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# Comparison of Contributions and Constraints in Rearing Small East African Zebu and Crosses with Tyrolean Grey Cattle in Uganda

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## Abstract

Low-income countries are concerned with increasing livestock productivity to improve income and food supply. This study aimed at determining contribution and constraints in rearing of Small East Africa Zebu (SEAZ) and Tyrolean Grey cattle crosses (TGZ).The potential of SEAZ and TGZ cattle have not been fully exploited. Tyrolean Grey cattle (TG) is indigenous to the alpine region of Austria, was introduced in Uganda in 2009. Cross sectional survey was carried out using 45 respondents comprising 37 farmers, three (03) artificial insemination technicians, three (03) extension workers, and two (02) farm managers in the Ugandan districts of Kole, Nakapiripirit and Kayunga. The findings of the study indicate that; TGZ significantly contributed to improved food security ($\chi 2=6.039$, $p<0.05$). TGZ performed better than the SEAZ in terms of heart girth according to age and sex. Constraints that are significantly associated with TGZ include; parasites and diseases ($\chi 2=7.967$, $p<0.05$), shortage of feeds and grazing land ($\chi 2=5.946$, $p<0.05$), shortage of water ($\chi 2=5.883$, $p<0.05$), high prices of veterinary drugs ($\chi 2=4.943$, $p<0.05$), theft ($\chi 2=5.385$, $p<0.05$), and lack of AI services ($\chi 2=13.507$, $p<0.001$). According to the respondents, there were no constraints significantly associated with SEAZ.

**Keywords:** Contributions, constraints, breeding, adaptation, Grazing

## 1. Introduction

The Small East African Zebu cattle (SEAZ) is a dual purpose indigenous cattle breed found mainly in the Eastern and Northern parts of Uganda (Acila et al., 2023). Although it is well adapted to harsh environmental conditions in areas where it exists *in situ* (Wurzinger *et al.*, 2014) typified by a prevalent low-input low-output production system. Its poor performance in terms of low meat and milk production, late maturity and small size are increasingly a concern to farmers who would like animals with higher productivity (Acila et al., 2023). To overcome these challenges, initiatives such as introduction of low-input but productive exotic cattle germplasm have been explored for those production systems.

Such germplasm introductions were embarked upon in 2009 when the Tyrolean Grey Cattle (TG) Breeders' Association (TGBA) donated 1000 doses of TG cattle semen to the National Animal Genetic Resources Centre and Databank (NAGRC&DB), the government agency mandated to spearhead livestock breeding in Uganda. A further donation of 1000 TG semen straws to the National Livestock Resources Research Institute (NaLIRRI), an institution under the National Agriculture Research Organization (NARO), and NAGRC&DB followed in 2015. TG semen was first used on the SEAZ cattle reared at Lusenke Stock Farm

in Kayunga District (Central Uganda) and among farmers in the neighborhood of the farm. This farm, owned by NAGRC&DB, is at the forefront of conserving SEAZ and one of its conservation strategies is to crossbreed the SEAZ with better performing breeds (Acila et al., 2023).

The Tyrolean Grey cattle is a dual purpose breed that originates from Austria and is used in typical mountain farming under rough conditions (Acila et al., 2023). They are among the few small bodied temperate breeds that could comfortably be used to cross with the small bodied SEAZ with no threat of dystocia (Acila et al., 2023). The SEAZ has over the years survived the introduction of exotic genetics that would have enabled it to achieve rapid progress in milk yields and daily growth performance like other temperate breeds (Acila et al., 2023). This study was designed to determine the contributions of the Small East African Zebu and crosses with Tyrolean Grey cattle. The study also assessed the constraints faced in rearing of the Small East African Zebu and crosses with Tyrolean Grey cattle.

## 2. Methods

This section provides a description of the study area, sampling techniques, methods of data collection, and methods of data analysis.

### 2.1 Description of the Study Area

The study was carried out in five districts of Uganda (Fig. 1) where the TGZ are reared. Akuyam parish in Nakapiripirit District. The coordinates are Longitude 34.7216° E Latitude 1.8503° N. It lies at 1,356-1,524m above sea level in a semi-arid area with temperature average of 30$^0$C per annum (Acila et al. 2023). Abeli in Kole district is at Longitude 32.6307E 32°38'3.458", Latitude 2.19564 N 2° 11'44.6316. It lies at 1061.8m above sea level, Longitude 32.7839 E 32°47"1.986", Latitude 2.21902, N 2° 13'8448. It lies at 1056.58m above sea level. Kayunga district is located in central Uganda, and the study there was conducted in Lusenke stock farm at a Latitude: 0.9822687 and Longitude: 32.9302079 (Acila et al., 2023).

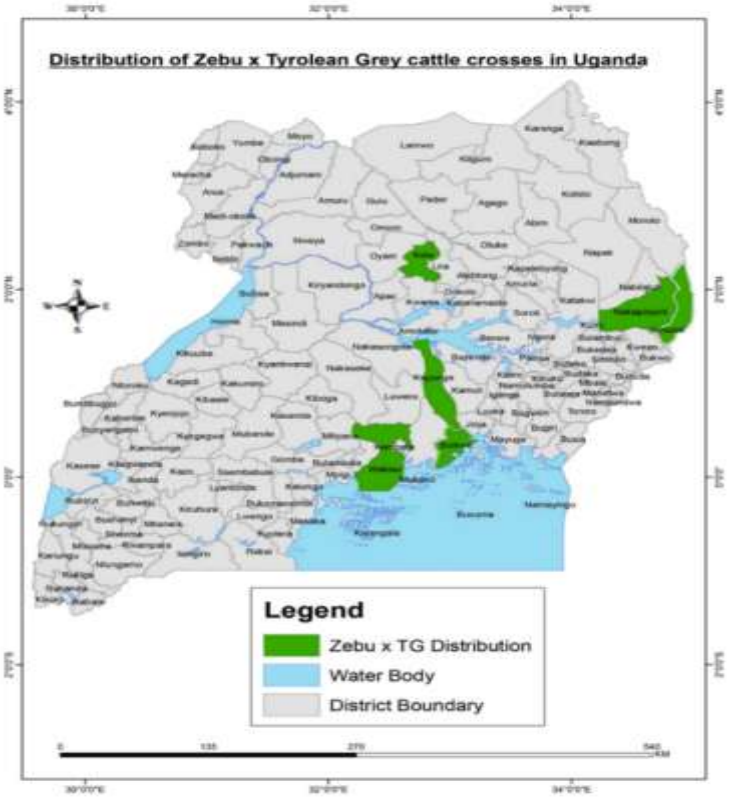



***Figure 1:*** *Map of Uganda showing the Study area (Acila et al., 2023)*

## 2.2 Sampling and Data Collection

This study adopted a cross sectional survey research design with qualitative and quantitative approaches to identify the contributions of SEAZ and TGZ to farmer's livelihood and assess the constraints associated with SEAZ and TGZ. Purposive sampling technique was used to identify and recruit all the 37 farmers rearing SEAZ and TGZ cattle, (03) artificial insemination (Al) Technicians, (03) extension workers, and (02) farm managers, totaling to 45 respondents. Primary data were collected from respondents by use of pre-tested semi-structured questionnaire, individual in-depth interviews, focus group discussion, and personal observation.

**Figure 2:** Tyrolean Grey cattle crosses and Small East African Zebu (Acila et al., 2023).

## 2.3 Data Analysis

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) for cleaning and eventual analysis. Descriptive statistics involved the use of percentages. The inferential tests employed the use of chi square, to test the association between the main study variables as well as to test the hypotheses. All tests were measured at 95% confidence interval.

## 3. Results and Discussion

### 3.1 Contribution of the Small East African Zebu and crosses with Tyrolean Grey cattle to farmer's livelihood

The test for relationship between breed and contribution to farmer's livelihood (Table 1) revealed that, the TGZ significantly contributed to improved food security ($\chi^2$=6.039, p<0.05). Milk production was the most important trait that farmers considered when selecting Breeds (Acila et al., 2023). This is probably because milk production for feeding the family and for generating cash income were the reasons for rearing the TGZ (Acila et al., 2023). Milk also represents an important part of small farmers' livelihoods, in particular in pastoral and agro-pastoral regions (Richard et al., 2019).

**Table 1:** Contributions of the Small East African Zebu and Tyrolean Grey cattle crosses to farmer's livelihood

| **Contribution of SEAZ and TGZ** | **SEAZ** | | | **TGZ** | | |
|---|---|---|---|---|---|---|
| | $\chi^2$ | df | Sig | $\chi^2$ | df | Sig |
| **Improved food security** | 1.748 | 1 | 0.186 | 6.039* | 1 | 0.014 |
| **Increased income** | 5.435 | 1 | 0.020 | 0.926 | 1 | 0.336 |
| **More manure** | 0.589 | 1 | 0.443 | 1.038 | 1 | 0.308 |
| **Employment** | 0.647 | 1 | 0.421 | 2.012 | 1 | 0.156 |
| **Social functions and cultural obligations** | 0.213 | 1 | 0.644 | 1.038 | 1 | 0.308 |

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

Indigenous livestock contribute to milk and meat supply, and represent an essential source of employment, income creation, and export earnings of many communities in rural areas in African countries (Behnke and Osman, 2016). Urbanization stimulates demand for Livestock Source Food since it involves improvements in infrastructure, which allow perishable goods to be traded more widely, as well as changes in food consumption patterns and habits (Happer and Wellesley, 2019). Livestock production improves farmers' incomes, especially in less endowed regions, contributing to their economic development and enabling them to access food, and therefore enhances their food security (Saxena et al., 2017).

Livestock are critical livelihoods for most rural households (Kaur et al., 2017). Although many high-income countries focus on the environmental impacts of livestock production, low-income countries are concerned with increasing livestock productivity to improve income and food supply and reduce high rates of childhood undernutrition and stunting (Tricarico et al., 2020). For example, recent research from southern Tanzania shows that heterogeneity in milk-producing households' economic organization, priorities, and capacities has significant implications for their ability and motivation to adopt dairy intensification technologies (Kihoro et al., 2021).

Livestock is valuable in sustainable agriculture by providing manure and labour for increased productivity and therefore enhancing the well-being and increased income of farmers in SSA (Mugumaarhahama et al., 2020). Indigenous livestock contribute to milk and meat supply, represent an essential source of employment, income creation, and export earnings of many communities in rural areas in African countries (Behnke and Osman, 2016). The importance of livestock in generating income for farmers has been reported in other studies in developing countries (Kugonza et al., 2012; Wendimu et al., 2018; Acila et al., 2023). They also have the ability to recycle nutrients and utilize marginal land and by-products and turn these inedible by-products into nutritious food for humans (Röös et al., 2017).

## 3.2 Grazing Methods Used in the Rearing of SEAZ and TGZ

From the results presented in (Figure 3), free-range system was common as reported by (81.6%) of the respondents, while (18.4%) of the farmers practiced rotational grazing.

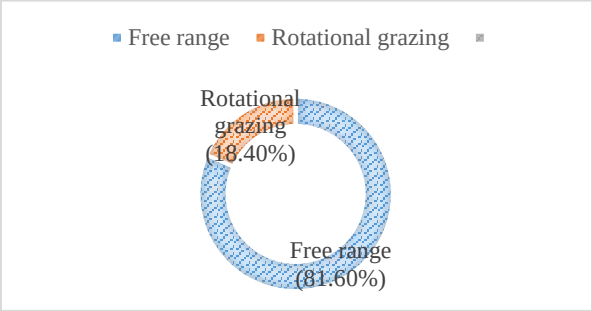



**Figure 3:** Grazing methods used in rearing of SEAZ and TGZ

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. Blindness due to eye damage caused during grazing was reported only in one of the arm. It has been observed that blindness usually occurs in grazing fields with a lot of overgrown spear grass or Brachiaria grass. The sharp endings of spear grass pierces eyes and some farmers claim that when Brachiaria grass seeds get into the eyes of animals, they cause blindness. Animals with TGZ genetics should not be grazed in such fields.

In the pastoral system, stock also graze in tall grasses, blindness was not reported. It seems this all depends on the type of grass in the grazing fields. Interventions like zero-grazing, moderate and rotational grazing can increase livestock productivity (Gebregergs et al., 2019). Feeding system by free-grazing constitutes a

source of diseases to animals, causing some crucial losses of the high reproductive performances through genetic erosion, reducing the adaptative values (loss of genetic diversity) and reducing the opportunities for efficient utilization (Agossou et al., 2017). Roschinsky *et al.* (2012), recommend introducing rotational grazing to allow more efficient pasture utilisation.

### 3.3 Breeding methods

The results in (Figure 4) 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.
The results on breeding methods are presented in Figure 4:

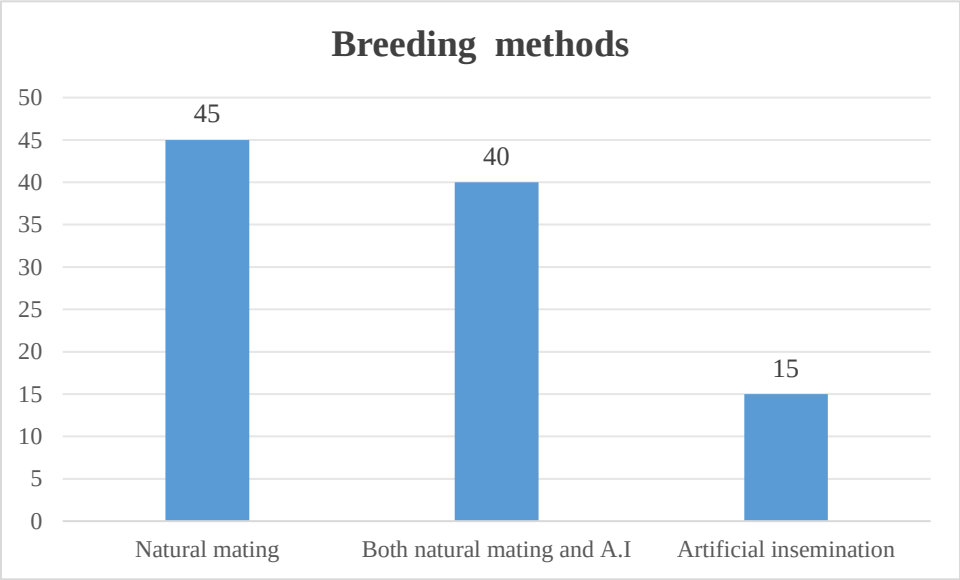



**Figure 4:** Breeding methods

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. Genetically superior animals are raised for meat and milk production using artificial insemination (Engidawork, 2018). 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).

However, some farmers reported use of artificial insemination alone and others cited use of natural mating and Artificial Insemination. Surprisingly, all the animals that were inseminated conceived. Introducing TGZ in the pastoral community was not an easy task as they had great fears for their animals dying during calving. They thought that calves got from crossing of SEAZ and TG would be too big for the SEAZ females to carry. Additionally, they were also not conversant with artificial insemination (AI), the breeding method used to introduce TG genetics into their herds. One calf died during calving, one TGZ bull was exchanged in the market for two SEAZ cows and another one was given away as bride price.

### 3.4 Sources of Information about the Cross-Breeding Programme

From the results in (Figure 5), 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.

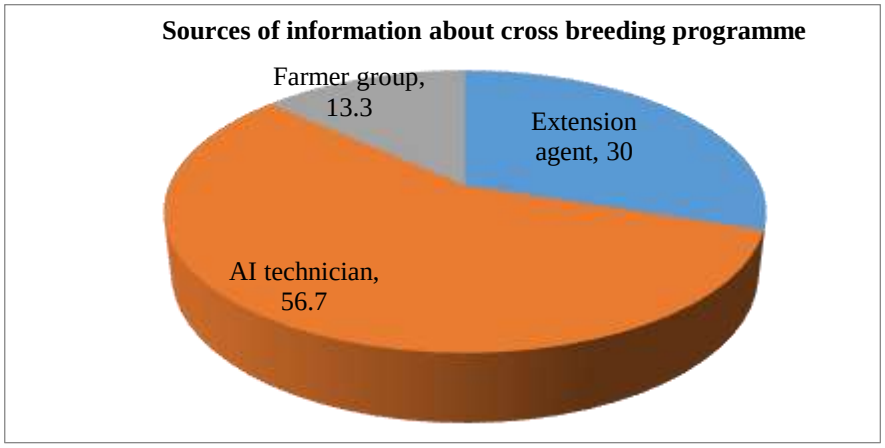



**Figure 5:** Sources of information about SEAZ and TGZ breeding programme

It was observed that farmers easily embrace new interventions as long as their leaders subscribe to them or are in agreement with them; so it is important to understand the cultural structure of the beneficiaries. Khalid et al. (2017) indicated that the information obtained directly from the project manager has a positive influence on technology adoption. Most of the technical personnel had very scanty information about the breed. For this group, written information could suffice. In the pastoral system, farmers did not in the first place understand artificial insemination; and secondly, they had no idea what sort of animal TGZ was. No pictures or video clips were shown to them; hence, the much resistance to inseminating their animals with TG semen. In one of the farms, the herdsmen thought the two TGZ products on the farm were a big type of SEAZ, but were wondering how they could produce far more milk than the other SEAZ.

### 3.5 Heart girth measurements across age groups of SEAZ and TGZ

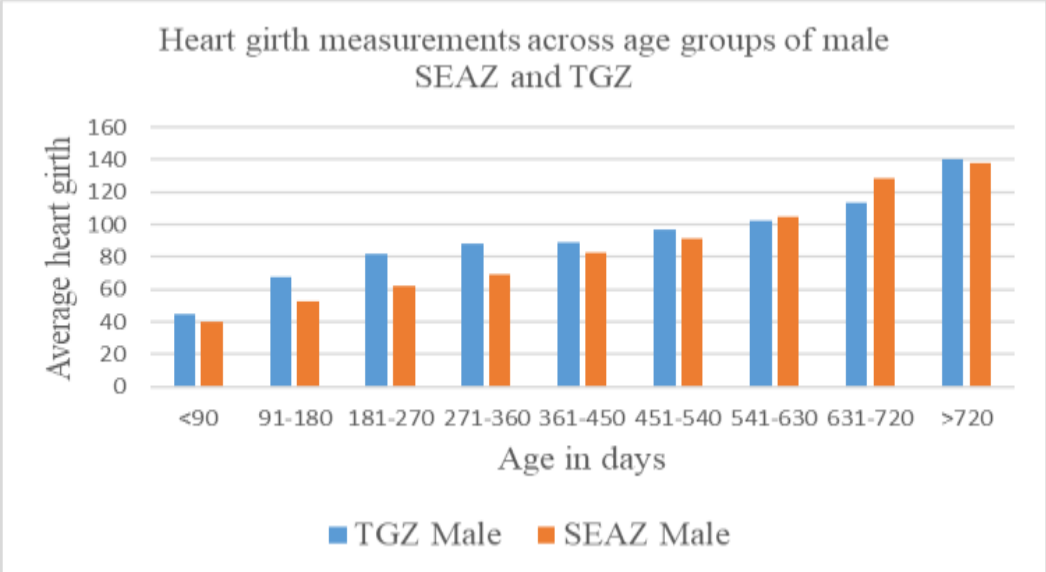
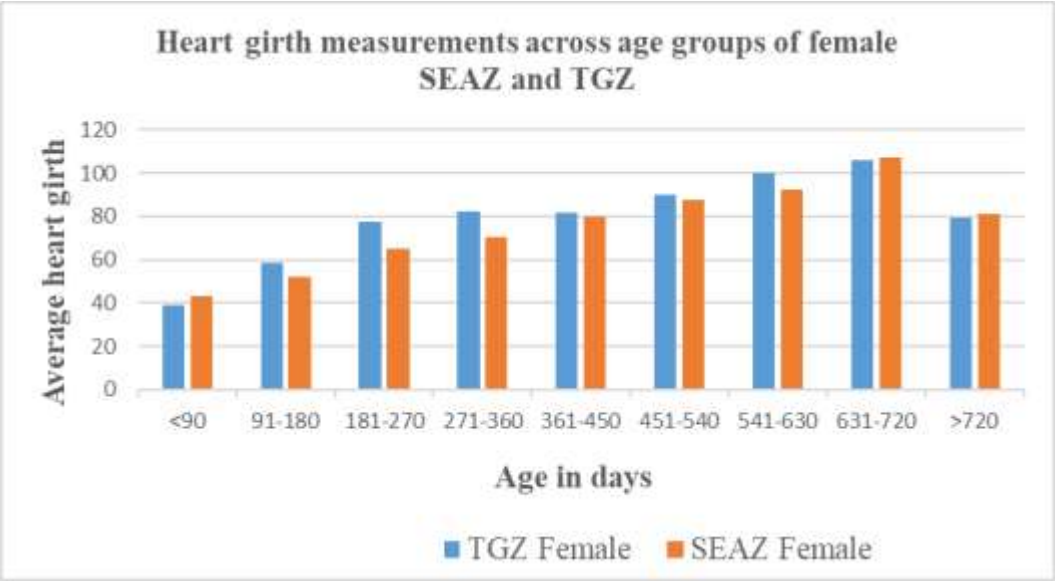



**Figure 6:** Heart girth measurements across age groups of SEAZ and TGZ

The results from (Figure 6) revealed that; the average hearth girth of the TGZ was higher than that of the SEAZ for all the other different age categories. In comparison with the SEAZ, the male TGZ presented higher heart girth on average 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 TGZ.This could have been during drought, since TGZ 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. In general, TGZ had higher heart girth measurements than SEAZ across age groups and sex. 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.




From (Figure 7) the finding indicate that; female TGZ had higher heart girth measurements in comparison to female SEAZ across six age categories except for categories; <90; 631-720; and >720. Overall, the TGZ had a higher heart girth on average compared to the SEAZ. This could be explained by the fact that, TGZ had great potential for growth intensity traits and have high feed conversion efficiency. The SEAZ had low genetic potential. 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). Overall, the TGZ had a higher heart girth on average compared to the SEAZ. This could be explained by the fact that, TGZ had great potential for growth intensity traits and have high feed conversion efficiency. The SEAZ had low genetic potential. TGZ performed better than the SEAZ in terms of heart girth according to age and sex.

### 3.6 Constraints in rearing of SEAZ and TGZ

The results below revealed that, TGZ were majorly and significantly constrained by parasites and diseases ($\chi^2$=7.967, p<0.05), shortage of feeds and grazing land ($\chi^2$=5.946, p<0.05), shortage of water ($\chi^2$=5.883, p<0.05), high prices of veterinary drugs ($\chi^2$=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). Despite the huge number of livestock, productivity remained very low to meet the expected demand due to several challenges, that limit productivity, the most stated constraints are; feed shortage, high prevalence of diseases and parasites, low genetic potential of indigenous breeds, limited or lack of access to artificial insemination (AI) services, inadequate veterinary services, lack of access to credit, poor market infrastructures, water shortage, land scarcity, and poor management practices across all production systems (Selamawit et al., 2017; Welay et al., 2018).

**Table 2:** Constraints in rearing of Small East African Zebu and Tyrolean Grey cattle crosses

| Constraints in rearing SEAZ and TGZ | SEAZ and TGZ | | Chi square test | | |
|---|---|---|---|---|---|
| | SEAZ | TGZ | $\chi^2$ | df | Sig. |
| **Parasites and diseases** | 28(62.2) | 40(90.9) | 7.967** | 1 | 0.005 |
| **Shortage of feeds and grazing land** | 25(55.6) | 25(56.8) | 5.946* | 1 | 0.015 |
| **Shortage of water** | 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** | 21(46.7) | 36(81.8) | 4.943* | 1 | 0.026 |
| **Cattle theft** | 20 (44.4) | 22 (50.0) | 5.385* | 1 | 0.020 |
| **Lack of AI services** | 25(55.6) | 23(52.3) | 13.507** | 1 | 0.000 |

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

Slow recovery of animals from disease. It was reported that recovery of TGZ from disease is slower than that of SEAZ; hence, for any disease treatment of TGZ, supplementation of feed with immune boosters during the recovery period should be considered imperative. Indigenous cattle genetic resources are usually resistant to some parasites, disease infections and environmental stress in their natural habitats (Nyamushamba et al., 2017). Therefore, an animal showing resistance to ticks and diseases becomes more profitable to the low-input production system (Acila et al., 2023).

In the pastoral production system, farmers termed "TGZ 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 crosses. Frequent disease outbreaks, inadequate veterinary care and water shortages have also been cited as reasons for the declining trend (Duguma, 2020). In the mixed crop-livestock production systems, feed is one of the major constraints affecting smallholder cattle production (Njarui et al., 2021).

In indigenous African cattle production systems, herd performance generally remains low due to lack of feed, health, or environmental constraints (Wilson, 2018). Due to its rain-dependent nature of production, feed availability and quality vary with agro-ecological conditions and the season of the year (Kashongwe et al., 2017). Seasonal feed availability and quality variations affect the production and reproduction performance of livestock (Kashongwe et al., 2017a), and low availability and quality of feed lead to reduced feed intake and affected performance when their nutritional requirements are higher than the nutrient intake from feeds. For instance, crop residues are the most available during crop harvesting season (Anyango et al., 2018; Gakige et al., 2020; Mwendia et al., 2017). Bekele et al. (2016) reported that feed shortage, disease prevalence, lack of improved breeds, lack of market access and lack of water during the dry season were among the challenges in cattle production.

Similar to South-Kivu province, livestock feeding and husbandry in Babati (Tanzania) were reported to be mainly extensive, with relatively large herds of local cattle, few improved breeds, daytime grazing, little purchased feed, feeding on crop residues and low productivity (Paul et al., 2020). The use of grazing lands for crop cultivation due to population growth and an increase in livestock are other reasons contributing to the feed shortage in Ethiopia (Bekele et al., 2016; Benti et al., 2021). Increasing population growth also reduced the land available for pasture development (Zoma-Traoré et al., 2020). On the other hand, in Uganda, Kiggundu et al. (2014) reported that the extreme dependence of farmers on grazing land with limited strategies for fodder conservation and supplementation is a factor in feed shortages. Indigenous dairy cattle breeds which belong to the *Bos indicus* genetic group are adapted to the harsh, hot and humid

tropical weather conditions (Nuraddis and Ahmed, 2017) and perform reasonably well under limited feed resources.

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. Kantanen et al.; (2015) noted that, this is a widespread consequence of the need to increase productivity, although it is latently accompanied with narrowing of within-breed genetic variation. Regions where this practice was previously promoted have reported loss of genetic variation (Kantanen et al., 2015).Several authors allude to the fact that at a higher level of cross-bred cattle, local animal genetic resources are lost (Udo et al., 2011; Galukande et al., 2013).

A farmer cited losing TGZ due to cattle raiding. This could have been because the TGZ are new breed that had been introduced in Uganda and, has high genetic potential than the SEAZ. The characterization of the smallholders' cattle production systems will contribute to better understanding of their current situation, the constraints they face and the opportunities they offer, and highlight potential hotspots for productivity improvements (Mugumaarhahama et al., 2020). For the reasons described above, achieving socioeconomic sustainability in the livestock sector in the developing countries must require a proper understanding of the roles and challenges with livestock production in developing countries (Adesogan et al., 2020).

### 3.7 Prevalence of Ticks

The results in (Figure 8) 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.

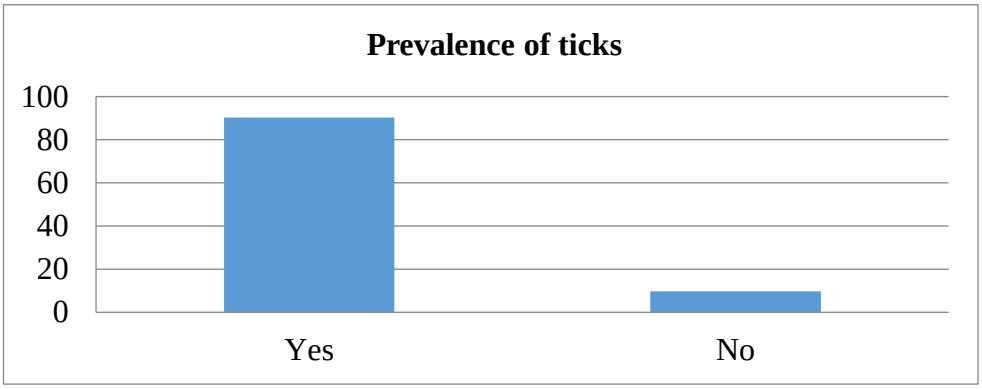



**Figure 8:** Prevalence of ticks

Although a number of farmers thought that TGZ calves survived better than SEAZ, it is probably because they give them more care and attention. Farmers should be encouraged to carry out disease and parasites control. Consequential health promoting practices should be encouraged among farmers. For example, regular tick control (spraying, dipping or pour-on) and deworming. Tick-borne diseases like East Coast Fever are a great menace to stock in the region. Pastoralists have limited access to animal health services and in most cases; animals are only vaccinated during governments' vaccination campaign (FAO, 2019).

### 3.8 Adaptation Problem of Tyrolean Grey Cattle Crosses

The results in (Figure 9) indicate that, a greater proportion of the respondents (52.6%) reported no adaptation problem with TGZ, while (47.4%) of the respondents reported adaptation problems.

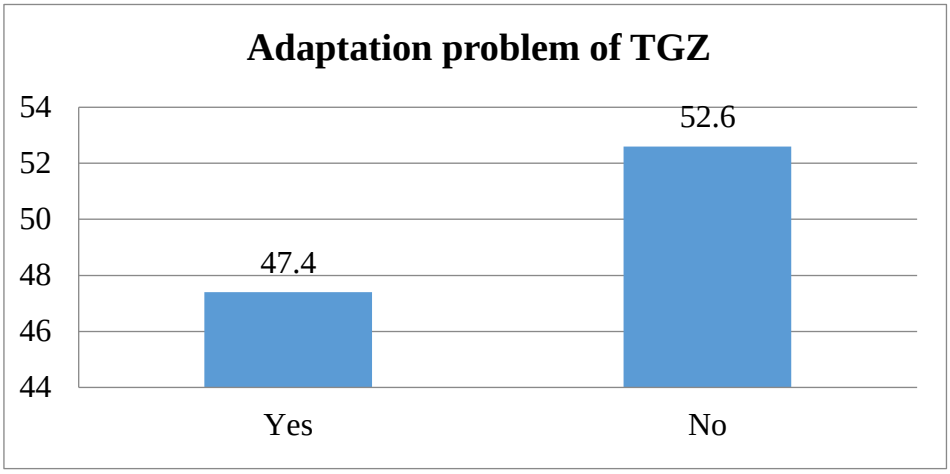



**Figure 9:** Adaptation problem of TGZ

Heat stress intolerance, although TGZ have adapted relatively well to the environment, they should be availed shades to shield them against strong sunlight. In the pastoral type of production system, TGZ are herded with calves near homesteads because they cannot move for long distances in the hot tropical sunlight unlike SEAZ. Failure to adapt would restrict their ability to produce the quantities of food demanded by the rising populations (Bosire et al., 2019). The *Bostaurus* 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 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 remain popular in Uganda because of their adaptive traits to the local underprivileged conditions. Traditional management practices, different landscapes, socio-cultural needs and endemic disease challenges have over time enhanced indigenous cattle breed adaptation to their localities (Acila et al.,2023).

## 4. Conclusion and Recommendation

Based on the findings of the study, the TGZ significantly contributed to improved food security. There was a significant difference in heart girth across age groups between SEAZ and TGZ.The TGZ performed better than the SEAZ in terms of heart girth according to age and sex. It was observed that farmers easily embrace new interventions as long as their leaders subscribe to them or are in agreement with them, so it is important to understand the cultural structure of the beneficiaries. In the pastoral type of production system, TGZ were herded with calves near homesteads because they cannot move for long distances in the hot tropical sunlight unlike SEAZ. This study recommends mitigation of heat stress intolerance, although TGZ have adapted relatively well to the environment, they should be availed shades to shield them against strong sunlight. Consequential health promoting practices should be encouraged among farmers. For example, regular tick control by spraying or dipping, and deworming. Proper sensitization of stakeholders, farmers, herdsmen, farm managers and civic leaders, sensitization should start first with the civic and technical personnel of the locality where the breed is to be introduced.

## 5. Acknowledgement

Fund for this study was a grant awarded to the first author by the Tyrolean Grey Cattle Breeders' Association of Austria. The facilities and permission provided by the collaborating institutions as well as the information by the respondents are acknowledged.

## 6. Data Availability

All the data used are presented in the manuscript. Any additional information needed can be obtained from the corresponding author upon a reasonable request.

## 7. Conflict of Interest

Authors do not have any conflict of interest.

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