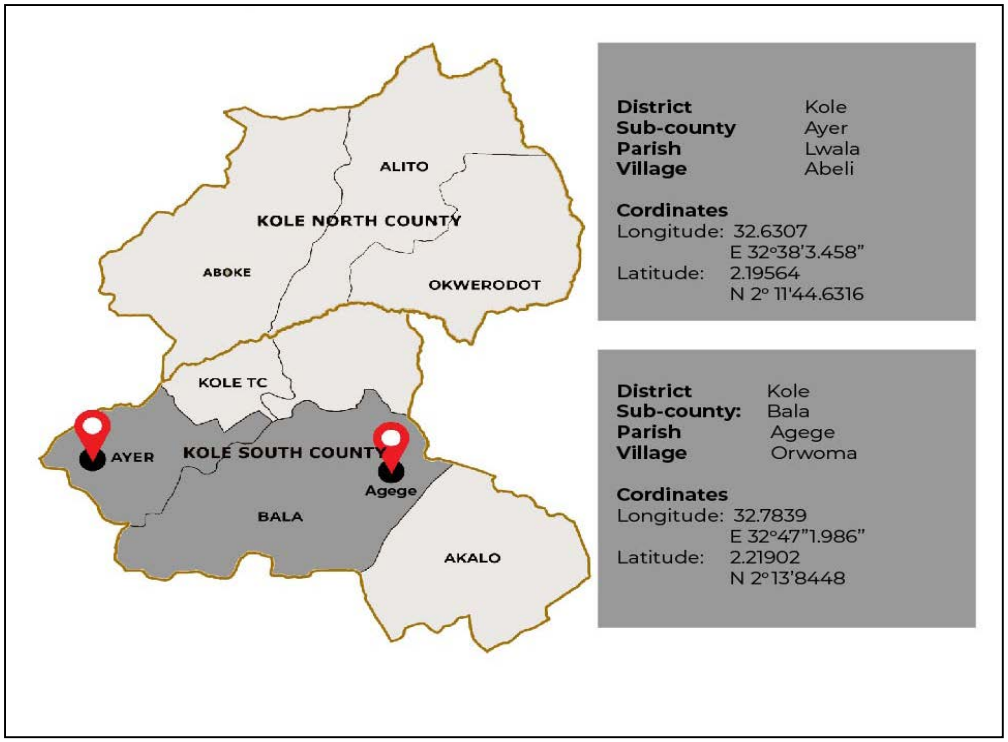

Figure 4: Map of Kole showing the Study area

TGX cattle on Nape farm in Kole district

Individual in-depth interview with farmers in Kole district

Interview with AI Technician

3.2 Research Design

This study used a cross sectional survey design. It was carried out between February and July 2020 and concentrated on obtaining data from farmers who owned the SEAZ and TGX. The study used mixed procedures that included both quantitative and qualitative approaches. Cross sectional survey design involves observation of individuals or groups or comparison of groups at one specific point in time (Sahaya G.; Selvam.; SDA, 2017). Cross sectional survey prevents respondents from interacting with others from whom data has been collected. These procedures limited the weaknesses of qualitative as well as for quantitative approaches (Sarantokos, 2005; Amin, 2005; Mugenda and Mugenda 1999).

3.3 Sample size and sampling techniques

Table 1: Sample size and Sampling Technique

Respondent	Sample size	Sampling technique
Farmers	35	Random sampling
AI Technician	03	Purposive
Extension workers	04	Purposive
Farm Managers	03	Purposive
Total	45	

Purposive sampling technique was used to select, 03AI technicians, 04 Extension workers and 03 farm managers, from Lusenke stock farm, Njeru stock farm and Gayaza high school farm for the study. Random sampling was used to select 35 cattle farmers who owned the SEAZ and TGX.

In order to generalize from a random sample and avoid sampling errors or biases, a random sample needs to be of adequate size. This is because what is important here is not the proportion of the research population that gets sampled, but the absolute size of the sample selected relative to the complexity of the population, the aims of the researcher and the kinds of statistical manipulation that will be used in data analysis (Taherdoost, 2016).

$$n = \frac{(100-p)\,z}{2\,E2}$$

n is the required sample size

P is the percentage occurrence of a state or condition

E is the percentage maximum error required

Z is the value corresponding to level of confidence required

3.4 Method of data collection and tools

The data collection tools were questionnaires, focus group discussion guides and Individual in-depth interview guides. The number of questionnaires 45 administered to the sampled respondents by physically delivering each questionnaire in an endeavor to get a high response rate. All questionnaires were returned representing 100% questionnaire return rate achieved. Researchers agree that the higher the questionnaire return rate, the more reliable are survey estimates. A response rate that is greater than 70% is adjudged sufficient. Therefore, the response rate of 100% was adjudged appropriate and hence further analysis was considered plausible (Dillman, 2000). The heart girth data was obtained solely from Lusenke Stock farm that is owned by NAGRC&DB. The heart girth measurements of SEAZ and TGX were periodically taken for three years (2011-2013). Geographical positioning systems were used to obtain data on location of the farm, longitude, latitude and altitude.

Use of structured questionnaires

The study used structured questionnaires, which were carefully designed to collect data according to the specification of research questions and hypothesis. The data collection instrument consisted of a set of questions to which the subjects responded. The questions captured data on breed preference, preferred traits, contributions of the breed type to farmers' livelihood and constraints in rearing the breed type.

Focus group discussion

Focus group discussion is an interactive discussion between six to eight pre-selected participants, led by a trained moderator and focusing on a specific set of issues (Hennick, M, Hutter, I, & Bailey, A.2011). The focus group discussion checklist was designed to pick information from the focus groups that would not be easily captured by the questionnaires.

Individual In-depth-interview

An interview is a one- to- one method of data collection that involves an interviewer and an interviewee discussing specific topics in depth (Hennick, M, Hutter, I, & Bailey, A.2011). The key informant interview guides supported the collection of qualitative data based on the knowledge, skills and experiences of the informants who are experts to broaden the knowledge gaps on the subject of the study. These data included views from AI technician, farm managers and extension workers.

3.5 Ethical considerations

An introductory letter was obtained from the School of Post–Graduate Studies and Research, Kyambogo University. The respondent consent was sought before data was collected and all data obtained was used for academic purpose only. Building a collaborative relationship of trust and rapport with participants was paramount. The privacy of the respondents was respected. The study

was conducted with a lot of responsibility and care and participants were informed about the objective of the study. Other people's work cited or referred to in this study was acknowledged.

3.6 Data collection procedure

3.6.1 Socio-economic characteristics of the cattle farmers

The detailed structured questionnaires were administered to (35) cattle farmers who owned the SEAZ and TGX (Appendix1). Focus group discussion was held with the farmers (Appendix 2). Individual in-depth interview (Appendix3), was used to obtain data from (03) AI Technicians, (03) farm managers and (04) extension workers on socio-economic characteristics of the farmers and key informers such as age, gender, and marital status, educational background, and time taken to keep the animals, labour source, herd size and land size owned.

3.6.2 Cattle production systems

The data on cattle production systems were obtained by use of detailed structured questionnaires of both multiple choice and open ended questions (Appendix1), focus group discussion guide (Appendix 2) and Individual In-depth interview guides (Appendix 3) were used to obtain data from the cattle production systems which included grazing systems, source of drinking water for the animals, mating systems, prevalence of ticks, adaptation problem of TGX to the environment, major source of information about the cross breeding programme and record keeping.

3.6.3 Farmers' perception of the performance of the Small East Africa Zebu vis-a-vis Tyrolean Grey cattle crosses

The detailed structured questionnaires of both multiple choice and open ended questions (Appendix1), focus group discussion guide (Appendix 2) and Individual In-depth interview guides (Appendix 3) were used to obtain data on farmers' perception of the performance of the SEAZ and TGX, which consisted of, breed preference, preferred traits such as ability to walk for long hours, resistance to

parasites and diseases, better draft power, survival during drought, better milk production, fast growth rate, docility, good mothering ability, high calf survival, hard hooves to withstand muddy places, horn shape and coat colour were obtained.

3.6.4 Constraints in rearing of the Small East Africa Zebu and Tyrolean Grey cattle crosses

Data on the constraints faced in the rearing of the SEAZ and TGX such as, parasites and diseases, shortage of feeds and grazing land, shortage of water, low genetic potential of the animals, conflicts between the livestock keepers and crop farmers, shortage of labour, high prices of veterinary drugs, theft, lack of AI services, adaptation problems, used were obtained by use of detailed structured questionnaires of both multiple choice and open ended questions (Appendix1), focus group discussion guide (Appendix 2) and Individual In-depth interview guide (Appendix 3).

3.6.5 Heart girth measurements according to age between Small East Africa Zebu and Tyrolean Grey cattle crosses

Heart girth is the circumferential measure taken, around the chest just behind the front legs and withers and recorded both in cm and in kg. Heart girth data was obtained from the data base in Lusenke stock farm (2011 -2013).

3.7. Tests for statistical assumptions

3.7.1 Test for multicollinearity

Multicollinearity exists when two or more independent variables are inter-correlated. The concern according to some scholars is not its presence but the effect it yields on the analysis (Baguley, 2012; Pedace, 2014). Pedace 2014 agrees that multicollinearity has significant effect only when the correlation coefficient of the interacting independent variables is equal to or greater than 0.7. In this study, the tolerance statistics and the variance inflation factor (VIF) were computed to test for multicollinearity. A VIF of greater than 5 is generally considered evidence of multicollinearity and a

tolerance statistic of less than 0.2 would be a cause for concern (Baguley, 2012). Variance Inflation factor for the independent variables was less than five (5). The results therefore indicate that there was no evidence of multicollinearity implying that the independent variables shared no significant amount of information that would make them compete to explain a variance in the dependent variable.

3.7.2 Test for normality

Normality test was conducted on study indicators in order to determine the appropriate tests to be carried out and make sure the assumption of normal distribution was not violated. Normality test was conducted on combined average of variables that define the dependent variables as well as the independent variables. The parameters tested for normality included age of animal and heart girth.

The histogram with normality curves as shown in (Fig 5) was used to interpret the presence of normality in the data.

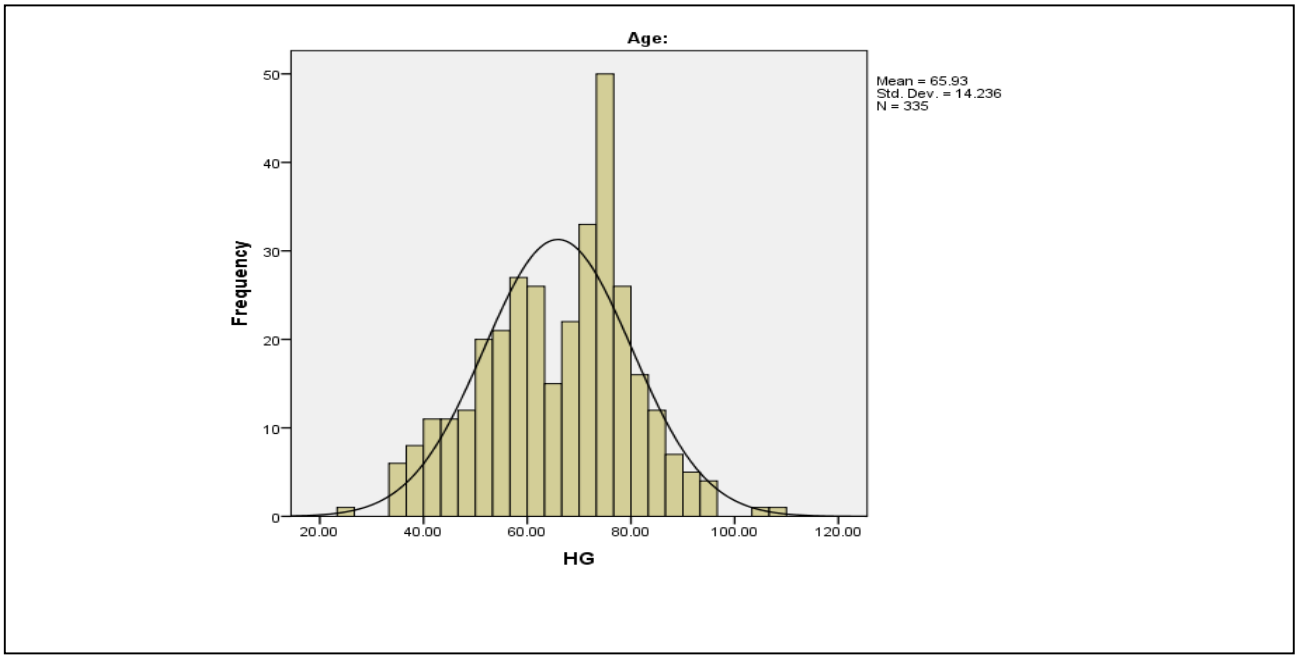

Figure 5: Histograms to test for normality of heart girth measurements

The results in (Figure 5) show that there was no minimum deviation from normality. Therefore, the overall distribution for all the variables, age of cattle in month were more skewed to the left. From the histograms, the distributions for heart girth of the SEAZ and TGX were symmetrical and not seriously peaked. This shows that the data was normal for selected variable. This finding is inconsistent with the central limit theorem that postulates that as the sample sizes get larger, the less the assumption of normality matters (Elliot & Woodward, 2007; Field, 2013).

3.7.3 Test for homogeneity of variance

Table 2: Test of Homogeneity of Variances

Test of Homogeneity of Variances			
0.			
Heart girth			
Levene Statistic	df1	df2	Sig.
.420	1	34	0.521

The levene test was used to test for homogeneity of variance of the heart girth. The test results in (Table 2) showed a non-significant levene statistic of 0.420. Given that the p value is not significant, there was a difference between the variances of the two cattle breed type hence the homogeneity of variances was satisfied.

3.8 Data Analysis

3.8.1 Quantitative data analysis

The choice of analysis procedures depended on how well the techniques were suited to the study objectives and scale of measurement of the variable in question. Data collected was subjected to field and desk editing to ensure accuracy, consistency and completeness. The data was then entered into Microsoft Excel and exported to SPSS (version 20) and STATA (version 15) for cleaning and eventual

analysis. The data was then explored for normality, linearity, homogeneity and factorability to decide on the probable statistics if relevant assumptions were met. Since most of the assumptions for parametric tests were met, the study utilized parametric test analysis. Whereas descriptive statistics involved the use of central tendency (mean), proportions, and standard deviations; the inferential tests employed the use of chi square to test the association between the main study variables. The independent sample t-test was used to measure differences in the means of heart girth between the SEAZ and TGX. Heart girth analysis data was presented inform of tables and graphs which formed a significant part of this study. All tests were measured at 95% confidence interval.

3.8.2 Qualitative data analysis

The written focus group discussions and Individual in-depth interviews were transcribed to capture all the information and expressions. The transcripts were then typed into a word file. The focus group discussion and key informant transcripts were read several times and themes that found to be related were grouped together using a combination of the topic guide and new themes that emerged from the data. This process led to a set of codes which then guided the thematic analysis which was linked to the research objectives. The findings were compared with results from the quantitative analysis for similarities or differences. Quotations from focus group discussion and key informants were used to illustrate typical responses verbatim.

CHAPTER FOUR: RESULTS

4.1 Socio- economic characteristics of the respondents

The results on the socio-economic characteristics of the respondents are presented in Table 3:

Table 3: Background characteristics of respondents

	F (Percentage)	Mean (±SD)
Gender of respondent		1.04 (0.208)
Male	43 (95.6)	
Female	2 (4.4)	
Age group of respondents		42.68 (13.761)
35 years and below	15 (36.6)	
36-50	15 (36.6)	
Above 50 years	11 (26.8)	
Education level of respondents		2.89 (1.603)
No formal education	11 (25.0)	
Primary	12 (27.3)	
Secondary	5 (11.4)	
Tertiary	3 (6.8)	
University	13 (29.5)	
Occupation of the respondent*		2.05 (1.545)
Cattle and small ruminant rearing	24 (44.4)	
Farming (crop production)	20 (37.0)	
Employed by government/NGO	6 (11.1)	
Petty business	2 (3.7)	
Civil servant	2 (3.7)	
Marital status		1.10 (0.379)
Married	37 (92.5)	
Single	2 (5.0)	
Widowed/separated	1 (2.5)	
Purpose of owning land*		1.21 (0.415)
Crop production	26 (51.0)	
Grazing and forage production	25 (49.0)	
Labour source for animal keeping		1.65 (0.834)
Family labour	23 (57.7)	
Hired labour	8 (20.0)	
Both family and hired	9 (22.5)	

Values in parenthesis are percentages and standard deviations, SD=Standard deviation. Multiple response analysis was allowed, case by case analysis and missing value excluded.

The results in (Table 3) reveal that, more than three quarters of the respondents (95.6%) were male, while only (4.4%) were female. The results also show that, slightly more than a quarter of the respondents (26.8%) were over 50 years. Equal proportions of the respondents (36.6%) were between 36-50 years of age and below 35 years respectively. The respondents had an average age of 42.68 (SD=13.761) with the youngest being 22 years and the oldest being 75 years. On education, more than a quarter of the respondents (29.5%) had university education and another (27.3%) had attained primary education. A quarter of the respondents (25%) had no formal education while approximately (11%) had attained secondary education.

With regard to the occupation of the respondents the results in (Table 3) reveal that, slightly more than half of the respondents (44.4%) were engaged in cattle and small ruminants rearing and approximately (37%) were engaged in crop farming. While only (11.1%) were in employment either in government institutions or non-governmental organizations and equal proportions (3.7%) were engage in petty business and civil service. The results reveal that, more than three quarters of the respondents (85.7%) were married, equal proportions (7.1%) were single and (7.1%) widowed/separated. Land owned was majorly for purposes of crop production (51%). However, some of the respondents (49%) also owned land for the purposes of grazing and forage production. The major source of labour for keeping the animals was family labour (57.5%), however, close to a quarter of the respondents (22.5%) used both family and hired labour while (20%) of the respondents used only hired labour.

4.1.1 Influence of socio- economic characteristics on breed type preferences

The results on influence of socio-economic characteristics on breed type preferences are presented in Table 4:

Table 4: Influence of socio- economic variables on farmers' cattle breed type preference

Variable (n=45)	Mean (±SD)		t (p-value)	Chi square (p value)
	SEAZ	**TGX**		
Gender	1.00 (0.000)	1.06 (0.236)		0.598 (0.439)
Age	44.4 (12.886)	42.13 (14.191)	0.472 (0.643)	0.472(O.643)
Education level	1.90 (1.287)	3.18 (1.585)		5.847 (0.211)
Occupation	1.30 (0.483)	2.28 (1.689)		3.287 (0.511)
Marital status	1.00 (0.000)	1.13 (0.434)		1.081 (0.582)
Purpose of owning land	1.00 (0.000)	1.29 (0.464)		3.332 (0.068)
Source of labour for rearing animal	2.00 (1.414)	2.46 (0.776)		6.042 (0.049)*
Household size	8.20 (4.077)	6.36 (3.332)	1.248 (0.232)	
Own land	1.00 (0.000)	1.16 (0.374)		1.837 (0.175)
Hectares owned	8.30 (6.533)	15.04 (38.443)	0.862 (0.396)	
Years of keeping reared animal	6.89 (8.936)	3.92 (2.261)	2.263 (0.057)	

**** p<0.001, ** p<0.01, *p<0.05*

The independent sample t-test and chi square were used for continuous and categorical socio economic variables respectively. The results in (Table 4) reveal that, all the socio economic variables did not significantly influence farmers' preference as regards the performance of the SEAZ and TGX except Source of labour (χ^2=6.042, p<0.05).

4.1.2 Ownership Cattle Breed Type

Table 5: Population distribution of SEAZ and TGX

Farm	SEAZ	TGX
Lusenke stock farm	626	63
Nakapiripirit	230	15
Kole	25	12
Kayunga farmers	14	4
Njeru stock farm		2
Gayaza		2
Total	895	98
Average	223.75	16.33333

4.2 Production system of the study area

4.2.1 Grazing methods used in rearing the Small East Africa Zebu and Tyrolean Grey cattle crosses

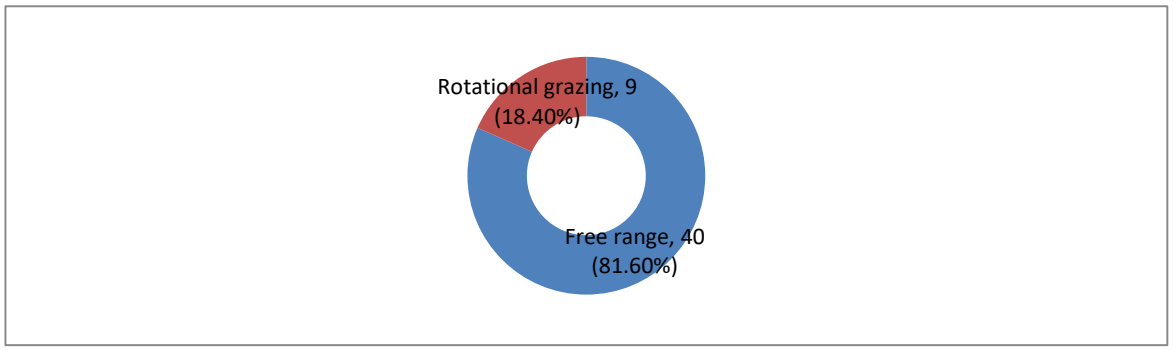

Figure 6: Grazing methods used in rearing the SEAZ and TGX

From the results presented in (Figure 6), free range system was common as reported by (81.6%) of the respondents, while (18.4%) of the farmers practiced rotational grazing.

4.2.2 Source of drinking water

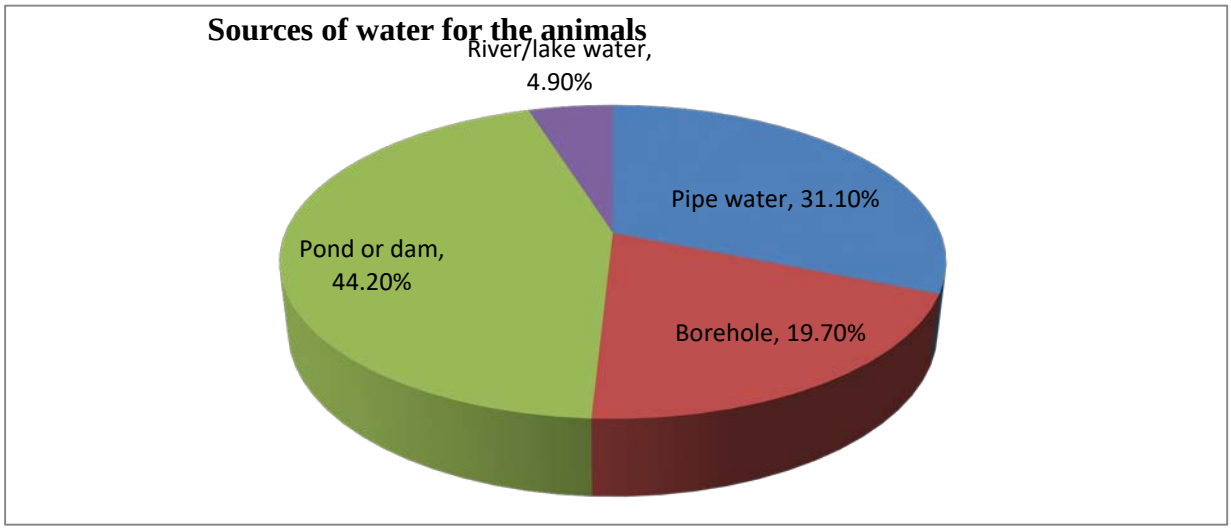

Figure 7: Sources of water for the animals

The results in (Figure 7) indicate that, pond/dam was the major water source as reported by (44.2%) of the respondents. About (31.1%) reported use of piped water, while some (19.7%) of the respondents drew water from the borehole and (4.9%) of the respondents also obtained water from the river/lake.

4.2.3 Breeding methods

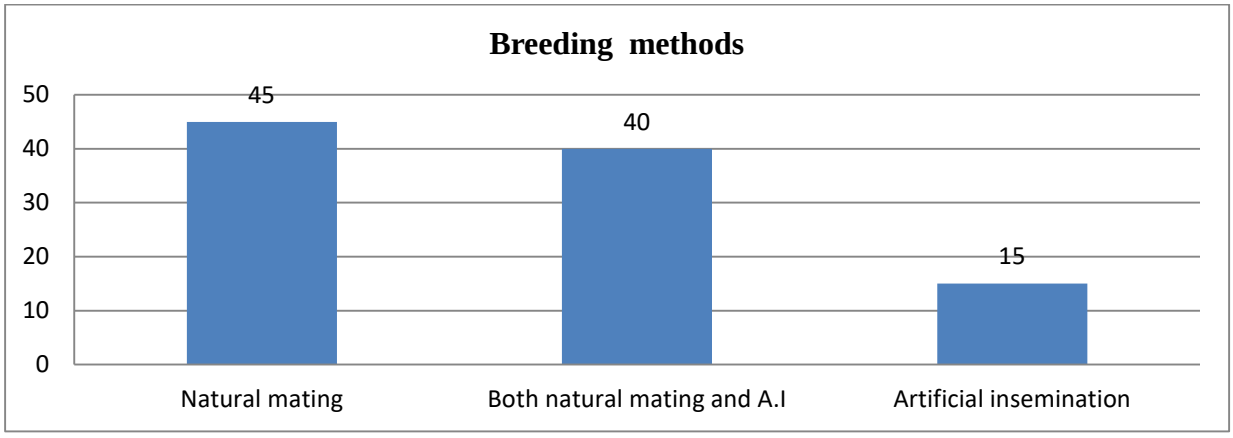

Figure 8: Breeding methods

The results in (Figure 8) reveal that, the natural mating was commonly reported (45%). However, some (15%) of the respondents reported the use of artificial insemination, while (40%) of the respondents reported use of both natural mating and artificial insemination for breeding

4.2.4 Prevalence of ticks

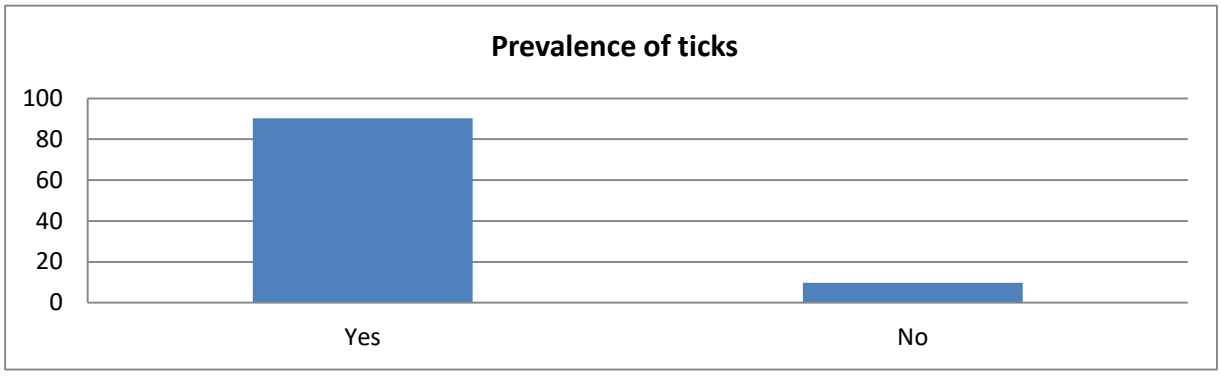

Figure 9: Prevalence of ticks

Multiple responses were accepted and missing value excluded

The results in (Figure 9) indicate that, a greater proportion of the respondents (90.3%) reported to have the problem of ticks in their farms, while (9.7%) of the respondents did not report ticks prevalence in their farms.

4.2.5 Keeping of farm records

Taking records has been found to be a rare practice by farmers and farms rearing the two breeds of cattle. The results from key informant interviews show that; majority of the farms visited as well as farmers interviewed did not keep any record.

4.3 Farmers' perception of the performance of the Small East Africa Zebu vis-à-vis Tyrolean Grey cattle crosses.

4.3.1 Sources of information about the cross breeding programme

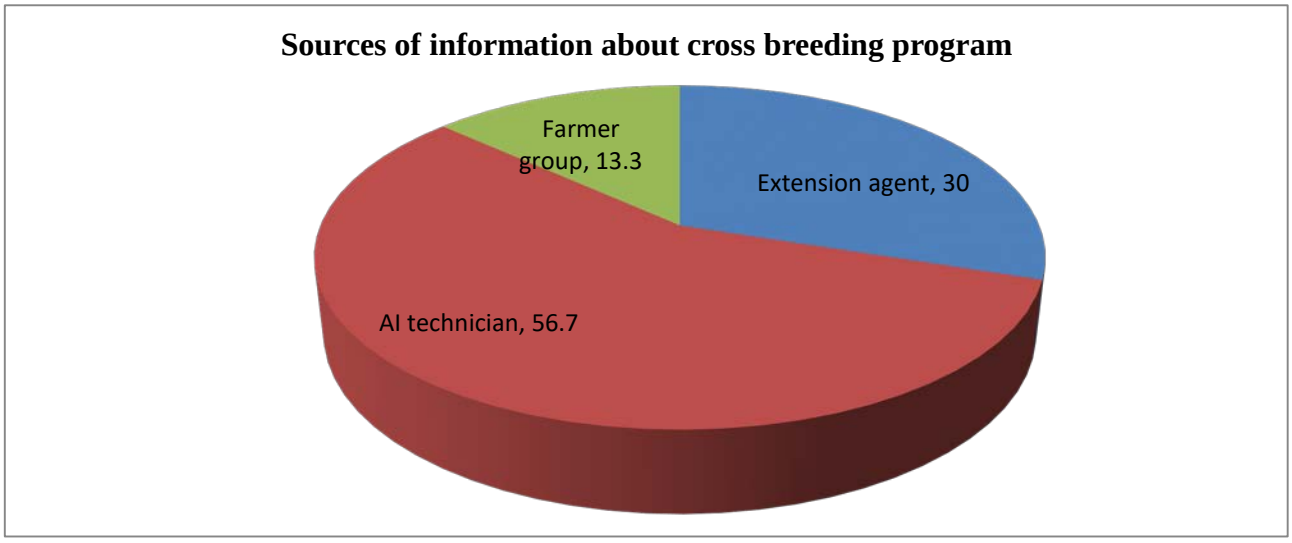

Figure 10: Sources of information about SEAZ and TGX breeding programme

From the results in (Figure10), most respondents (56.7%) cited AI technicians as the major source of information about the cross breeding programme, while (30%) cited extension workers. Some (13%) of the respondents cited farmer groups as their source of information.

4.3.2 Preferred traits of the Small East Africa Zebu and Tyrolean Grey cattle crosses

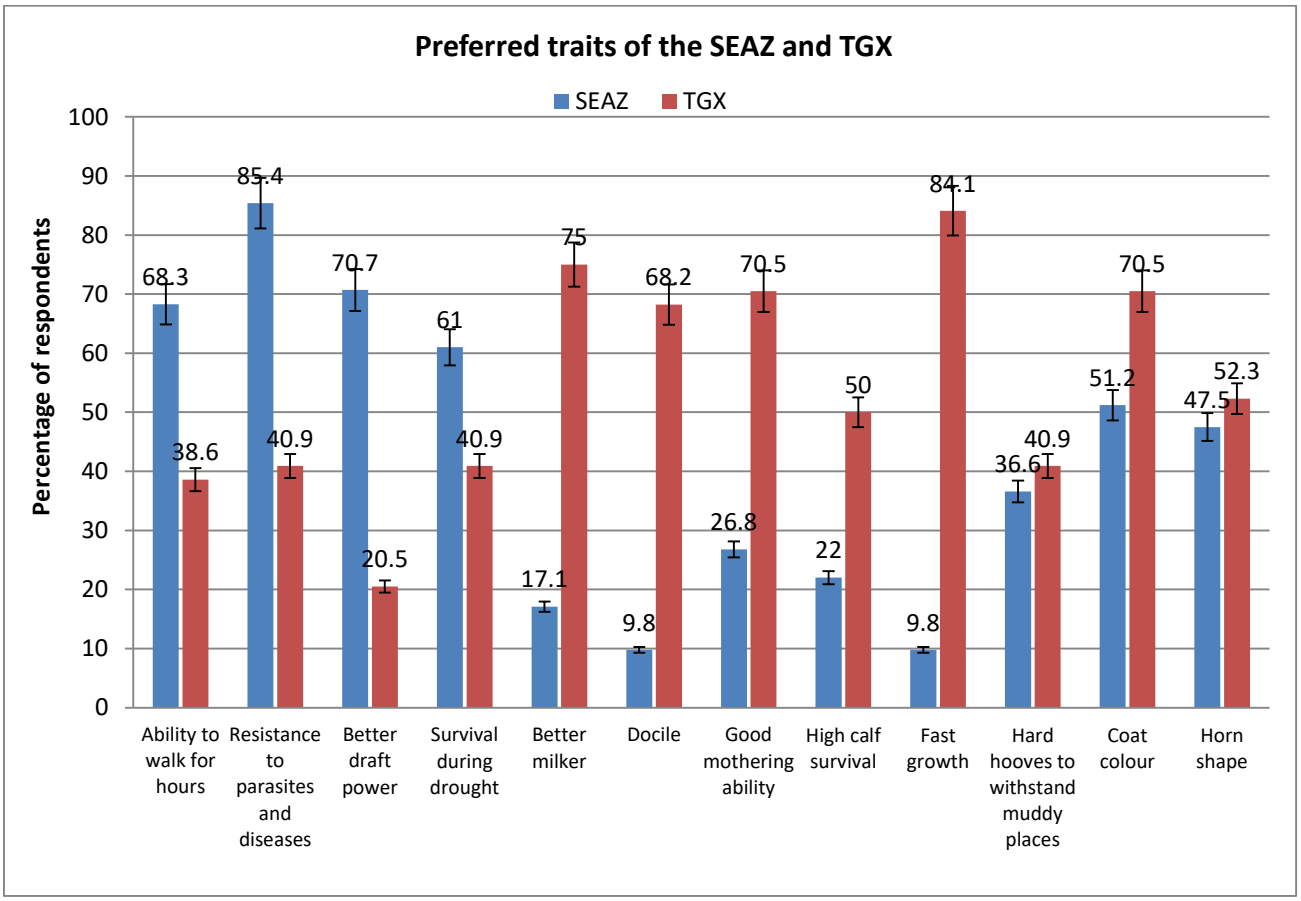

Figure 11: Preferred traits of the SEAZ and TGX

The results in (Figure 11) reveal that, the SEAZ scored (68.3%) for ability to walk for long hours compared to TGX (38.6%). The SEAZ scored (85.4%) for resistance to parasites and diseases while, the TGX scored (40.9%).The SEAZ scored (70.7%) for better draft power while, the TGX scored (20.5%). The SEAZ scored (61%) for survival during drought as compared to (40.9%) for the TGX. The TGX scored (75%) for better milk, while the SEAZ scored (17.1%). The TGX scored (68.2%) for docility, while the SEAZ scored (9.8%). The TGX scored (70.5%) for good mothering ability, while (26.8%). The TGX scored (50%) for high calf survival, while the SEAZ scored (22%).The TGX scored (84.1%) for fast growth, while the SEAZ scored (9.8%). The TGX scored (40.9%) for hard hooves to withstand muddy places better, while the SEAZ scored (36%). The TGX scored (70.5%)

for coat colour, while the SEAZ scored (51.2%).The TGX scored (52.3%) for horn shape, while the SEAZ scored (47.5%).

4.3.3 Testing for the relationship between preferred cattle breed type and preferred traits

To test if the preference of cattle breed type was significantly associated with the preferred traits; the chi square test was used Table 6:

Table 6: Testing for the relationship between preferred cattle breed type and preferred traits

Preferred traits	χ^2	Df	Sig
Ability to walk for hours	2.354	1	0.125
Resistance to parasites and diseases(SEAZ)	4.477*	1	0.035
Better draft power (SEAZ)	6.943**	1	0.008
Survival during drought	1.547	1	0.214
Better milker(TGX)	13.976***	1	0.000
Docile(TGX)	4.847*	1	0.028
Good mothering ability(TGX)	10.174***	1	0.001
High calf survival	0.335	1	0.563
Fast growth (TGX)	11.242***	1	0.001
Hard hooves to withstand muddy places better(TGX)	4.498*	1	0.034
Coat colour	1.964	1	0.161
Horn shape	3.333	1	0.068

**** p<0.001, ** p<0.01, *p<0.05*

Multiple responses were accepted, case by case analysis and missing value excluded

The results of the chi square test (Table 6)reveal that, traits such as; better draft power (χ^2=6.943, p<0.01), resistance to parasites and diseases (χ^2=4.477, p<0.05) were significantly associated with the SEAZ. On the other hand, docility (χ^2=4.847, p<0.05), better milker (χ^2=13.976, p<0.001), good

mothering ability (χ^2=10.174, p<0.001), and fast growth (χ^2=11.242, p<0.001) and hard hooves to withstand muddy places better (χ^2=4.498, p<0.05), were significantly associated with the TGX.

4.3.4 Adaptation problems of Tyrolean Grey cattle crosses to Environment

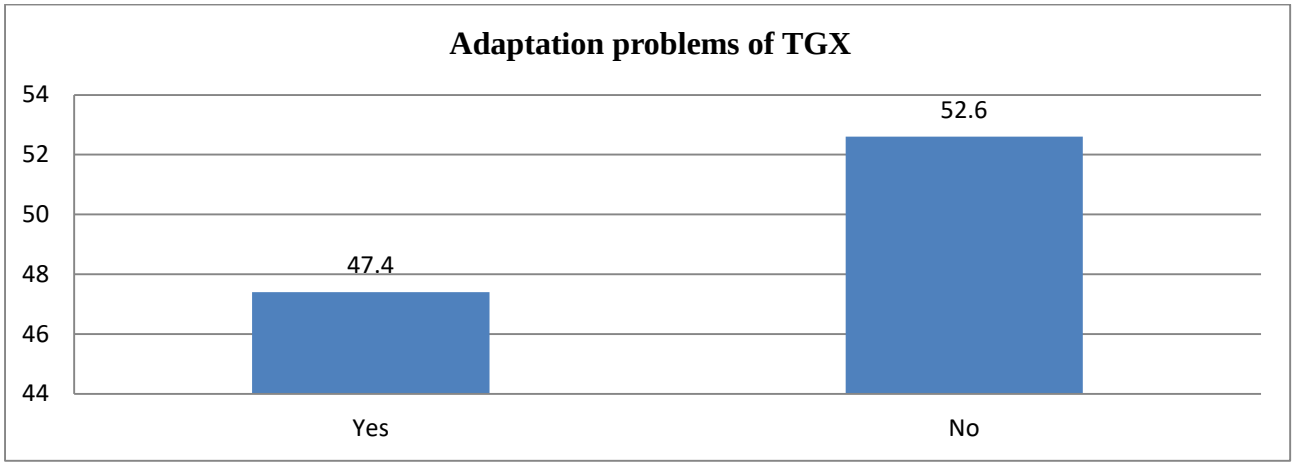

Figure 12: Adaptation problems of TGX to the Environment

The results in (Figure 12) indicate that, a greater proportion of the respondents (52.5%) reported no adaptation problem with TGX, While (47.4%) of the respondents reported adaptation problems.

4.3.5 Breed preference

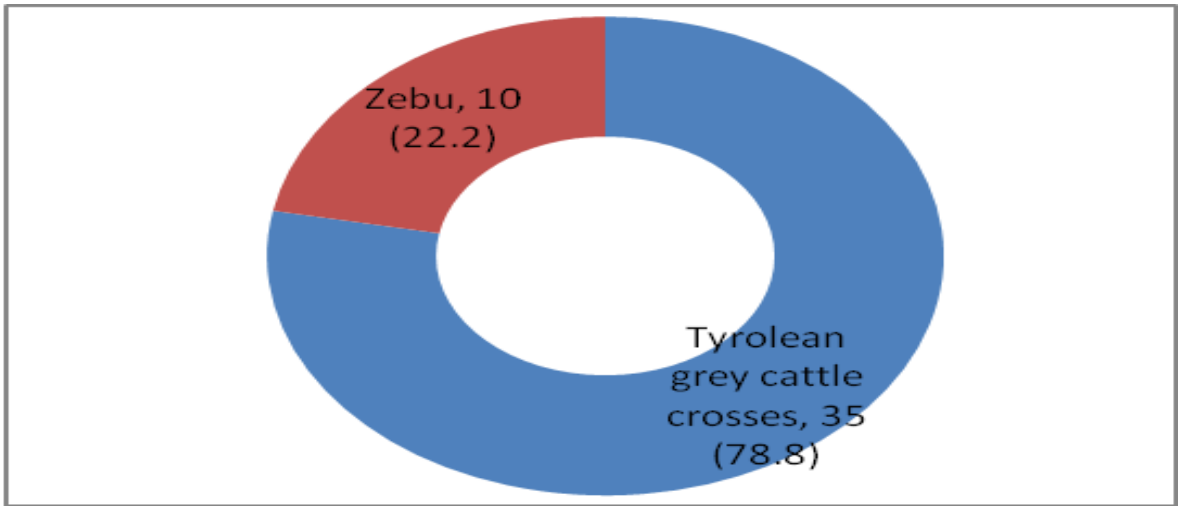

Figure 13: Breed preference

The results in (Figure13) reveal that, more than three quarters (78.8%) of the farmers preferred the TGX, while close to a quarter (22.2%) preferred the SEAZ.

4.3.6 Constraints in rearing the Small East Africa Zebu and Tyrolean Grey cattle crosses

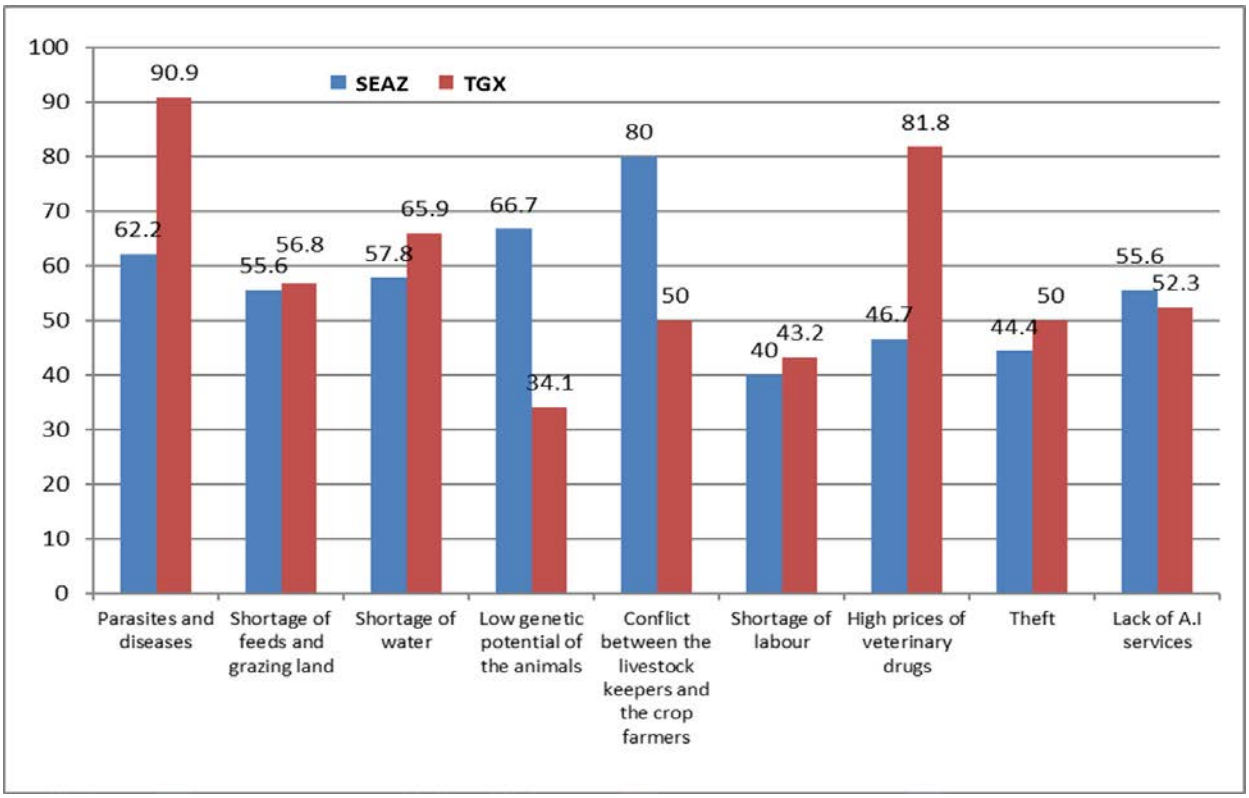

Figure 14: Constraints in rearing the SEAZ and TGX

From the results presented in (Figure14), the TGX were majorly constrained by parasites and diseases (90.9%), while the TGX scored (62.2%). The TGX scored (56.8%) for shortage of feeds and grazing land, while the SEAZ scored (55.6%).

The TGX scored (65.9%) for shortage of water, while the SEAZ scored (57.8%). The SEAZ scored (66.7%) for low genetic potential, while the TGX scored (34.1%). On the other hand, the SEAZ scored high (80%) for conflict between the livestock keepers and crop farmers, while the TGX scored (50%). The TGX scored (43.2%) for shortage of labour, while the SEAZ scored (40%). The TGX scored

(81.8%) for high prices of veterinary drugs, while the TGX scored (46.7%). The TGX scored (50%) for cattle theft, while the SEAZ scored (44.4%). The SEAZ scored (55.6%) for lack of AI services, while the TGX scored (52.3%).

4.3.7 Testing for the relationship between preferred cattle breed type and constraints in rearing the breed type.

The results on the relationship between preferred breed type and constraints in rearing the breed type are presented in Table 7:

Table 7: Testing for the relationship between preferred cattle breed type and constraints in rearing the breed type

Constraints in rearing the cattle breed type	**SEAZ**		**Chi square test**		
	SEAZ	TGX	χ^2	Df	Sig.
Parasites and diseases(TGX)	28(62.2)	40(90.9)	7.967**	1	0.005
Shortage of feeds and grazing land(TGX)	25(55.6)	25(56.8)	5.946*	1	0.015
Shortage of water(TGX)	26(57.8)	29(65.9)	5.883*	1	0.015
Low genetic potential of the animals	30(66.7)	15(34.1)	1.151	1	0.283
Conflict between the livestock keepers and the crop farmers	36 (80)	22(50.0)	2.500	1	0.114
Shortage of labour	18 (40)	19(43.2)	3.606	1	0.058
High prices of veterinary drugs(TGX)	21(46.7)	36(81.8)	4.943*	1	0.026
Theft(TGX)	20 (44.4)	22 (50.0)	5.385*	1	0.020
Lack of AI services(TGX)	25(55.6)	23(52.3)	13.507***	1	0.000

*** p<0.001, ** p<0.01, * p<0.05

Multiple responses were accepted, case by case analysis and missing value excluded.

The results in(Table 7) reveal that, the TGX were majorly and significantly constrained by parasites and diseases (χ^2=7.967, p<0.05), shortage of feeds and grazing land (χ^2=5.946, p<0.05), shortage of water (χ^2=5.883, p<0.05), high prices of veterinary drugs (χ^2=4.943, p<0.05), theft (χ^2=5.385, p<0.05), and lack of AI services (χ^2=13.507, p<0.001).

4.4 Heart girth measurements vis-à-vis age

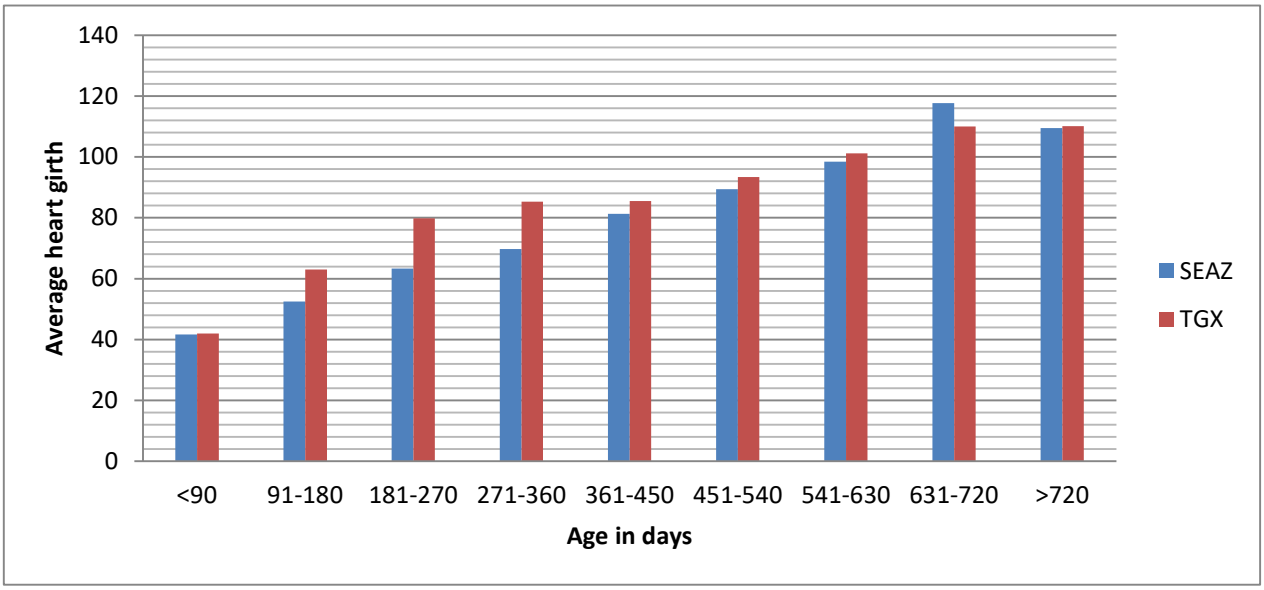

Figure 15: Heart girth measurement of the SEAZ and TGX vis-à-vis age

The results in (Figure 15) reveal that, the average hearth girth of the TGX was greater than that of the SEAZ for all the different age categories, except for the age category 631-720 days where the SEAZ had the highest heart girth on average compared to the TGX.

4.4.1 Heart girth measurements vis-à-vis age and sex

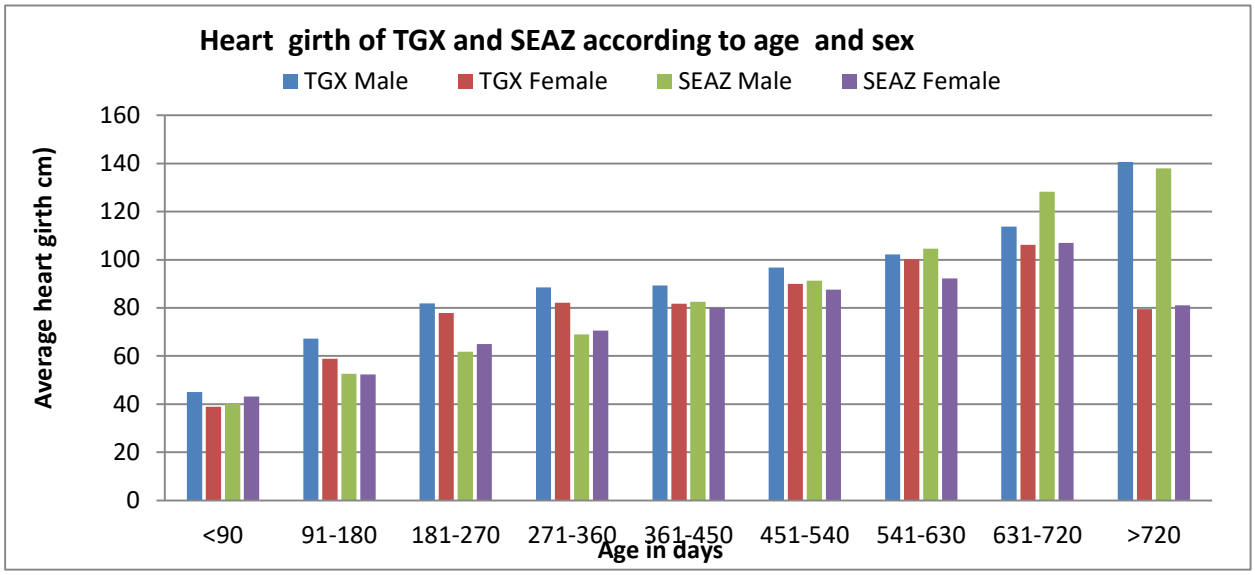

Figure 16: The average heart girth of the TGX and SEAZ according to age and sex.

The results in (Figure 16) reveal that, male TGX had higher heart girth on average as compared to the female TGX across all the different age groups. In comparison with the SEAZ, the male TGX also presented higher heart girth on average as compared to the male SEAZ across seven age groups except age group 541-630 and 631-720 days. On the other hand, the female TGX presented higher heart girth on average as compared to female SEAZ across six age categories except for categories; <90; 631-720; and >720 days. The TGX had a higher heart girth on average as compared to the SEAZ.

4.4.2 Independent sample t-test to measure differences in heart girth between the Small East Africa Zebu and Tyrolean Grey cattle crosses

Table 8: Independent sample t-test to measure differences in the heart girth between the Small East Africa Zebu and Tyrolean Grey cattle crosses

	T	Df	Sig. (2 tailed)	Mean Difference	Std. Error Difference
Heart girth	2.857	331.426	0.005	4.340	1.540

The results of the t-test (Table 8) reveal that, there was a significant difference in the heart girth between the SEAZ and TGX ($t=2.857$, $p<0.01$) with the TGX performing better than the SEAZ. Reject the null hypothesis "There is no difference in heart girth across the age groups between SEAZ and TGX" was rejected. Accept the alternative hypothesis "There is a significant difference in heart girth according to age between SEAZ and TGX" was accepted.

CHAPTER FIVE: DISCUSSION

5.1 Socio- economic characteristics of the respondents

The results from (Table 3) revealed that, more than three quarters of the respondents (95.6%) were male while 4.4% were female and this show that; most of the farm managers and/or farmers rearing the SEAZ and TGX were mainly male. This implied that, there was gender imbalance as observed from the percentage of men involved in the study compared to women. This could be because males are more interested in animal rearing than female. This could have been that, they are the household heads, they own resources and at the same time, they are the decision makers hence decide upon which economic activity to take. According to the studies carried out in Tanzania and North western Ethiopian highlands the male household heads constituted the highest percentages which were not very different as obtained in this study (Ayenew *et al*., 2011).Men always dominate and women do most of the work in terms of rearing, milking and treatments for the animals that fall sick yet goals and priorities of men and women in the households differ (MAAIF, 2016; UBOS, 2017).

The results from (Table 3) revealed that; slightly more than a quarter of the respondents (26.8%) were over 50 years of age. Equal proportions of the respondents (36.6%) were between 36-50 years of age and below 35 years of age respectively. This finding implies that most of the respondents rearing the SEAZ and TGX were of middle age and youth. It is possible that this category of people took up the rearing of this animal because of its genetic potential with regard to its reproduction and production. Moreover, the TGX require close attention and monitoring in terms of care of which the old aged were not in a better position to provide, the respondents had an average age of 42.68 (SD=13.761) with the youngest being 22 years and the oldest being 75 years of age. This implies that livestock production in this country is highly appreciated by people who are of age between 36-50 years of age. This could be because age is related to experience and therefore older farmers are likely to be more experienced

and able to discern the importance of cross breed more as compared to the less experienced young farmers, (Murage and IIatsia, 2011). These results agree with those of Kafle and Shah (2012) who observed a positive and significant relationship between age and technology adoption. The study area had relatively better potential of economically active population who could participate in dairy cattle production.

The results from (Table 3) revealed that, more than a quarter of the respondents (29.5%) had university education and training on dairy production, another (27.3%) had attained primary education level and a quarter of the respondents (25%) had no formal education, while approximately (11%) had attained secondary level education respectively implying that the farmers rearing the SEAZ and TGX had some level of literacy and have some reasonable knowledge of taking care of the cattle breeds. Education also affects the production and management of improved dairy cow breeds; most dairy cow breeds need high management and husbandry practices. The average years spent by the majority of cattle farmers in school were relatively high; this means that education plays an important role in livestock production. With more years spent in school, they are better positioned to recognize the importance of crossbreed animals. Like the current result, according to Lemma (2017), education levels of household heads have impacts on potential of milk production. Therefore, uneducated farmers are challenge for adoption of new technology in the development of dairy sector such as use of AI for breeding and synchronization. Experiences of the dairy farmers on dairy farming, education status and participation of the dairy farmers in various dairy farming related organizations also had positive and significant relationship with adoption of the improved dairy husbandry practices (Fita *et al*., 2012).The more educated a household head is, the more he/she is likely to acquire, understand, obtain, disseminate new technologies within a shorter time and more efficient when allocating

resources compared to a household head with fewer years of education (Kafle and Shah 2012; Ebojei *et al*. 2012).

The results revealed that, the major source of labour for keeping the animals was family labour (57.5%), however, close to a quarter of the respondents (22.5%) used both family and hired labour while, some (20%) of the respondents used only hired labour (Table 3). Source of labour for rearing animal, Family labour constituted the highest percentage. The reason could have been to reduce the cost of labour payment and proper farm management. This was an indication that dairy cattle management requires the attention of family members since they have high value. This in line with the current results, different authors: Megersa et al. (2011); Gillah (2012) reported the same result from different parts of Ethiopia.

5.2 Production system of the study area

5.2.1 Grazing methods in rearing the Small East Africa Zebu and Tyrolean Grey cattle crosses

The results of the study from (Figure 6) revealed that, the majority of the respondents reported practicing free grazing (81.6%) compared to rotational grazing (18.4%). This is in line with the findings of Kratli et al.; (2013) who pointed out that free range is probably more common, since it demands less work and investment. Indigenous cattle are managed by open grazing on communal rangelands, involving mobility in search of pastures and water in resource-scarce and highly variable marginal areas to enable human habitation and subsistence. Roschinsky *et al.* (2012), recommend introducing rotational grazing to allow more efficient pasture utilisation. Gizachew & Smit (2012) noted that in Ethiopia, letting the pasture rest at critical stages of the growth cycle of the forage species encourages the recovery of desirable species and can therefore increase the quality of the pasture.

5.2.2 Source of drinking water

Water sources varied according to the production system. The results from (Figure 7) revealed that, pond/dam was the major water source as reported by (44.2%) of the respondents. About (31.1%) reported use of piped water; this was majorly used in the semi-intensive cattle production system. While (19.7%) of the respondents drew water from the borehole and (4.9%) of the respondents also obtained water from the river/lake. This was majorly used in the pastoral and agro-pastoral production system. Borehole, pond/dam was mostly used in the pastoral and agro-pastoral production system as a source of water. River/lake and piped water was the major source of water used in the semi-intensive cattle production system.

5.2.3 Breeding methods

The results in (Figure 8) revealed that, natural mating was reported by majority of the respondents (45%), while (40%) of the respondents reported use of both natural mating and artificial insemination for breeding. However, about (15%) of the respondents reported the use of artificial insemination. According to Mugisha et al.; (2014), this might be an indication that farmers are constrained in their choice of breeding service. However, some farmers reported use of artificial insemination alone and others cited use of natural mating and Artificial Insemination. This could be because of low cost and high availability of bulls in the area. Poor access to Artificial Insemination is a common situation among smallholder farmers.

5.2.4 Prevalence of ticks

The results in (Figure 9) revealed that, a greater proportion of the respondents (90.3%) reported to have the problem of ticks in their farms, while (9.7%) of the respondents did not report ticks prevalence in their farms. Tick prevalence was more in the pastoral or free-grazing production system, where cattle move from place to place in search of pastures and water. Farmers reported that, they do

not have cattle crush therefore; they could not spray their animals against ticks. Pastoralists have limited access to animal health services and in most cases; animals are only vaccinated during governments' vaccination campaign (FAO, 2019).They keep indigenous breeds, with herd size ranging from few to 100 heads (FAO,2019). However, tick prevalence was not reported in Semi-intensive system because farmers keep cattle, mainly cross-bred, in kraals, paddocks and cattle barns/stalls and feed them with high-quality feed. They make significant investments in animal health, such as regular vaccination and deworming (FAO, 2019).

5.2.5 Keeping of farm records

The results from key informant interviews showed that; majority of the farms visited as well as farmers interviewed did not keep any record. Taking records has been found to be a rear practice by farmers and farms rearing the two breeds of cattle. Few farms had evidence of records, farmers had poor recording system and culture, information on the breeds was mainly got from memory and oral communication. This had challenges related to inaccuracy in records and hence human memory failure. Success in genetic improvement to a larger extent depends, among others, on accurate recording of the farm operations and periodic analysis of the data to design future plans and take corrective measures as appropriate (Aynalem et al 2011). At farm level, it is desirable for farmers to start keeping breeding records so that they can plan and control breeding for the future. However, the extent to which record keeping is practiced is dependent on the level of education, literacy among the households, the level of awareness and how the farmers view the record-keeping in terms of helping them to make farm decisions (Ococh, 2013).

5.3 Farmers' perception of the performance of the Small East Africa Zebu vis-à-vis Tyrolean Grey cattle crosses.

5.3.1 Sources of information about the cross breeding programme

Two major source of information about the cross breeding program were cited by the respondents. From the results (Figure 10), most respondents (56.7%) cited AI technicians, while about (30%) cited extension workers. Some (13%) of the respondents cited farmer groups as their source of information. There is need to improve information flow about the cross breeding programs to the farmers. As such other information sources like farmer groups, neighbours and others need to be explored. This would reduce the pressure put to the extension agents and AI technicians as much as they would be considered reliable sources. Crossbreeding has been widely used in order to combine the high milk yield potential of exotic breeds with the adaptability of the local ones. Alemayehu, (2014) pointed out that cross breeding in Ethiopia resulted in good improvement in physiological adaptation in addition to production of milk and meat, especially when supplemented with adequate management levels in terms of nutrition and disease control.

5.3.2 Preferred traits of the Small East Africa Zebu and Tyrolean Grey cattle crosses

The results from (Figure11) revealed that, the SEAZ scored (68.3%) for ability to walk long hours as compared to the TGX (38.6%). These breeds have unique genetic attributes such as adaptation and tolerance to drought, heat, diseases and ability to utilize low-quality indigenous forages. According to Nalule, (2010) pastoral communities select breeding cattle with attributes to withstand challenges created by landscapes, this is common in semi-arid region of Karamoja where cattle have to trek long distances in search of pastures and water. The results from (Figure11) revealed that, the SEAZ scored (85.4%) for resistance to parasites and diseases as compared to the TGX (40.9%).This result agree with that of Hiemstra, (2015) who observed that many farmers who keep dual-purpose breed are

pleased with the good resistance of their herd and the low treatment costs. Traditional management practices, different landscapes, Socio-cultural needs and endemic disease challenges have overtime enhanced indigenous cattle breed adaptation to their localities. The adaptations to diverse Agro-Ecological Zones take the form of variations in body sizes and levels of productivity (Kugonza et al., 2011), morphometric traits variations (Kabi et al., 2015) and resilience to endemic diseases (Magona, Walubengo and Kabi, 2011; Kabi et al., 2014). According to Bishop (2012), several studies have indicated that indigenous cattle can endure and be sustainably productive in the presence of disease challenges, a phenomenon referred to as tolerance or resilience to disease and endemic stability to infection. Jonsson et al., (2012), have also noted that continuous exposure of endemic diseases such as tick-borne diseases among indigenous cattle populations has led to the development of tick-borne disease tolerant traits.

The results in (Figure 11) revealed that, the SEAZ scored (70.7%) for better draft power as compared to the TGX (20.5%). According to Murage and Ilatsia *et al*., (2011) reasons for rearing animals are; animal traction, reproduction, symbol of wealth, security, dowry payment, employment, prestige, and as a shield against inflation. This could have been because the TGX are new breed that have been introduced in Uganda and most farmers have not tried to use them for ploughing. The results in (Figure11) showed that, the SEAZ scored (61%), for survival during drought as compared to the TGX (40.9%). This is in line with the findings of Jaritz (2014) who indicated that animal breeds were originally selected according to their functions, and only those that adapted best to the environment, husbandry conditions, and the demands of their holders survived. For example, in the semi-arid region of north eastern Uganda, the climatic conditions vary from arid to semi-arid with seasonal availability of pasture and water (Nalule, 2010), to which traditional Karamojong shorthorn zebu cattle are well adapted.

The results from (Figure 11) revealed that, the TGX scored (75%), for better milker as compared to the SEAZ (17.1%). Milk production was the most important trait that farmers considered when selecting breeds. This is probably because milk production for feeding the family and for generating cash income was the reasons for rearing the SEAZ and TGX. According to Usman *et al*., (2013), In addition, consumers' increasing demand for superior quality food and regional products indicates that there are open markets for such products (Warschum et al.; 2013). Whereas much of the expansion of livestock production in Africa have been in form of increased stocks of animals (FAO, 2015), While strategies to transition to more productive livestock production systems have been shown to be helpful in simultaneously reaching desirable outcomes on climate and food availability (Havlik et al.; 2014).The results from (Figure 11) revealed that, the TGX scored (84.1%) for fast growth as compared to SEAZ (9.8%). Fast growth rate can be of advantage to farmers aiming at producing heifers for sale. The preference for high growth rate of calves might be related to early breeding of heifers, because the farmers are still in the process of building their dairy herds. Besides getting a better price for old dairy cows, farmers receive also a higher price for the bull calves when sold to a fattener because they grow faster (Geuder et al., 2012).

The results from (Figure11) revealed that, the TGX scored (68.2%) for docility as compared to the SEAZ (9.8%). In the pastoral production system, farmers termed "TGX as mental" because they are so docile that, they keep following herds' men wherever they go, while in the semi-intensive production system, it was reported that they are aggressive. This could be because of rearing them with large animals like the Friesians. Docility therefore as a dairy cow trait, allows for ease in handling and, by extension, ease in milking (Gergovska et al 2014). The results from (Figure 11) revealed that the TGX scored (70.5%) for good mothering ability as compared to the SEAZ (26.8%) The dual-purpose breeds are not selected exclusively for milk production; dual-purpose cows have a more

diverse genotype, in general they show better health, higher fertility and a better longevity than the Holstein Friesian (Piccand et al., 2013).

The results from (Figure 11) revealed that, the TGX scored (70.5%) for coat color and (52.3%) for horn shape as compared to the SEAZ (51.2%) and (47.5%) respectively. This result agrees with that of Nalule, (2010) who observed that specific features of the SEAZ such as size and shape of horns, multiple colourations, and body size are carefully selected for by kraal leader through utilization of specific sires and dams. Horn shaping and spacing are also critical traits in enabling cattle to graze in thickets and difficult terrain (Kugonza et al., 2012b).The results from (Figure 11) revealed that the TGX scored (40.9%) for hard hooves to withstand muddy places better as compared to the SEAZ (36%).However, the SEAZ and TGX was cited with foot rot on one of the farms visited due to floods in the pasture land. The results from (Figure 11) revealed that, the TGX scored (50%) for high calf survival as compared to the SEAZ (22%).

5.3.3 Testing for the relationship between preferred cattle breed type and preferred traits

The results of the chi square test (Table 6) revealed that, traits such as; better draft power (χ^2=6.943, p<0.01) and resistance to parasites and diseases (χ^2=4.477, p<0.05) were significantly associated with the SEAZ. On the other hand, docility (χ^2=4.847, p<0.05), better milker (χ^2=13.976, p<0.001), good mothering ability (χ^2=10.174, p<0.001), fast growth (χ^2=11.242, p<0.001) and hard hooves to withstand muddy places better (χ^2=4.498, p<0.05), were significantly associated with the TGX. The overall results revealed that, the TGX performed better than the SEAZ. There is a difference in farmers ‘perception of SEAZ and TGX as regards preferred traits.

5.3.4 Adaptation problems of Tyrolean Grey cattle crosses to the Environment

The results in (Figure 12) revealed that, a greater proportion of the respondents (52.5%) reported no adaptation problem with TGX, While (47.4%) of the respondents reported adaptation problems. Adaptation problems were mostly reported in the pastoral system where the TGX had to move long distance in search of pastures and water. The majority of the farmers cited that, they had to group TGX with calves and graze them together. Farmers also pointed out that, TGX are susceptible to heat stress and during hot weather they stay under shades. According to Odhong et al. (2015), other important traits such as adaptation to local environment and utilization of available feed resources are important in meeting the health and welfare needs of the animals. Weerasinghe et al.; (2013) pointed out that with the increased demand for livestock products and the need to bridge productivity gaps in developing countries, poorly planned crossbreeding of locally adapted breeds with imported exotic breeds have been widely adopted yielding animals with unknown breed composition. Suitability of these crosses to various production environments is largely unknown.

5.3.5 Breed preference

The SEAZ and TGX constituted the study. The results from (Figure 13) revealed that, more than three quarters (78.8%) of the farmers preferred the TGX as compare to the SEAZ (22.2%). The TGX are still new and was introduced in the country most recently about 9 years ago. As such, because of its genetic potential, it has been much preferred as compared to the SEAZ. Majority of the farmers who preferred and reared the TGX were the University graduates. This probably could have been because of better milk yield to boost their income during retirement. The *Bostaurus* (Exotic) breeds that are predominantly found in temperate countries, have a high production potential, but poor adaptation to tropical hash environment (Roschinsky et al., 2015). The majority of the farmers in the study area reared the SEAZ, this may be attributed to their status as low risk, low investment animals. These

breeds require no supplementation during the dry season, often subsisting on poor quality forages, and require minimal levels of veterinary care. These are the strong points of the indigenous breeds. These cattle provide the only means of survival in an environment unsuitable for any other type of land use. SEAZ are preferred not in terms of the quantities of milk they produce, but due to their ability to provide milk under extreme condition in which their exotic counterparts would be unable to survive, let alone produce. The SEAZ like other breeds in the tropics is characterized by low-productivity and low growth rates but highly adapted to harsh environmental conditions (Wurzinger et al, 2014).

5.3.6 Constraints in rearing the Small East Africa Zebu and Tyrolean Grey cattle crosses

The results from (Figure 14) revealed that, the TGX scored (90.9%) for parasites and diseases as compared to SEAZ (62.2%).This study is in line with the findings of Magona, Walubengo and Kabi, (2011) who noted that improved dairy cattle are more vulnerable to local diseases and parasites particularly tick-borne diseases, internal helminths and trypanosomiasis, whose effective control requires substantial investments. The findings of this study are in agreement with that of Balikowa, (2011) who observed that although indigenous cattle have been faulted for low productivity and reproductive performances, they still remain popular in Uganda because of their adaptive traits to the local underprivileged conditions. (Hill, 2014; Felius et al.; 2015; Kristensen et al.; 2015) pointed out that Locally-adapted native livestock breeds with distinct microevolutionary histories and minimal external gene flow will have accumulated novel genomic variation and haplotype combinations for quantitative health, fertility and production traits.

The results from (Figure 14) revealed that, the TGX scored (65.9%) for shortage of water compared to SEAZ (57.8%).The nomads and transhumant pastoralists are becoming increasingly restricted regarding where they can move their animals in search of water and feed, due to restricted access to land. The results from (Figure 14) show that, the TGX scored (56.8%) for shortage of feeds and

grazing land as compared to SEAZ (55.6%).According to Roschinsky et al. (2012), farmers with separate herds tend to let their crossbreed cattle graze on pasture which they consider to have higher quality. Underfeeding of animals also leads to lower growth rates and reproduction problems. Feed accounts for 50–75 % of the cost of production (Spurlock et al. 2012).In addition; feed efficiency has become an important trait in genetic selection (Spurlock et al., 2012). Indigenous cattle provide the most suitable means of exploiting marginal lands with scarce resources and sustainable pastoral livelihoods (Hoffmann, 2011).

The results from (Figure 14) revealed that, the SEAZ scored (66.7%) for low genetic potential as compared to TGX (34.1%). The results of the study are in agreement with the findings of Renaudeau et al.; (2012) who noted that Indigenous livestock, although adapted to the local environments, are poor milk and meat producers compared to the commercial breeds raised in the extensive system. According to Wurzinger et al, (2014), the Zebu breed like other breeds in the tropics is characterized by low-productivity and low growth rates but highly adapted to harsh environmental conditions. In Ethiopia, the poor genetic potential for productive traits, substandard feeding, poor health care and management practices are the main contributors to low productivity (Belay *et al.*, 2012). According to Balikowa (2011) in Uganda, smallholder cattle farmers have been encouraged to replace their indigenous cattle with high yielding exotic breeds. The results from(Figure14) revealed that, SEAZ scored (80%) for conflicts between the livestock keepers and crop farmers as compared to TGX (50%).In particular, the rapid increase in human and livestock population is putting high pressure on rangeland (FAO, 2013). Climate change and land conflicts are also causing problems. The results in (Fig14) revealed that; the TGX scored (43.3%) for shortage of labour as compared to the SEAZ (40%). This study is in line with Roschinsky *et al.* (2012) who stated that, investment capital for establishing paddocks is scarce and rotating animals with herdsmen is becoming more difficult due to labour

scarcity. The results in (Figure 14) revealed that, the TGX scored (81.8%) for high prices of veterinary drugs for treatment as compared to the SEAZ (46.7%). Udo et al., (2011), reported that intensification demands increased use of purchased inputs and services, including feeds, replacement stock, breeding and veterinary health services, credit facilities, producer organizations and market access for both inputs and outputs, and an increase in livestock management skills. Udo et al., (2011), further noted that the less financially privileged farm households may exhibit less interest in investing their scarce resources and efforts in more intensive livestock systems.

The results in (Figure 14) revealed that, the TGX scored (50%) for cattle theft as compared to the SEAZ (44.4%). A farmer cited losing the due to cattle raiding. This could have been because the TGX are new breed that had been introduced in Uganda and, has high genetic potential than the SEAZ. The results in (Figure14) revealed that, the SEAZ scored (55.6%) for lack of AI as compared to TGX (52.3%). According to Galukande et al., (2013), the use of artificial insemination, embryo transfer and exotic village bull schemes have been used at various stages as tools to support the introduction of exotic germplasm especially in cattle since 1960. In Uganda, these practices have been mainly amplified by local NGOs and other developmental community-based organizations targeting smallholder cattle farmers with the objective of increasing milk productivity (Balikowa, 2011). Genetically superior animals are raised for meat and milk production using artificial insemination (Mugisha et al., 2014; Engidawork, 2018).

5.3.7 Testing for the relationship between preferred cattle breed type and constraints in rearing the breed type.

The results of the chi square test (Table 7) revealed that, the TGX were majorly and significantly constrained by parasites and diseases (χ^2=7.967, p<0.05), shortage of feeds and grazing land (χ^2=5.946, p<0.05), shortage of water (χ^2=5.883, p<0.05), high prices of veterinary drugs (χ^2=4.943,

$p<0.05$), theft ($\chi^2=5.385$, $p<0.05$), and lack of AI services ($\chi^2=13.507$, $p<0.001$). All the constraints were majorly and significantly associated with the TGX. There was no constraint significantly associated with SEAZ. One would have expected low genetic potential, but it seems the respondents do not seriously consider this as a challenge.

5.4 Heart girth measurements of Small East Africa Zebu vis-à-vis Tyrolean Grey Cattle crosses according to age and sex

The results in (Figure 15) revealed that, the average hearth girth of the TGX was higher than that of the SEAZ for all the other different age categories, except for the age category 631-720 where the SEAZ had the highest heart girth on average compared to the TGX. This could have been during drought, since TGX are unable to move long distance in search of pasture and water. It could also be due to tick infestations, since they are not well adapted to the environment. According to Lukuyu et al., (2016) variability in the heart girth measurements may arise due to positioning and tension of the tape on the body of the animal. It has been established that the relationship between live weight and body measurements is highly dependent on age, sex and breed. According to Lukuyu et al., (2016) body linear measurements, and specifically heart girth (HG) have been shown to be useful predictors of cattle live weight. Since the dairy cattle are crossbreeds of exotic breeds with different types of indigenous cattle which may differ in body structure Lukuyu et al., (2016). Live weight (LW) forms the basis for a range of research and management activities including assessment of growth rates, responses of animals to different diets and environmental conditions and determination of feed requirement. However, according to Lukuyu et al., 2016, Lagu, (2012), the dairy cattle are crossbreeds of exotic breeds with different types of indigenous cattle which may differ in body structure.

The results from (Figure 16) revealed that, male TGX had higher heart girth on average as compared to the female TGX across all the different age groups. In comparison with the SEAZ, the male TGX also presented higher heart girth on average as compared to the male SEAZ across seven age groups except age group 541-630 and 631-720 days where the male SEAZ had higher heart girth than TGX. On the other hand, the female TGX presented higher heart girth on average as compared to female SEAZ across six age categories except for categories; <90; 631-720; and >720. Overall, the TGX had a higher heart girth on average as compared to the SEAZ. This could be explained by the fact that, TGX had great potential for growth intensity traits and have high feed conversion efficiency. The SEAZ had low genetic potential. Body weight is closely related to body measurements, with HG generally accepted as the most satisfactory single predictor of LW in cattle (Lesosky etal.; 2012; Lukuyu etal.;2016). However, accurate estimation of LW could be influenced by several parameters including animal breed, sex and age. Hence, these variables were used in LW prediction by various authors (Rashid, Hoque, Huque, & Bhuiyan, 2016; Tsegaye, Belay, & Haile, 2013). Apart from its use in assessing animals' growth, health and feed use efficiency, LW is used to evaluate the type, function and potential values of animals intended for use as breeding stock, meat production, milk production and draught power (Lesosky et al., 2013). The TGX performed better than the SEAZ in terms of heart girth according to age and sex.

5.4.1 Independent sample t-test to measure differences in the heart girth and age between the Small East Africa Zebu and Tyrolean Grey cattle crosses

The findings of the independent sample t-test (Table 8) revealed that, there was a significant difference in the heart girth between the SEAZ and TGX ($t=2.857$, $p<0.01$) with the TGX performing better than the SEAZ in terms of heart girth. There is difference in heart girth according to age between SEAZ and TGX.

CHAPTER SIX: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

The study aimed to determine the performance of the Small East African Zebu (SEAZ) and the Tyrolean Grey cattle crosses (TGX) in the selected cattle corridor districts (Kole,and Nakapiripirit) of Uganda. SEAZ is an indigenous breed in Uganda while the TG breed is indigenous to the alpine region of Austria and was introduced in the country through use of semen in 2009. Heart girth data collected for over three years at Lusenke Stock Farm (National Animal Genetic Resources Centre and Databank – NAGRC&DB) was used in the study. This study used cross-sectional survey design embracing qualitative and quantitative approaches. Data was obtained by use of structured questionnaires, focus group discussion, review of records and Individual In-depth interview with 45 respondents who included 35 farmers, 03AI technicians, 03farm managers and 04 extension workers. Heart girth data collected for over three years at Lusenke Stock Farm (National Animal Genetic Resources Centre and Databank – NAGRC&DB) was used in this study. Assessment of farmers' perception as regards SEAZ and TGX was done using Chi squareχ^2 and Independent sample t-test. With regard to breeding systems, natural mating was commonly reported by the majority (45%). A greater proportion of the respondents (90.3%) reported to have the problem of ticks in their farms. The greater majority of respondents (82%) use free range in grazing the SEAZ and TGX. Water sources vary from farm to farm. The results indicated that pond/dam was the major water source as reported by (44.2%) of the respondents. Majority of the farms visited as well as farmers interviewed did not keep any record. Two major source of information about the cross breeding program were cited by the respondents, AI technicians (56.7%), and extension workers (30%).The results of the chi square test revealed that, traits such as; better draft power (χ^2=6.943, $p<0.01$) and resistance to parasites and diseases (χ^2=4.477, $p<0.05$) were significantly associated with the SEAZ. On the other hand, docility (χ^2=4.847, $p<0.05$),

better milker (χ^2=13.976, p<0.001), good mothering ability (χ^2=10.174, p<0.001), fast growth (χ^2=11.242, p<0.001) and hard hooves to withstand muddy places better (χ^2=4.498, p<0.05), were significantly associated with the TGX. The overall results reveal that, the TGX performed better than the SEAZ. The results indicated that a greater proportion of the respondents (52.5%) reported no adaptation problem with TGX, while (47.4%) of the respondents reported adaptation problems. The results of this study (Figure 16) revealed that, more than three quarters (78.8%) of the farmers preferred the TGX as compared to the SEAZ (22.2%).

The results of the chi square test showed that, the TGX were majorly and significantly constrained by parasites and diseases (χ^2=7.967, p<0.05), shortage of feeds and grazing land (χ^2=5.946, p<0.05), shortage of water (χ^2=5.883, p<0.05), high prices of veterinary drugs (χ^2=4.943, p<0.05), theft (χ^2=5.385, p<0.05), and lack of AI services (χ^2=13.507, p<0.001).

Generally, the average heart girth of the TGX was higher than that of the SEAZ for all the other different age categories except for the age category 631-720 days where the SEAZ had the greatest heart girth on average compared to TGX. The results reveal that, male TGX had higher heart girth on average as compared to the female TGX across all the different age groups. The male TGX also presented higher heart girth on average as compared to the male SEAZ across eight age groups except age group 631-720 days. On the other hand, the female TGX presented higher heart girth on average as compared to female SEAZ across six age categories except for categories; <90; 631-720; and >720 days. The results of the independent sample t-test showed that, there was a significant difference in the heart girth between the SEAZ and TGX (t=2.857, p<0.01). The TGX showed better performance than the SEAZ. “There is a difference in heart girth according to age between SEAZ and TGX.

6.2 Conclusion

The TGX was the most preferred cattle breed type and showed better performance than the SEAZ in terms of heart girth according to age and sex.

6.3 Recommendation

Taking records has been found to be a rear practice by farmers and farms rearing the SEAZ and TGX. At farm level, it is desirable for farmers to start keeping breeding records so that they can plan and control breeding for the future. Based on the findings of the study, the TGX was the most preferred and showed better performance as compared to the SEAZ and therefore this study recommends continued importation of TGX to Kole and Nakapiripirit to boost milk and meat production. It was difficult to follow up animals; NAGRC&DB should put a system in place to follow up the products of the semen given out. Training of cattle farmers in various aspects of herd management will improve cattle productivity. Extension services for cattle farming should be strengthened through increasing the number of extension workers.

Future Research

The study recommends survey of adaptability and grazing systems in agro-ecological zones of Uganda.

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APPENDICES

APPENDIX 1: QUESTIONAIRE FOR FARMERS

Dear respondent

I am Sr. Goretti Acila a graduate student of Kyambogo University, undertaking a study entitled ***Farmers perception of Zebu x Tyrolean Grey cattle crosses Performance in Uganda***. You are assured of confidentiality of any view expressed in relation to this study. I therefore entreat you to provide accurate information for true results. Thank you for your kind cooperation.

District	**Sub-county**	**Parish**	**Village**

Date of interview:

Interviewee:

Questionnaire No

SECTION A: Demographic characteristics of the respondent

Tick in the box

1. Gender of the respondent

   a) Male ☐ b) Female ☐

2. How old are you?

3. What is your level of educational?

   a) No formal education ☐ b) primary ☐ c) Secondary ☐

   d) Tertiary ☐ e) University ☐

4. Marital status

   a) Married ☐

   b) Single ☐

   c) Others (Widowed or divorced) ☐

5. What is your household size?

6. Do you own some land?

   (a) Yes ☐ (b) No ☐

7. If yes, how many hectares of land do you own?

8. What proportion of land do you use for the Zebu and Tyrolean Grey cattle? (in hectares)

9. What is the purpose of owning land?

1. Crop production ☐
2. Grazing and forage production ☐
3. Others specify…….. ☐

10. What is your Main occupation?
    1. Cattle and small ruminants rearing ☐
    2. Farming ☐
    3. Fishing ☐
    4. Petty business ☐
    5. Employed by government/NGO ☐
    6. Civil service ☐

11. How many Zebu and Tyrolean Grey cattle crosses do you own?

Number of Zebu cattle
Number of Tyrolean Grey cattle crosses

12. How long have you kept the Zebu x Tyrolean Grey cattle crosses?

Number of Zebu cattle
Number of Tyrolean Grey cattle crosses

13. What is the source of labour for looking after the animals?

Family labour ☐ Hired labour ☐

SECTION B: Farmer's perception about the performance of the Zebu and Tyrolean Grey cattle crosses

Tick in the box

14. Which breed would you prefer to keep?

Breed	Yes	No
Zebu		
Tyrolean Grey cattle crosses		

15. Why do you prefer the Zebu cattle?

16. Why do you prefer the Tyrolean Grey cattle crosses?

Cattle' attributes	Rate your preference to Zebu and the Tyrolean Grey cattle crosses?	
	Zebu cattle	Tyrolean Grey cattle crosses
Ability to walk for hours		
Resistance to parasites and diseases		
Better draft power		
Survival during drought		
Better milker		
Docile		
Good mothering ability		
High calf survival		
Fast growth		
Hard hooves to withstand muddy places better		
Easy calving of the Zebu carrying Tyrolean Grey cattle genetics		
Coat colour		
Horn shape		

17. What is the effect of crossing on the performance of the Tyrolean Grey cattle crosses? **Tick all that apply)**

1. Heat tolerance ☐
2. Increase in milk and meat production ☐
3. Resistance to parasites and diseases ☐
4. Highly fertile ☐

18. What is the contribution of the Zebu x Tyrolean Grey cattle to your livelihood?

	Contribution of Zebu x the Tyrolean Grey cattle crosses to your livelihood?			
	Zebu cattle		Tyrolean Grey cattle crosses	
	High	Low	High	Low
Improved food security				
Increased income				
More manure				
Employment				
Social functions and cultural obligations				
Source of draught power				
Source of biogas energy				

19. What constraints do you face in the rearing of the Zebu cattle? Rank any 10 (1-10) according to the order of importance

Parasites and diseases ☐
Shortage of feeds and grazing land ☐
Shortage of water ☐
Low genetic potential of the animals ☐
Conflict between the livestock keepers and the crop farmers ☐
Shortage of labour ☐
Lack of markets for livestock products ☐
High prices of veterinary drugs ☐
Lack of dips ☐
Poor fertility of the animals ☐
Theft ☐
Lack of A.I services ☐

20. What constraints do you face in the rearing of the Tyrolean Grey cattle crosses? Rank any 10 according to the order of importance

1. Parasites and diseases ☐
2. Shortage of feeds and grazing land ☐
3. Shortage of water ☐
4. Low genetic potential of the animals ☐
5. Conflict between the livestock keepers and the crop farmers ☐
6. Shortage of labour ☐
7. Lack of markets for livestock products ☐
8. High prices of veterinary drugs ☐
9. Lack of dips ☐
10. Poor fertility of the animals ☐
11. Theft ☐
12. Lack of A.I services ☐

21. Do you keep records in your farm?

Yes ☐ No ☐

22. What is the source of drinking water for the Zebu and the Tyrolean Grey cattle crosses?

Pond/dam ☐

Pipe water ☐

River ☐

Rain water ☐

23. Is there any adaptation problems with the Tyrolean Grey cattle crosses?

Yes ☐ No ☐

24. Is there prevalence of ticks in your farm?

Yes ☐ No ☐

Thank you so much for your positive response

ACILA GORETTI

Kyambogo University

APPENDIX 2: FOCUS GROUP DISCUSSION FOR FARMERS

Dear respondent

I am Sr. Goretti Acila a graduate student of Kyambogo University, undertaking a study entitled ***Farmers perception of Zebu x Tyrolean Grey cattle crosses Performance in Uganda***. You are assured of confidentiality of any view expressed in relation to this study. I therefore entreat you to provide accurate information for true results. Thank you for your kind cooperation.

District	Sub-county	Parish	Village

Date of interview:

Interviewee:

SECTION A: Demographic characteristics of the respondent

Tick in the box

1. Gender of the respondent
2. How old are you?
3. What is your educational background?
4. What is your marital status?
5. What is your household size?
6. Do you own some land?
7. If yes, what is your land holding in hectares?
8. What proportion of land do you use for the Zebu x Tyrolean Grey cattle crosses?
9. What are the purposes for owning land?
10. What is your Main occupation?
11. How long have you kept the Zebu cattle?
12. How long have you kept the Tyrolean Grey cattle crosses?

13. How many Zebu cattle do you own?
14. How many Tyrolean Grey cattle crosses do you own?
15. What is the source of labour for looking after the animals?

SECTION B: Farmer's perception of the performance of the Zebu and Tyrolean Grey cattle crosses

16. Between the Zebu and the Tyrolean Grey cattle which breed do you prefer do you prefer?
17. Why do you prefer the Zebu cattle?
18. Why do you prefer the Tyrolean Grey cattle crosses?
19. What is your main source of livelihood?
20. What are the roles of the Zebu cattle in your household?
21. What are the roles of the Tyrolean Grey cattle crosses in your household?
22. What constraints do you face in the rearing of the Zebu cattle?
23. What constraints do you face in the rearing of the Tyrolean Grey cattle crosses?

SECTIONC: Reproduction and production performance of the Zebu and that of its crosses with the Tyrolean Grey cattle.

Cattle production systems

24. Do you keep records in your farm?
25. If yes, what type of records?
26. What breeding system do you use?
27. Where did you get the information about the Crossbreeding program?
28. Which grazing method do you use on your farm?
29. What is the source of drinking water for the Zebu and the Tyrolean Grey cattle crosses?
30. Is there prevalence of ticks on your farm?
31. Is there any adaptation problems with the Tyrolean Grey cattle crosses?

Thank you so much for your positive response

ACILA GORETTI

Kyambogo University

APPENDIX 3: INDIVIDUAL IN-DEPTH INTERVIEW GUIDE FOR KEY INFORMERS

Dear respondent

I am Sr. Goretti Acila a graduate student of Kyambogo University, undertaking a study entitled ***Farmers Perception of the Zebu x Tyrolean Grey cattle crosses Performance in Uganda***. You are assured of confidentiality of any view expressed in relation to this study. I therefore entreat you to provide accurate information for true results. Thank you for your kind cooperation.

District	Sub-county	Parish	Village

Date of interview:

Interviewee:

Questionnaire No:

SECTION A: Demographic characteristics of the respondent

Tick in the box

1. Gender of the respondent
2. How old are you?
3. What is your educational background?
4. What is your marital status?
5. What is your household size?
6. Do you own some land?
7. If yes, what is your land holding in hectares?
8. What proportion of land do you use for the Zebu x Tyrolean Grey cattle crosses?
9. What are the purposes for owning land?
10. What is your Main occupation?
11. How long have you kept the Zebu cattle?
12. How long have you kept the Tyrolean Grey cattle crosses?
13. How many Zebu cattle do you own?
14. How many Tyrolean Grey cattle crosses do you own?
15. What is the source of labour for looking after the animals?

SECTION B: Farmer's perception of the performance of the Zebu and Tyrolean Grey cattle crosses

16. Between the Zebu and the Tyrolean Grey cattle which breed do you prefer do you prefer?

17. Why do you prefer the Zebu cattle?
18. Why do you prefer the Tyrolean Grey cattle crosses?
19. What is your main source of livelihood?
20. What are the roles of the Zebu cattle in your household?
21. What are the roles of the Tyrolean Grey cattle crosses in your household?
22. What constraints do you face in the rearing of the Zebu cattle?
23. What constraints do you face in the rearing of the Tyrolean Grey cattle crosses?

SECTIONC: Reproduction and production performance of the Zebu and that of its crosses with the Tyrolean Grey cattle.

Cattle production systems

24. Do you keep records in your farm?
25. If yes, what type of records?
26. What breeding system do you use?
27. Where did you get the information about the Crossbreeding program?
28. Which grazing method do you use on your farm?
29. What is the source of drinking water for the Zebu and the Tyrolean Grey cattle crosses?
30. Is there prevalence of ticks on your farm?
31. Is there any adaptation problems with the Tyrolean Grey cattle crosses?
32. If yes, what adaptation problems?

Thank you so much for your positive response

ACILA GORETTI

Kyambogo University

APPENDIX 4: HEART GIRTH DATA FROM LUSENKE STOCK FARM (NAGREC& DB)

Tag	Date of Birth	Breed	Sex	Heart girth 04.02.2012	Age in days 04-Feb-12	Heart girth 18.02.2012	40957 18-Feb-12	Age in days 18-Feb-12	Heart girth 25.02.2012	25-Feb-12	Age in days 25-Feb-12	Heart girth 01-Mar-12	40969 01-Mar-12	Age in days 01-Mar-12	Heart girth 08-Mar-12	40976 08-Mar-12	Age in days 08-Mar-12	Heart girth 15-Mar-12	40983 15-Mar-12
6513	16-Aug-11	TX	F	48	172	49	18-Feb-12	186	49	25-Feb-12	193	50	01-Mar-12	198	50	08-Mar-12	205	52	15-Mar-12
6518	13-Oct-11	TX	F	57	114	59	18-Feb-12	128	63	25-Feb-12	135	67	01-Mar-12	140	67	08-Mar-12	147	67	15-Mar-12
6520	26-Oct-11	TX	F	51	101	51	18-Feb-12	115	51	25-Feb-12	122	55	01-Mar-12	127	55	08-Mar-12	134	56	15-Mar-12
6878	10-Oct-11	TX	F	53	117	54	18-Feb-12	131	55	25-Feb-12	138	49	01-Mar-12	143	50	08-Mar-12	150	51	15-Mar-12
6879	22-Sep-11	TX	F	43	135	43	18-Feb-12	149	45	25-Feb-12	156	46	01-Mar-12	161	47	08-Mar-12	168	47	15-Mar-12
6501	27-Jul-11	TX	M	61	192	62	18-Feb-12	206	62	25-Feb-12	213	65	01-Mar-12	218	67	08-Mar-12	225	67	15-Mar-12
6502	11-Jul-11	TX	M	57	208	62	18-Feb-12	222	63	25-Feb-12	229	65	01-Mar-12	234	69	08-Mar-12	241	69	15-Mar-12
6509	14-Aug-11	TX	M	48	174	52	18-Feb-12	188	55	25-Feb-12	195	55	01-Mar-12	200	51	08-Mar-12	207	52	15-Mar-12
6523	17-Aug-11	TX	M	57	171	49	18-Feb-12	185	49	25-Feb-12	192	49	01-Mar-12	197	50	08-Mar-12	204	52	15-Mar-12
6505	22-Jul-11	Zebu	F	57	197	66	18-Feb-12	211	65	25-Feb-12	218	65	01-Mar-12	223	64	08-Mar-12	230	64	15-Mar-12
6511	07-Sep-11	Zebu	F	44	150	44	18-Feb-12	164	45	25-Feb-12	171	42	01-Mar-12	176	43	08-Mar-12	183	44	15-Mar-12

6515	01-Aug-11	Zebu	F	40	187	41	18-Feb-12	201	43	25-Feb-12	208	40	01-Mar-12	213	42	08-Mar-12	220	43	15-Mar-12
6751	01-Oct-11	Zebu	F	36	126	36	18-Feb-12	140	36	25-Feb-12	147	43	01-Mar-12	152	43	08-Mar-12	159	43	15-Mar-12
6755	08-Oct-11	Zebu	F	38	119	40	18-Feb-12	133	40	25-Feb-12	140	41	01-Mar-12	145	41	08-Mar-12	152	42	15-Mar-12
6761	08-Sep-11	Zebu	F	36	149	36	18-Feb-12	163	35	25-Feb-12	170	36	01-Mar-12	175	38	08-Mar-12	182	38	15-Mar-12
6762	01-Oct-11	Zebu	F	44	126	49	18-Feb-12	140	50	25-Feb-12	147	48	01-Mar-12	152	49	08-Mar-12	159	50	15-Mar-12
6763	01-Oct-11	Zebu	F	29	126	29	18-Feb-12	140	29	25-Feb-12	147	25	01-Mar-12	152	25	08-Mar-12	159	26	15-Mar-12
6882	01-Nov-11	Zebu	F	37	95	38	18-Feb-12	109	39	25-Feb-12	116	41	01-Mar-12	121	42	08-Mar-12	128	42	15-Mar-12
6883	09-Sep-11	Zebu	F	50	148	51	18-Feb-12	162	51	25-Feb-12	169	40	01-Mar-12	174	41	08-Mar-12	181	42	15-Mar-12
6892	17-Oct-11	Zebu	F	38	110	38	18-Feb-12	124	38	25-Feb-12	131	38	01-Mar-12	136	38	08-Mar-12	143	40	15-Mar-12
6893	11-Oct-11	Zebu	F	42	116	43	18-Feb-12	130	44	25-Feb-12	137	44	01-Mar-12	142	43	08-Mar-12	149	44	15-Mar-12
6897	01-Oct-11	Zebu	F	39	126	40	18-Feb-12	140	40	25-Feb-12	147	43	01-Mar-12	152	45	08-Mar-12	159	45	15-Mar-12
6899	07-Oct-11	Zebu	F	32	120	32	18-Feb-12	134	32	25-Feb-12	141	36	01-Mar-12	146	35	08-Mar-12	153	35	15-Mar-12
6758	10-Nov-11	Zebu	F		86		18-Feb-12	100		25-Feb-12	107		01-Mar-12	112		08-Mar-12	119		15-Mar-12
6370	10-Dec-11	Zebu	F		56		18-Feb-12	70		25-Feb-12	77		01-Mar-12	82		08-Mar-12	89		15-Mar-12

6764	01-Oct-11	Zebu	F		126		18-Feb-12	140		25-Feb-12	147		01-Mar-12	152		08-Mar-12	159		15-Mar-12
6503	29-Jul-11	Zebu	M	67	190	63	18-Feb-12	204	63	25-Feb-12	211	65	01-Mar-12	216	65	08-Mar-12	223	67	15-Mar-12
6512	17-Sep-11	Zebu	M	61	140	63	18-Feb-12	154	65	25-Feb-12	161	65	01-Mar-12	166	67	08-Mar-12	173	69	15-Mar-12
6514	22-Aug-11	Zebu	M	43	166	44	18-Feb-12	180	45	25-Feb-12	187	46	01-Mar-12	192	47	08-Mar-12	199	48	15-Mar-12
6516	14-Sep-11	Zebu	M	41	143	43	18-Feb-12	157	44	25-Feb-12	164	42	01-Mar-12	169	44	08-Mar-12	176	45	15-Mar-12
6752	01-Oct-11	Zebu	M	25	126	27	18-Feb-12	140	29	25-Feb-12	147	37	01-Mar-12	152	36	08-Mar-12	159	36	15-Mar-12
6754	05-Oct-11	Zebu	M	39	122	39	18-Feb-12	136	39	25-Feb-12	143	41	01-Mar-12	148	43	08-Mar-12	155	44	15-Mar-12
6756	01-Oct-11	Zebu	M	44	126	44	18-Feb-12	140	44	25-Feb-12	147	45	01-Mar-12	152	46	08-Mar-12	159	46	15-Mar-12
6759	01-Oct-11	Zebu	M	0	126	46	18-Feb-12	140	46	25-Feb-12	147	47	01-Mar-12	152	48	08-Mar-12	159	49	15-Mar-12
6760	01-Oct-11	Zebu	M	32	126	32	18-Feb-12	140	32	25-Feb-12	147	27	01-Mar-12	152	27	08-Mar-12	159	28	15-Mar-12
6880	01-Nov-11	Zebu	M	42	95	42	18-Feb-12	109	41	25-Feb-12	116	42	01-Mar-12	121	41	08-Mar-12	128	43	15-Mar-12
6881	02-Nov-11	Zebu	M		94		18-Feb-12	108		25-Feb-12	115		01-Mar-12	120		08-Mar-12	127		15-Mar-12
6894	01-Oct-11	Zebu	M	39	126	41	18-Feb-12	140	42	25-Feb-12	147	39	01-Mar-12	152	41	08-Mar-12	159	42	15-Mar-12
6895	10-Oct-11	Zebu	M	39	117	38	18-Feb-12	131	38	25-Feb-12	138	44	01-Mar-12	143	45	08-Mar-12	150	45	15-Mar-12

6896	01-Oct-11	Zebu	M	46	126	46	18-Feb-12	140	47	25-Feb-12	147	44	01-Mar-12	152	45	08-Mar-12	159	46	15-Mar-12
6371	31-Dec-11	Zebu	M		35		18-Feb-12	49		25-Feb-12	56		01-Mar-12	61		08-Mar-12	68		15-Mar-12