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Improvement and diversification of Burundi goat trade and marketing : towards a formalized grading system in Burundi.

Bigirimana, Didace

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UNIVERSITY OF BURUNDI

Improvement and diversification of Burundi goat trade and marketing: Towards a Formalized grading system in Burundi.

FACULTY OF ECONOMICS AND MANAGEMENT SCIENCES

Department of Rural, Social and Environment Economy

IMPROVEMENT AND DIVERSIFICATION OF BURUNDI GOAT TRADE AND MARKETING: TOWARDS A FORMALIZED GRADING SYSTEM IN BURUNDI.

By :

BIGIRIMANA Didace

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE AWARD OF MASTER OF SCIENCE IN RURAL, SOCIAL AND ENVIRONMENT ECONOMY OF UNIVERSITY OF BURUNDI.

Specialty of Rural Economy and Agri-Food Companies

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Bujumbura, September 2020

DEDICATION

To Almighty God,

To our parents,

To all our brothers and sisters,

To all our friends,

To all our knowledge.

I dedicate this work.

ACKNOWLEDGEMENTS

First of all, I would like to thank the almighty God for providing a healthy life, bringing me up to this stage and blessing my family and Burundi. This thesis is the result of the efforts of many people without whom this work could not have been done. The contributions are different from one person to another and the value of this thesis depends on it enormously. I am very grateful for the interest, the patience and the generosity with time and the information that they have all provided.

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In addition, I thank all administrative staff of IITA- Burundi and Institut des Sciences Agronomiques du Burundi (ISABU) scientists for their support in carrying out this work, especially Engineer Déo Nzisabira who helped me to develop the survey questionnaire, organize data collection and edit the dissertation manuscript. Lastly my deep appreciation goes to the farmers and goat traders in Buganda and to the communal tax collectors for their cooperation during the entire period of data collection. To anyone who has contributed in any way to the making of this thesis, I say thank you.

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BCS	Body condition score
CLiP	Crop and Livestock integration Project
DPEAE	Direction Provinciale de l'Environnement, l'Agriculture et de l'Elevage
DRC	Democratic Republic of Congo
EC	European Commission
ECVMB	Enquête sur les Conditions de Vie des Ménages au Burundi
ENAB	Enquête Nationale Agricole du Burundi
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
ISABU	Institut des Sciences Agronomiques du Burundi
ISTEEBU	Institut de statistiques et d'études économiques du Burundi
KWH	Kruskal Wallis H-test
MINEAGRIE	Ministère de l'Environnement, de l'Agriculture et de l'Elevage
MIS	Market Information System
MSA	Meat Standards Australia
MWU	Mann Whitney U-test
PND	Plan National pour le Développement
USDA	United States Department of Agriculture

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RESUME

Le commerce des chèvres au Burundi utilise des méthodes de négociation des prix basées sur une évaluation qualitative du bétail. Le marché de la chèvre de Buganda attire une grande foule d'acteurs de la chaîne de valeur mais n'utilise pas un système de classement officiel. L'absence de ce système crée une asymétrie de l'information et à la subjectivité des transactions.

Ce travail permet d'analyser la possibilité de l'introduction de la classification des animaux, et documenter les informations relatives au commerce rural de la chèvre au Burundi comme une étape vers l'amélioration du système de tarification informel existant dans le pays. Pour atteindre cet objectif, un échantillonnage de 74 chèvres, 74 éleveurs et 74 commerçants a été utilisé comme matériels d'étude et des données transversales ont été collectées pour la période mars-juin 2020.

Les résultats de l'étude montrent qu'il y a une corrélation positive entre prix et le poids vif (80%), le cinquième quartier et la longueur du corps (79%), le poids de la carcasse (76%) et la profondeur de la poitrine (62%). Par ailleurs, une chèvre de moins de 48 mois a la capacité d'augmenter son prix de 15 128,46 BIF qu'une chèvre de plus de 48 mois. Une chèvre femelle a une probabilité d'augmenter ses gains de 13 381,52 FIB par rapport à un mâle ; la taille de la poitrine augmente le prix de 832,99 FIB par centimètre et une unité (kg) de poids vif conduit à une augmentation de 3 179,54 FIB par bétail. Cependant, à partir du classement que nous avons fait, une chèvre ayant été notée "très bon" pour la longe par le classeur des animaux gagne 21 370,19 FIB de plus qu'une chèvre notée "bien" ; 35 286,17 FIB de plus qu'une chèvre notée « moyenne » ; 40 560,81 FIB de plus qu'une chèvre notée « médiocre » ; et 47 532,85 FIB de plus qu'une chèvre notée « très médiocre ».

Pour réduire l'asymétrie de l'information entre les vendeurs et les acheteurs des chèvres, nous suggérons l'introduction d'un système de classement prenant en compte des facteurs tels que l'âge, le sexe, le poids vif et la condition corporelle, et la proposition des prix pour chaque catégorie.

Mots-clés : Système de classement, Prix, Condition corporelle, Mesures corporelles

ABSTRACT

Goat trade in Burundi uses price negotiation methods that are based on qualitative assessment of livestock. The Buganda livestock market attracts a large crowd of value chain actors but it

does not use an official grading system. The absence of that system creates asymmetric information and to the subjectivity of transactions.

This work was carried out to investigate the feasibility of introducing live grading and document related information for Burundi's rural goat trade as a step towards improving the existing informal pricing system used in the country. To achieve this objective, a sampling was used to select 74 goats, 74 famers and 74 traders to use as the study information and cross-sectional data were collected for period of two months (March-June 2020).

The results of the study show that there is a positive correlation between price and live weight (80%), fifth quarter and body length (79%), carcass weight (76%), and chest depth (62%). On the other hand, a less than 48 months old goat has the capacity to increase its price by BIF 15,128.46 than a goat older than 48 months. A female goat has a probability of increasing his earnings of 13,381.52 FIB compared to a male; size of chest depth increase price by 832.99 FIB per centimeter and one unit (kg) of live weight leads to increase 3,179.54 FIB per livestock.

However, from the livestock grading that we made, a goat with "very good" score for loin earns 21,370.19 FIB more than a goat scored "good"; 35,286.17 FIB more than a goat scored "medium"; 40,560.81 FIB higher than a goat scored "poor"; and 47,532.85 FIB than a goat scored "very poor".

To reduce the asymmetric information between sellers and buyers of goats, we suggest the introduction of a grading system that take into account factors such as age, sex, live weight and body condition, and the price proposal for each category.

Key words: Grading system, Price, Body condition, body measurements

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CHAPTER 1. INTRODUCTION

1.1. Background Information

Livestock contributes significantly to the economies of countries in sub-Saharan Africa. Livestock systems represent a potential pathway out of poverty for many smallholders in the developing world. Approximately 70% of the world's rural households derive their livelihoods from agriculture through integrated crop and livestock subsistence farming (FAO 2009; World Bank 2008). Goat farming occupies a large place in developing countries and in 1981, 96% of the world total of goats was in these countries (Jansen & Burg, 2004). The economic importance of goats in Africa and especially for the most disadvantaged populations is often underestimated (Sawadogo, 2012). In 2016, 33.7% of the total goat population was in Africa, i.e. 388 million out of the 1,003 million existing in the world (FAO, 2018).

Beyond the supply of products necessary for humans, livestock fulfills several functions. It was estimated in 2014 that around 1.3 billion people worldwide are employed in different livestock product value chains worldwide (Herrero, et al. 2014). The majority of the world's rural poor, and a significant proportion of the urban poor, keep livestock and use them in a variety of ways that extend far beyond income generation (Ruhangawebare, 2010). In addition to food and income, it provides social security / insurance and serves as mobile banks, wealth accumulation, and social esteem (Davie et al., 2007; Ruhangawebare, 2010).

Burundi's economy is mainly rural and relies heavily on the agricultural sector. The National Development Plan (PND 2018-2027) reveals that agriculture contributes 39.6% to the Gross Domestic Product (GDP) and provides 84% of jobs. Agriculture is practiced in conjunction with animal husbandry. The National survey on living conditions of Burundi households (ECVMB, 2014) shows that the rate of monetary poverty in 2014 was 64.6% of the total population.

In Burundi, livestock is essentially of the traditional type and it's mainly composed of cattle, goats, and poultry. Goat farming is widespread in Burundi, especially among the poor. In 2018, the Burundi Institute of Statistics and Economic Studies (ISTEEBU) estimated that the country had nearly 3.3 million head of goats and that 41% of households in the country keep at least one goat (ENAB, 2017-2018). Goat is mainly kept for meat and organic manure.

Livestock marketing in Africa is characterized by the use of an indigenous animal grading system that is based on levels of important traits including age (adults vs young), conformation (excellent, good, and fair), body condition (fat, normal, and thin), and sex. Grades are the

defined parameters that segregate similar products into homogenous groups and clearly describe them using consistent terminology that can be commonly understood and applied by market participants (Farina and Reardon. 2000; Giovannucci and Reardon 2000). They are the specific systems of classifications that uniformly and consistently identify both the quantifiable and qualifiable attributes of a product (Jones and Hill 1994). These attributes (or traits) are more often than not indicators of product quality.

Grades convey not only valuable information about the products, but also facilitate price determination, thereby assisting in defining contracts for delivery. The system improves the efficiency of markets and helps to make them more transparent. Grading also serves to differentiate and segment the market into niches, providing a valuable impetus to the development of quality. It also contributes to the development of domestic markets by distinguishing superior quality levels and rewarding them with higher prices (Friend et al. 2000; Giovannucci and Reardon 2000).

In Burundi, goat trade is based on conformation (excellent, good, poor), body condition (fat, normal, and thin), sex and purpose for which the goat is required (breeding vs slaughter). The current study was conducted in order to improve the efficiency of goat markets and helps goats' sellers and buyers to interact in transparency.

One can understand the importance of goat trade in the Burundian economy by considering the large crowds that visit goat markets on market days and the amount of cash transacted during sales. A large proportion of the population participates at goat markets. Goat trade contributes significantly to the Burundi's gross domestic product (GDP). Development of markets provides the necessary incentive for farmers to invest in goat production, thereby achieve higher production volumes (Homann, et al., 2007).

Goats provide livelihoods for millions of resource-poor smallholder farmers in Burundi and, if properly instituted, goat trade would help to combat food insecurity. However, the marketing and processing of goats and their by-products is poorly developed in many developing countries, severely constraining the 'market-orientated 'farmer.

1.2. Problems statement and justification

Goat trade in Burundi, as in many other countries in sub-Saharan Africa, uses price negotiation methods that are based on qualitative assessment of livestock (body conformation, body condition, and sex). These methods are subjective and can lead to errors in quantifying the fair value of a product.

The Buganda livestock market in Cibitoke Province attracts a large crowd of value chain actors (producers, traders and consumers) but it does not use an official grading system. Available literatures reveal that presence of a formalized grading system confers benefits (e.g. dissemination of market information and rewarding quality) to actors (Giovannucci & Reardon, 2000; Mugunieri et al., 2008; and Sebside, 2008).

The absence of an official grading system exposes producers to high price variability and poor advice on market trends. It also prevents producers from entering the livestock market and encourages the multiplication of middlemen along the value chain.

Gazetting a goat grading system in Burundi will promote goat production, marketing and distribution. If the grading system is similar in aspects to neighboring countries, this can promote cross-border trade. Harmonization of a livestock grading system is widely used in international trade to stabilize market prices (Mugunieri et al. 2008). For example, the quality grading system of the United States Department of Agriculture (USDA) (Lusk & al., 2001) and that of the Meat Standards Australia (MSA) are similar (Legrand & al., 2017).

Despite the significance of the goat trade in enhancing food security in Burundi, there are a number of constraints livestock that farmers are facing. Livestock farmers are faced with inadequate marketing information, especially on prices, poorly developed marketing infrastructure, weak institutional, legal and regulatory framework and inadequate access to financial services for livestock rearing activities. Therefore, a formalized standardization system is necessary to inform production and to segregate product prices based on the defined standards as well as to stabilize prices on the market. Thereby, buyers and sellers will be sure of the supply and demand of the market.

This study is designed to address the prevailing information gap on the subject, contribute to proper understanding of grading systems on livestock markets, provide information and to improve the goat marketing to the benefit of small farmers, traders, consumers and other market participants.

This study will provide a basis for policy makers to improve marketing and ultimately production of goats. This research will also serve as a reference for researchers to embark on similar or related work in other markets of the country.

1.3. Research questions

The research questions that the work will answer are the following:

1. What is the prevail goat grading system in Burundi's rural livestock markets?
2. What will be the key components of an appropriate grading system?
3. What would be the relationship between the grading system and price?
4. What trading conditions would need to change for the proposed grading system to function optimally in real market environment?

1.4. Objective of the Study

1.4.1. Overall objective

The overall objective of this study is to assess the feasibility of introducing live grading and to document related information for Burundi's rural goat trade as a step towards improving the existing informal pricing system used in the country.

1.4.2. Specific objectives

1. Describe the prevail goat grading system in Burundi's rural livestock markets?
2. Evaluating the relationship between the grading system and price;
3. Analyzing and documenting the rationale behind the identified grading system;
4. Ascertain the validity of the grading system in real market environment.

1.5. Hypothesis

To respond to our objective, the study uses the following hypothesis:

- **H_{01}**: There is no difference in price according to the body condition, live weights and body measurements (withers height, body length, chest dept, heart girth) of the goat on Buganda goat market.
- **H_{03}**: The factors age, sex, live weight, chest depth, loin do not determine price of goat at the market.
- **H_{03}:** There is no statistically difference significance between price and different grade of loin for goat.

1.6. Significance of the Study

The study covers the goat trade in Burundi and describes the system for assessing the quality of goats on the market. It documents the existing marketing channels and the activities of the different market actors along the value chain.

The study also compares the indigenous system for assessing the quality of goats with the so-called standard classification system initiated together with market actors. This could be a major input in establishing an appropriate grading system according to the specificities of the goats marketed on the Buganda market.

1.7. Organization of the Study

This study is organized into five chapters. The first chapter provides a general background to the study, problem statement, study objectives and research questions. The second chapter gives a review of the literatures on marketing analysis from different sources while the third chapter covers methodologies used in this study, in line with description of the study area. The fourth chapter deals with the results and discussions of the findings, while conclusion and recommendations are presented in the fifth chapter.

CHAPTER 2. LITERATURE REVIEW

2.0. Introduction

This chapter compares the information published on goat marketing over a certain period and situate the research within the existing knowledge. This literature review section also makes it possible to develop a theoretical framework and an effective research methodology by showing how it addresses the gap and contributes to the improvement of knowledge on research problem and question. In this chapter, the researcher provides an overview of the theory on the grading system of animals, its advantages, and the theory on statistical tools used for the evaluation of the existing relationship between the variables used in this study.

2.1. Theoretical Perspectives on Key Concepts

2.1.1. Market

A market is a real or fictitious place of exchange. Traditionally, market can be defined as a specific geographical area where buyers and sellers meet for exchange of goods and services (Zeberga, 2010). Abbott and Makeham (1990) define "a market" as an area in which one or more sellers by giving products/services and their close substitutes exchange with and compete for the patronage of a group of buyers.

In the market, there are economic agents who offer a good / service and others who come to get it. This therefore creates a network of exchanges. These exchanges can be done in a physical place, with direct contacts (Sunday market for example) or in a fictitious (or virtual) way, the contact then not being direct (financial markets or internet sales).

For Lemercier & Zalc. (2012), the market is a place of price formation allowing to obtain an equilibrium. Kotler (2002) define market as a place or sphere within which price-making force operates and in which exchanges of title tend to be accompanied by the actual movement of the goods affected.

2.1.2. Price theory

The theory of price is an economic theory that states that the price for any specific good or service is based on the relationship between its supply and demand. The theory of price studies how prices are decided and how they increase and decrease due to economic forces such as changes in supply and demand. Price theory is defined as a price which is applied in partial equilibrium.

The prices revealed by the game of market exchanges and competition between producers,

carried within them all the information essential to the deployment of the supposed virtues of this form of economic organization, without a central authority, state or not, doesn't have to mingle in it, notably by producing statistical information (Desrosières, 2003).

Price plays a very important role in the economic system due to its multiples functions and any reform on a market must necessarily be based on the price system. Price allows making shopping decisions, encourage market participation and producers to produce more goods. Increased incentive for producers to supply goods leads to an increase in choice; allows consumers to choose from a large number of products and price telling producers which goods consumers will buy, therefore allows producers to anticipate the desired quality.

The price system relying on information spurs competition and efficiency. Unlike competitive markets, agricultural markets have their own specificities and constraints. Fluctuations in prices are a natural feature in commodity markets because market demand meets supply under market compensation conditions (Piot-Lepetit and M'Barek, 2011). Storage is considered to be an essential instrument for smoothing price fluctuations (Vercammen, 2012). Piot-Lepetit and M'Barek show that stored products influence market supply and demand by lowering purchase prices, increasing selling prices and promoting market compensation.

The price stimulates production, allows a better allocation of income/benefits between different market actors, and is also the key element for food security especially for the two first pillars (Availability and Accessibility of food).

2.1.3. Defining of grades

Grades are the defined parameters that segregate similar products into homogenous groups and clearly describe them using consistent terminology that can be commonly understood and applied by market participants (Giovannucci & Reardon 2000). Price is the essential element of the market and any market reform must be based on price formation. Where the market process is based on barter and exchange, visual inspection can assess the physical and biological state of the commodity (Jones & Hill, 1994).

Grades comprise one of these sets of rules that provide the guidelines for information signals in the market. Jones & Hill (1994) also added that the grades are used to classify products with respect to selected characteristics deemed economically or aesthetically important in markets in which personal selection are neither physically nor economically feasible.

The problem here is to determine the factors to include in the official grades which in turn affect quality via discounts and premia.

2.1.4. Body Condition Scores (BCS)

Every goat producer has animals that are either too thin or too fat. Body condition score (BCS) has been shown to be an important practical tool in assessing the body condition of goats because BCS is the best simple indicator of available fat reserves (Rauri Alcock & al. 2015, Villaquiran, et al. 2004). Scoring is performed in goats using a BCS ranging from one to five. A BCS of 1.0 is an extremely thin goat with no fat reserves and a BCS of 5.0 is a very over-conditioned (obese) goat.

It is important to note that BCS cannot be assigned by simply looking at an animal. Instead, the animal must be touched and felt (Villaquiran, et al. 2004). The first body area to feel in determining BCS is the lumbar area, which is the area of the back behind the ribs containing the loin. Scoring in this area is based on determining the amount of muscle and fat over and around the vertebrae. Lumbar vertebrae have a vertical protrusion and two horizontal protrusions. Both processes are used in determining BCS. The grader should run your hand over this area and try to grasp these processes with your fingertips and hand. The second body area to feel is the fat covering on the sternum. Scoring in this area is based upon the amount of fat that can be pinched. A third area is the rib cage and fat cover on the ribs and intercostal spaces (Villaquiran, et al. 2004).

2.2. Review on Empirical Studies

2.2.1. Advantages of grading

The grading system is very important for improvement of goat marketing and production. Sebside (2008) explains that in the presence of this system, producers can receive a premium for animals producing high quality meat; no time is wasted by bargaining, thus consumers tend to buy graded animals for a fixed price; reduces purchasing risks, consumers benefit by paying a fixed price for a specified grade; and provides a quick, cheap and easy method of comparing individual animals under differing management system, seasons or environments.

For Giovannucci & Reardon, (2000), a common system and terminology have several benefits such as improved incentives for quality and safety; make market information meaningful, facilitate price/quality comparisons and reduce the risk of deception and fraudulent marketing.

Grades also enable diverse market mechanisms such as future's trading commodity exchanges, inventory credits or warehouse receipts schemes, and letters of credits facilitate resolution of dispute regarding quality and/or composition of shipped producers (Giovannucci & Reardon, 2000).

In developing countries like Burundi, farmers are not always familiar with the goat market and the grading system could help farmers to determine prices even if they do not frequent goat markets. It is the transparency of the market, especially access to information relating to the price and quality of livestock that will help farmers to effectively participate in the market. However, in the absence of such baseline information, it may be difficult to achieve certain improvements in the sector in terms of livestock trade or production.

2.2.2. Factors affecting meat quality

There are several factors that affect the meat quality of goat at slaughter. Meat quality can be defined strictly in terms of its physical biological and chemical properties, or in terms of consumers' perceptions (Casey & Webb, 2010). The most interesting factors are age, sex, breeder weight (live and carcass) and body condition according to the different authors. Meat quality changes markedly with the animal's age or weight at slaughter. Hence, appropriate slaughter weights should be identified for various breeds to get better dressing percentage, meatiness and quality (Sebsibe, 2008).

Meat quality differences between sexes of animals are not fully understood, but is believed to be caused by differing levels of sex hormones circulating in the blood (Sebsibe,2008; Casey & Webb, 2010). Castrated males have meat that tends to be relatively darker and larger than that of females of similar age. Fat content is higher in castrated compared to intact kids (Abdullah & Musallam, 2007). The study by Todaro, & al., (2004)," shows that male kids are heavier at birth than females, and this disparity remained for the final live weight, slaughter weight, empty body weight and carcass weight.

2.2.3. Factors affecting carcass composition

Carcass and meat quality are the selling points that should be guaranteed through grading or classification systems, or certified production systems (Casey & Webb, 2010). Carcass weight is a main factor affecting the composition of the carcass and is closely related to age at slaughter. As animals mature, they normally gain weight resulting in a heavier carcass. Much of the weight gain of a mature animal is fat rather than muscle.

Thus, at heavier live weight, an animal's carcass will have lower proportions of muscle and bone and a higher proportion of fat (Sebsibe,2008). The study by Ghosh (2019) shows that as the goats become older, they lose their body fats very rapidly.

Increases in age, independent of changes in weight, tend to have a short influence on the carcass composition of sheep. Normally, as animals age they gain weight that is largely made up of fat.

It is this increase in weight that results in an increase in fatness. Santos & al. (2007) were observed few sex effects on meat quality traits as well as on the composition of dissected carcass but females deposited more internal fat than males. At all weights, females tend to be fatter than ram lambs under similar management (Sebsibe, 2008).

Some breeds mature earlier than others and the main breed differences in carcass composition are related to the rate of fat deposition during the later stages of growth. To achieve a similar level of fatness with breeds of different maturity types, it is necessary to market earlier maturing lambs at lighter weights than later maturing lambs (Sebsibe, 2008).

The conformation of a carcass refers to its shape. Carcasses that are short in the leg and plump or 'blocky' in appearance are said to have 'good' conformation. Carcasses with a longer 'leggy' appearance are said to be of 'poor' conformation. Carcasses having good conformation generally contain more fat and less protein than those of poor conformation (Sebsibe, 2008).

2.2.4. Factors affecting goat price

Price determination and price discovery are the two main processes supporting any market framework (Jones & Hill, 1994). In developing countries, goat markets are generally underdeveloped. Farmers rely on informal market channels with the main buyers being traders and neighboring farmers. The authors show that in certain local African markets of sub-Saharan Africa, the price of goats depends on the physical conditions (goat size, fat) of the animal and often age, breed and sex played a minor role (Homann & al., 2007). Lack of alternative market options, lack of competition among buyers, and urgency of cash needs (i.e. in regard to the problems faced by farmer) have been shown to determine the goat price at market.

2.2.5. Live weight and body measurements on goat market

For goat traders who seek the quality and quantity of goat, it is important to accurately determine the quality and quantity of live goat. De Villiers & al. (2009), Rauri Alcock & al. (2015), Perez & al. (2016) and Pesmen & Yardimci (2008) indicate that the body measurement of different parts / area of goat establishes a strong relationship with live weight. For several meat-types goats, live weight can successfully be predicted using some body measurements (heart girth, withers height, body length and chest depth) considering the correlation coefficients in goats (Pesmen & Yardimci, 2008; De Villiers & al. 2009).

According to De Villiers (2009), Badi & al. (2002), Benyi & Karbo (1998), the goat trader is free to use the measure-tape similar to those used for cattle and pigs or a scale to determine the

quantity of live goat. The goat marketing can use the body measurements or live weight of the goat to avoid subjectivities in quantification.

2.2.6. Seasonal variation in body condition of goat

In Burundi, the dry season is characterized by a lack of pasture and pastoralists migrate their livestock during the summer period to regions where there is still pasture such as forests, valleys and plains. This migration of cattle is called "Kugisha" in Kirundi, which means transhumance in English. The passage from one season to another is manifested by a variation of diet in terms of quantity and quality, and therefore that variation determines body condition of livestock.

Mugunieri & al (2008) shows that the body condition attributed to livestock was not static, and varied depending on seasons. This is because body condition significantly influenced grade. This grading system shows a shift in boundaries while allocating grade scores could find explanation in the argument by Erdman (1950), the principal idea behind assigning grade was to maximize return to sellers. The variation of body condition of a livestock constitutes a limit for grading system on the market because a livestock of grade II in the summer season can shift in grade I in the dry season.

2.2.7. Importance of the livestock grading system on marketing

According to Mugunieri & al. (2008) and Sebside, (2008), the presence of a formalized grading system confers benefits to actors such as dissemination of market information and rewarding quality. Grades have obvious value for international transactions; they also provide a valuable impetus to the development of quality and the domestic market by distinguishing among quality levels and rewarding with higher prices to the better products (Giovannucci & Reardon, 2000).

Since livestock traits are varied (color, size, quality ...), the marketing of livestock products must be supported by a clear communication system between sellers and buyers.

The grading system is very important for specifying and unifying the traits of animal products in order to facilitate exchange operations on the market. Thus, the basic role of grading is to expedite the marketing process (Pierce, 1976) but also to establish a common tool / system understandable by all market players. Harmonization of a livestock grading system is widely used in international trade to stabilize market prices (Mugunieri et al. 2008).

2.3. Theoretical Framework

According to the Economic Theory, the price system can coordinate economic affairs so as to allow peaceful cooperation and productive specialization between free individuals (Boettke and Candela 2017).

There are several ways to study the relationship between price and the independents variables. In this section, we present the nonparametric test of Kruskal Wallis and that of Mann Whitney, ANOVA and multiple regressions, the justification for the choice of these tests, the conditions of application and the distribution of the data.

2.3.1. Kruskal-Wallis H Test

The Kruskal-Wallis H test is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. This test is analogous to the one-way analysis of variance (ANOVA), but unlike the latter it does not require the assumption that the samples come from approximately normal populations or the universes having the same standard deviation (Kothari, 2004).

The most well-known nonparametric alternative to the ANOVA F test was proposed by Kruskal and Wallis in 1952. This procedure may be the only choice for some researchers if the data consist of rank scores; in other instances, it may be adopted in place of a parametric procedure if the normality assumption is suspected. The chief advantage of adopting the Kruskal- Wallis (KW) test is the potential for substantially greater statistical power when the data are non-normal in shape (Blair & Higgins, 1980).

In this test, the data are ranked jointly from low to high or high to low as if they constituted a single sample. To apply the KW procedure, the entire set of N observations is that R_{ij} represents the rank of the i^{th} observation in the j^{th} group. The statistic test is *H* for this test which is worked out as under:

$$H = \left[\frac{12}{n(n+1)}\sum_{i=1}^{k}\frac{{R^2}_i}{n_i}\right] - 3(n+1) \qquad (1)$$

Where H is dependent variable, $n = n_1 + n_2 + ... + n_k$ and R_i represents the sum of the ranks for the j^{th} group, is compared to the critical value, $X_2[(1-\alpha); V_1]$, the (1 - α) centile of the chi-square distribution with V_1 df, where V_1 is as previously defined.

If the null hypothesis is true, there is no difference between the sample means and each sample has at least five items, then the sampling distribution of *H* can be approximated with a chi-square distribution with (k – 1) degrees of freedom. We can reject the null hypothesis at a given level of significance if *H* value calculated, as stated above, exceeds the concerned table value of chi-square.

2.3.2. Choice of statistical test

In terms of selecting a statistical test, the most important question is "what is the main study hypothesis?". Certain statistical tests are only valid under certain conditions concerning the distribution of the variable (s). Other tests on the contrary are valid separately from any distribution and we call them the "free-distribution tests or nonparametric test" (Bertrand & Maumy, 2011). Non-parametric tests are the "free-distribution" and, as such, can be used for non-normal variables.

Some tests aim to show equality on certain parameters and these are called "parametric tests or non-free distribution". Parametric tests are those that make assumptions about the parameters of the population distribution from which the sample is drawn.

This is often the assumption that the samples data are normally distributed and the samples were sufficiently large (usually $n > 30$) to justify their use based on the central limit theorem or the variances are not heterogeneous (Léon, 1998; Andrew &al., 2010).

Usually parametric tests are more powerful. Therefore, they will be chosen rather than nonparametric tests. Likewise, parametric tests are generally more effective than nonparametric tests. However, they are also more restrictive, because it is necessary to check the application conditions which are more numerous in this case. A non-parametric test will generally be chosen when the conditions for applying the parametric test are not verified or it is impossible to verify its conditions (Campbell & Shantikumar, 2006). When comparing two or more independent samples, when the outcome is not normally distributed and the samples are small, a nonparametric test is appropriate. The Kruskal-Wallis test (nonparametric test) is used for comparing ordinal or non-normal variables for more than two groups, and is a generalization of the Mann-Whitney U-test. Mann Whitney U-test is a nonparametric test used to compare outcomes between two independent groups.

2.3.3. Conditions for applying the Kruskal Wallis H test

We observe, independently, a random variable X of continuous law, on $k \geq 3$ populations, or on a population divided into $k \geq 3$ sub-populations.

We thus assume that we have k independent random samples $(X_{1,1}, \dots, X_1, n_1), \dots, (X_{k,1}, \dots, X_{k,nk})$ and $k \geq 3$ series of observations $(X_{1,1}, \dots, X_1, n_1)$ for the first and $(X_{k,1}, \dots, X_{k,nk})$ for the last. We denote by $Li(X)$ the law of the random variable X on the (sub) population of order i with $1 \leq i \leq k$. Without making specific assumptions, the Kruskal-Wallis test does not test the equality of the means or that of the medians.

The Kruskal-Wallis test is used to test the following hypotheses:

$H_0 = L_1(X) = \cdots = Li(X) = \cdots = L_k(X)$ against H1: The laws $H_0 = L_1(X) = \cdots = L_k(X)$ are not all the same.

2.3.4. Decision rule and test conclusion

- First case: One of the numbers n_1 , $1 \leq i \leq k$, is less than or equal to 4. For a given threshold α, tables of the Kruskal-Wallis law provide us with a critical value C_α . Then we decide:

$$\begin{cases} If\ KW_{n.}(Obs.) \geq C_\alpha\ \ H_1\ is\ true, \\ If\ KW_{n.}(Obs.) < C_\alpha\ \ H_0\ is\ true. \end{cases}$$

The actual significance level of the test is generally strictly less than α.

- Second case: If $n_1 \geq 5$, for all $1 \leq i \leq k$, we use the approximation $KW_{n.} \approx X^2(k-1)$. For a given threshold α, tables of the law of X^2 provide us with a critical value C_α such that $PH_0(-C_\alpha < Z_{n1,n2<}C_\alpha) = 1 - \alpha$. Then we decide:

$$\begin{cases} If\ KW_{n.}(Obs.) \geq C_\alpha\ \ H_1\ is\ true, \\ If\ KW_{n.}(Obs.) < C_\alpha\ \ H_0\ is\ true. \end{cases}$$

When we reject H_0, we decide that H_1 is true with a risk of error of the first kind α. When we keep H_0, it is with a risk of error of second kind β.

2.3.5. Mann Whitney U-test for two independent samples

The Mann-Whitney U-test (M-WU) is a non-parametric test used to assess for significant differences in a scale or ordinal dependent variable by a single dichotomous independent variable. If the hypothesis of the t-test cannot be met, yet the observations are independent, the M–W test, may be an appropriate method for two group comparisons, if the data are at least ordinal.

It is used when there is reason to believe that the data are not normally distributed, when the sample sizes are small, or when the variances are heterogeneous (Andrew &al., 2010; Leon,1998). It can be used for dimensional data, as well as ordered categorical data (Leon,1998).

The Mann–Whitney U-test can be used when the aim is to show a difference between two groups in the value of an ordinal, interval or ratio variable (Andrew &al., 2010). The M-W U-test is also the mathematical basis for the Kruskal Wallis H-test (KWH).

The Kruskal-Wallis test is similar to Wilcoxon's Rank Sum test in that we are comparing the sum of ranks applied to the data (Thomas & al,2015). Thus, the test is also called Mann–Whitney–Wilcoxon (MWW), Wilcoxon rank-sum test, Wilcoxon–Mann–Whitney test, or Wilcoxon two-sample test. This makes the M-W U-test the appropriate analysis to use when analyzing dependent variables on an ordinal scale.

The test was initially designed in 1945 by Wilcoxon for two samples of the same size and was further developed in 1947 by Mann and Whitney to cover different sample sizes (Laerd Statistics,2018). Thus, the test is also called MWW, Wilcoxon rank-sum test, Wilcoxon–Mann–Whitney test, or Wilcoxon two-sample test.

The assumptions of the Mann–Whitney test include:

- The dependent variable should be measured at ordinal or continuous level.
- The independent variable should consist of two categorical, independent groups.
- There must be independence of observation, which means that there is no relationship between the observations in each group, the group themselves (Statistics, 2018).

The test statistic for the Mann Whitney U Test is denoted U and is the smaller of U_1 and U_2, defined below.

- $U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$ (2)
- $U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$ (3)

Where:

- R_1 = sum of the ranks for group 1, R_2 = sum of the ranks for group 2 and U is the Mann Whitney value;
- n_1 being the number of subjects in sample 1, and n_2 being the number of subjects in sample 2.

2.3.6. Regression analysis

Regression analysis is a statistical forecasting model that is concerned with describing and evaluating the relationship between given variables, i.e. the dependent and independent variables (Manage, 2007). Regression analysis is primarily used for two conceptually distinct purposes. First, regression analysis is widely used for prediction (Rawlings *et al*,. 1998) and forecasting, where its use has substantial overlap with the field of machine learning. Second, in some situation regression analysis can be used to infer causal relationships between the independent and dependent variables.

In general, the dependent (criterion) variable will be denoted by Y, and the independent (predictor) variables by $X_1, X_2, \ldots, X_n$. The score of person i on variable X_j is symbolized by X_{ij}. The population multiple correlation is denoted by R^2, ordinary correlations by ρ, standard deviations by σ. Population regression weights are denoted by β_i, with β' denoting the corresponding weights when all variables have been adjusted to standard score form. The purpose of the multiple regression method is to derive weights $\beta_1, \beta_2 \ldots, \beta_n$ for the variables $X_1, X_2, \ldots, X_n$, and an additive constant μ, such that the resulting weighted composite Y, which is defined by the multiple regression equation.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \mu \quad (4)$$

An error term μ is a residual variable produced by a statistical or mathematical model, which is created when the model does not fully represent the actual relationship between the independent variables and the dependent variables.

Regression analysis treats all independent (X) variables in the analysis as numerical. Numerical variables are interval or ratio scale variables whose values are directly comparable. Often, however, we can include an attribute or nominal scale variable such as binary, categorical or ordinary variables. A dummy variable is a numerical variable used in regression analysis to represent subgroups of the sample in the study. Dummy variables are useful because they enable us to use a single regression equation to represent multiple groups. The numbers are used to indicate or identify the levels of subgroups and do not have intrinsic meaning of their own. Dummy variables are created in this situation to trick the regression algorithm into correctly analyzing attribute variables. After the integration of the qualitative variables, the regression equation (1) becomes:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \delta_1 D_1 + \delta_2 D_2 + \cdots \delta_n D_n + \mu \quad (5)$$

Whereby δ_1- δ_n are the parameters to be estimated and D_1- D_n the dummy expressed for the independent variables.

2.3.7. Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) is an extremely useful technique concerning researches in the fields of economics and in researches of several other disciplines. This technique is used when multiple sample cases are involved (Kothari, 2012).

The ANOVA technique enables us to perform this simultaneous test and as such is considered to be an important tool of analysis in the hands of a researcher. The ANOVA technique is important in the context of all those situations where we want to compare more than two populations.

The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variation within each of these samples, relative to the amount of variation between the samples (Kothari, 2012). Thus, while using ANOVA, we assume that each of the samples is drawn from a normal population and that each of these populations has the same variance. We also assume that all factors other than the one or more being tested are effectively controlled. This means that we assume the absence of many factors that might affect our conclusions concerning the factor(s) to be studied (Kothari, 2012).

In short, we have to make two estimates of population variance viz., one based on between samples variance and the other based on within samples variance. Then the said two estimates of population variance are compared with *F*-test.

The Formula for ANOVA is:

$$\boldsymbol{F = \frac{\text{Estimate of population variance based on between samples variance}}{\text{Estimate of population variance based on within samples variance}}}$$

The ANOVA procedure is of two types, one-way and two-way with several dimensions. But for this study, only the one-way ANOVA will be discussed while the two-way procedure will be covered in subsequent lectures. Thus, the one-way ANOVA indicates whether the mean of a dependent variable is the same or differs across independent unrelated groups.

2.3.8. Skewness and kurtosis test for normality

In statistics, normality tests are used to determine whether a data set is modeled for normal distribution. Many statistical functions require that a distribution can be normal or nearly normal.

The normality test helps to determine how likely it is for a random variable underlying the data set to be normally distributed. There are several normality tests such as the Skewness Kurtosis test, the Jarque Bera test, the Shapiro Wilk test, the Kolmogorov-Smirnov test, and the Chen-Shapiro test. There are both graphical and statistical methods for evaluating normality:

- Graphical methods include the histogram and normality plot
- Statistically, two numerical measures of shape – skewness and excess kurtosis – can be used to test for normality. If skewness is not close to zero, then your data set is not normally distributed.

Several measures of skewness and kurtosis were proposed by Hogg (1974) in order to reduce the bias of conventional estimators when the distribution is non-normal. The two most widely used measures of skewness and kurtosis are based on standardized moments. Skewness is a measure of the asymmetry of the probability distribution of a random variable about its mean. It represents the amount and direction of skew. On the other hand, Kurtosis represents the height and sharpness of the central peak relative to that of a standard bell curve (Looney, 1995).

The null and alternative hypotheses for the normality test are:

- H_0: The data follows a normal distribution.
- H_1: The data does not follow a normal distribution.

The test rejects the hypothesis of normality when the p-value is less than or equal to 0.05. Failing the normality test allows to state with 95% confidence, the data does not fit the normal distribution. Passing the normality test only allows to state no significant departure from normality was found. An acceptable range for being normally distributed are $(-1,1)$ for skewness and $(-2,2)$ for kurtosis.

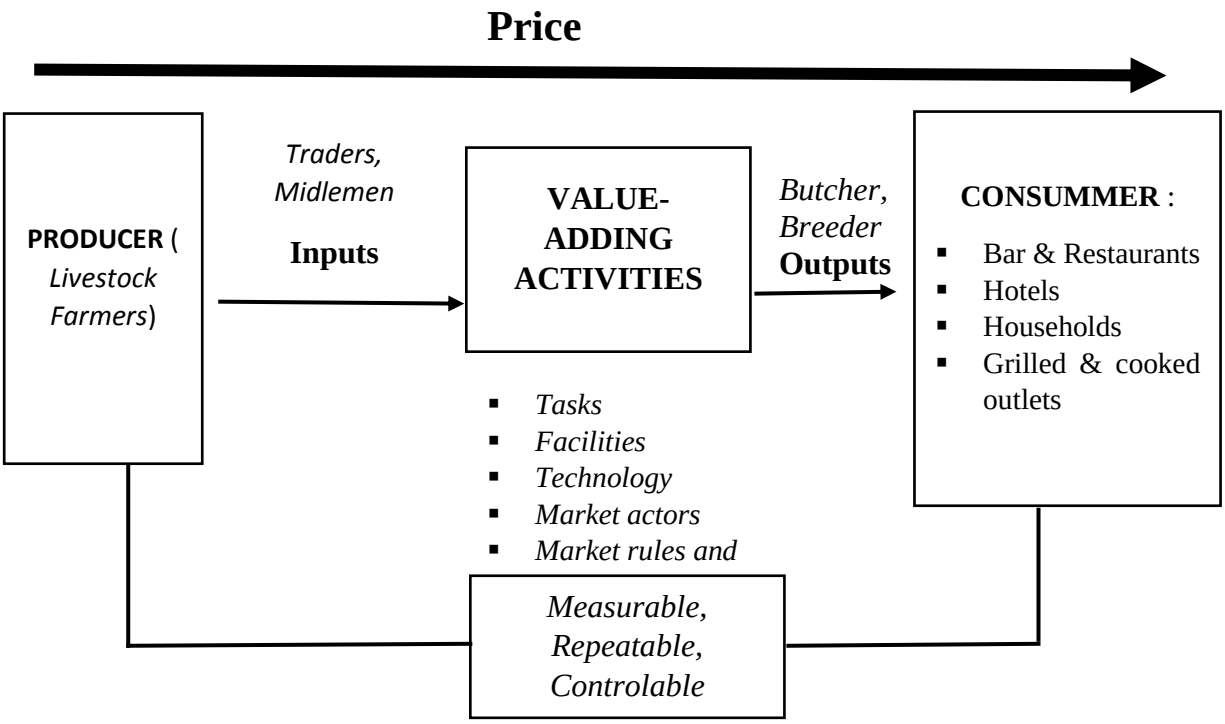
In the social sciences, outcome variables usually show values of skewness and kurtosis that clearly deviate from the normal distribution (Blanca et al.,2013). Blanca et al., (2013) and Micceri, (1989) found several classes of deviation from the normal distribution in addition to asymmetry and kurtosis, and concluded that normal distributions are rare with actual data in the social sciences.

2.4. The Conceptual Framework

The conceptual framework for analyzing the goat trade in the Buganda district, Imbo region is presented in the following figure. According to the field survey, actors in the goat value chain were identified among farmers, middlemen, traders, butchers and consumers.

The farmers can trade with a number of actors depending on time, place and situations. If the whole system works properly and if there is a good collaboration between all actors in the chain, the market will be efficient because the price will be determined objectively. Since sales will be primarily depend on price, it is necessary to explain the relationship between prices and factors that influence goat price.

Figure 1: Relationship between study variables



Source: Author

CHAPTER 3. RESEARCH METHODOLOGY

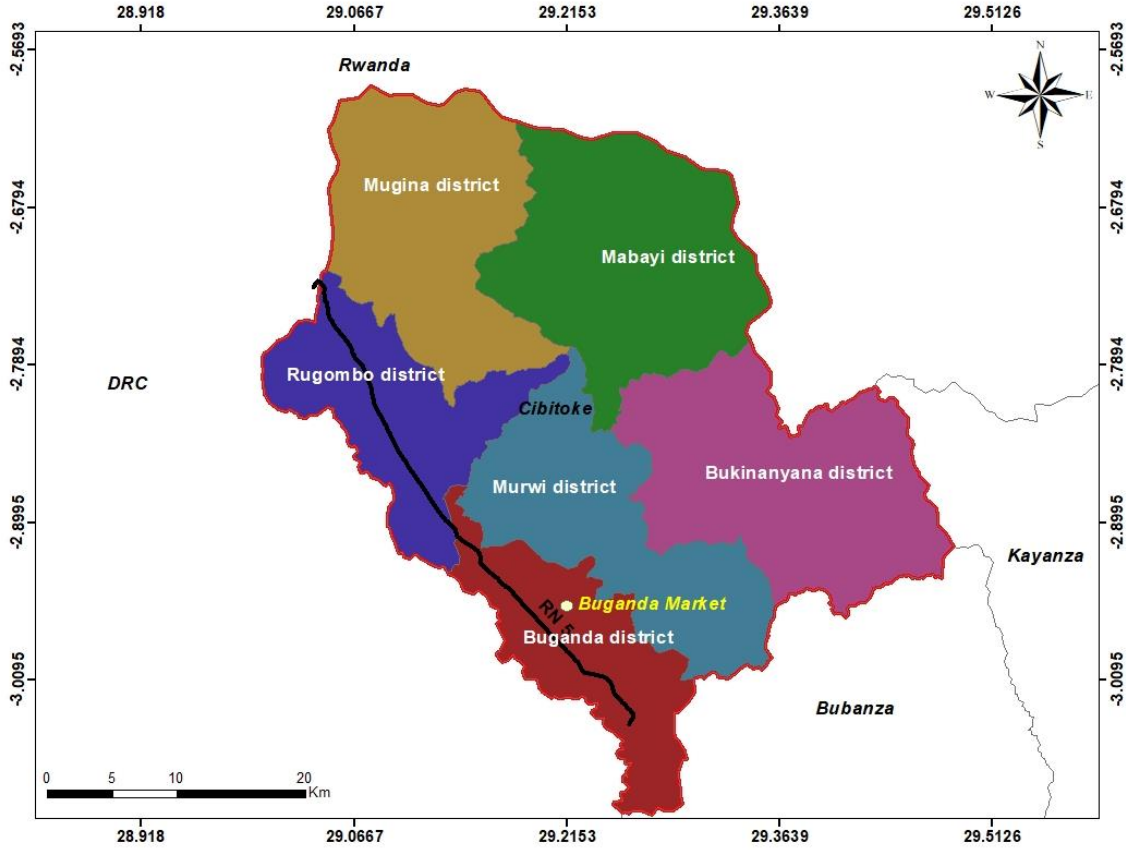
3.0. Introduction

The methodology research provides the description of the techniques and procedures used to identify, select, process and analyze information about goat trade and marketing. This chapter allows the readers to critically evaluate the overall validity and reliability of the research. The methodology presents also the tools or materials that the study used to explain the relationship between the different study variables and the way they were used. Analytical techniques consist of multiple regression model procedures, specification of nonparametric tests (Kruskal Wallis and Manney Whitney) and analysis of covariance. The detailed description of the methodological process is explained below.

3.1. The study area and justification for selection

The study was conducted in Burundi, Cibitoke province, especially Buganda district which is in the Imbo region. Meat is part of the eating habits of the inhabitants of the Imbo plain. The Buganda market brings together many traders whose main activity is the sale of goats and their by-products. There are a number of outlets along the Bujumbura-Cibitoke road which bring together a lot of customers who consume grilled or cooked meat. In addition, the district is close to Bujumbura city, and is also close to the border with the Democratic Republic of Congo (DRC), which attracts traders from different areas to bring their animals to the market.

Figure 2: Map of livestock supply networks on Buganda market



Source: Author

3.2. Description of the study area

The problems faced by the goat-raising in Buganda is the inadequate market and marketing facilities. Inaccessible, distant markets, lack of marketing facilities, outlets, only 2 days per a week and poor market management are real constraints to both consumers and producers. The lack of slaughterhouses and storage houses is another problem.

The Buganda goat lacks a price-fixing agency. The lack of control of price creates doubts and suspicions between primary producers and consumers. The proper pricing of goat meat is, thus, an effective means of regulating goat meat production. Quality control is of concern to the consumer. Therefore, quality control and inspection of the dressed meat are essential to ensure that consumer preferences are met.

3.3. Buganda goat market organization

The Buganda goat market has an area of influence that goes beyond the limits of the province of Cibitoke. This market is supplied with goat by a network of rural markets and collection, the main ones are Mugwi and Rugombo. There are middlemen on the market, made up of facilitators and commission agents. More or less complex links may exist between the middlemen and the sellers, and these middlemen can influence the variation of the profit margin of the trader and farmer's income.

The market is held twice a week, every Wednesday and Sunday. The market is animated by different actors with diverse functions. Indeed, one can cite, the farmers (buyers, sellers); middlemen, butchers, and wholesalers. The market is managed by the municipal administration of Buganda.

3.4. Study design

In Burundi, the selection process for livestock intended for slaughter is implemented by three agents, namely producers, butchers and consumers. These actors make an ex post confirmation of inherent quality of livestock presented by the producers. In this study, we document an approach used by these market agents to reach a consensus on parameters defining the quality of goat destined for slaughter and its monetary value.

A cross sectional research design was used for this study. In this design, data on body condition and conformation of goats in the hands of a producer, trader, butcher or consumer, were collected by the researcher, taking care not to repeat measurements on the same animal.

This was done to avoid the problem of serial correlation of residuals, the design was appropriate for descriptive study and for determining the relationship between the variables.

3.5. Sampling Unit and Sample Size

The sampling frame for this study was constituted by goat market actors in the study area. A simple random sampling technique was used to select goats on the market and market actors. By using the simple random sampling technique,74 goats, 74 farmers and 74 traders were selected. The proportion of each category of sellers and buyers was selected according to the market actors presented on the market day. In the process of data collection, market actors were interviewed and goats were assessed (weighted and felt) at the market place. Carcass weights were measured at the slaughterhouse.

The sample size is calculated with the following formula:

$$n = \frac{t_p * p * (1-p) * N}{t_p * (1-p) + (N-1) * m^2} \quad (7)$$

Where:

- n: sample size used to obtain significant results for an event and a fixed level of risk;
- t_p: confidence intervals for a proportion (the typical value of the 95% confidence level will be 1.96);
- p: estimated proportion of population with the characteristic (proportion considered to be 0.5 to provide maximum sample size).
- m: margin of error (degree of accuracy expressed as a proportion generally set at 5%);
- N: size of population (famers, goats and traders).

Applying formula (1), the sample size for the study is n = 68 goats. The total number of goats sold at the market was obtained from the municipal tax collector. The sampling frame was therefore calculated from the average of goats (5000) sold at Buganda market in two months preceding the data collection. The selection of the goat to be assessed was conditioned by the acceptance of farmer (seller) and trader (buyer) to be interviewed on social and economic aspects.

Table 1: Summary of study sample sizes

Value Chain Actor	Number	Location
Famers	74	Buganda Market
Goats	74	Buganda Market and at Slaughterhouses
Traders	74	Buganda Market and at grilled and cooked outlets

Source: Author

3.6. Data Collection Methods

Both primary and secondary data collection methods were used to obtain the information required for the study.

3.6.1. Primary data

Data used in this study were largely primary data collected from the samples of respondents using questionnaires and observations. The questionnaires were designed for farmers, and traders. Primary data consists of qualitative and quantitative data necessary for a good understanding of the different aspects of the problem statement. The survey was made at the goat market, the slaughterhouse and the point of sale of goat meat in the capital of Buganda commune. On the market, respondents (farmers & traders) were interviewed by means of a questionnaire. Liveweight was determined using electronic goat and sheep scale (Brecknell model max=300kg, d=0,2kg). A Cattle-Weight-Measure-Tape was used to measure the height at withers, chest girth, body length and heart girth. Body condition scoring was done as described by the table 2.

3.6.2. Secondary data

In this study, secondary data were obtained from the Directorate of the Environment, Agriculture and Livestock (DPEAE), by reading various publications from the Ministry of the Environment, Agriculture and Livestock (MINEAGRIE), the Central Library of the University of Burundi, the Institute of Statistics and Economic Studies of Burundi (ISTEEBU) and the Internet. Secondary data used by the researcher to supplement information from primary data.

3.7. List of attributes that were assessed on live goats

The grading of goats was done in accordance with age, sex, weight, body condition and body conformation. These measurements and observations were recorded at the market, on goats brought to the market by producers or goats in the hands of buyers.

3.7.1. Definition of the attributes that were assessed in the study.

The attributes assessed in this study included:

- Age: categories were based on dentition and/or records.
- Sex: differentiating between male or female animals. If male, it was categorized into castrated or uncastrated. A castrated male being one whose testicles were rendered dysfunctional through an approved procedure.
- Live weight: the weight of animal before slaughter determined through an appropriate and acceptable method. The live weight was determined by any appropriate method including weighing scale and weight band.
- Lordosis: Excessive inward curvature of the spine.

- Kyphosis: Excessive outward curvature of the spine.

Sex and breed are nominal/discreet variables while age and live weight are continuous variables. During data analysis, information from continuous variables such as age and live weight was first transformed into ordinal variables to facilitate the application of the Kruskal Wallis H test. This test is applied when a continuous response variable is present against independent variables having the number of subgroups greater than three. The age was distributed as follows: under 20, from 20 to 30, from 30 to 48, from 48 to 80 and live weight: under 15 kg; from 15 to20 kg; from 15 to20 kg; from 30 to30 kg, and from 30 to 50 kg.

3.7.2. Body condition score

Body condition score is the score assigned through visual appraisal of specific body parts. The extent to which specific skeletal body parts are either hidden or smoothened by fresh or fat. In this study, body condition scoring was done on three areas of the goat, namely ding the loin, tailhead and brisket according to the method of Villaquiran and al. (2004), as summarized in table 2.

Table 2: Description for body condition scores for goats

Body score	Tailhead	Loin	Brisket

Very good	The bone structure of the goat is no longer noticeable and the tail head is almost completely buried in fatty tissue. Muscle very well-developed i.e., semi tendinosis, biceps tail-head filled and mounded	Wide and very well-developed loin up to the shoulder region, spinous processes are hidden smoothened by flesh and/or fat. The thickness of the muscle and fat is so great that reference marks on the transverse process are also lost. It is impossible to grasp the transverse process.	Brisket well developed, covered with flesh and/or fat. Sternal fat now extends and covers the sternum, joining fat covering cartilage and ribs. It cannot be grasped.
Good	The processes cannot be felt and fat cover around the tail head is easily seen as slight mounds, soft to touch. Folds of fat are beginning to develop over ribs and thighs.	The outline of the transverse process of the lumbar vertebrae is no longer discernible. The transverse process forms a smooth, rounded edge, with no individual vertebrae discernible.	Sternal fat is difficult to grasp because of its width and depth. It cannot be moved from side to side.
Medium	The short ribs can only be felt with firm thumb pressure. Areas either side of tail head have fat cover which can be easily felt.	The outline of the transverse process of the lumbar vertebrae is slightly discernible. Less than one-quarter of the length of the transverse process is discernible.	Sternal fat is wide and thick. It can still be grasped but has very little movement. Joints joining cartilage and ribs are barely felt.
Poor	The processes can easily be felt, but feel rounded, rather than sharp. There is some tissue cover around the tail head. Individual ribs are no longer visually obvious.	The hand can grasp the transverse process but the outline of the transverse process is difficult to see. About one third to one-half of the length of the transverse process is discernible.	Sternal fat is wider and thicker but can still be grasped and lifted by the thumb and forefinger. The fat layer can still be moved slightly from side to side. Joints are less evident.
Very poor	The individual processes are sharp to the touch, no tail head fat. The hip, bones and ribs are prominent	The spinous process of the lumbar vertebrae can be grasped easily between the thumb and forefinger; the spinous process is rough, prominent, and distinct giving a saw-tooth appearance. Very little muscle and no fat can be felt between the skin and bone.	Sternal fat can be easily grasped between thumb and fingers and moved from side to side. The cartilage and joints joining ribs and sternum are easily felt.

Source: Villaquiran and al. (2004)

Scoring was done in goats using a BCS ranging from 1.0 to 5.0, with 0.5 increments. Scoring was done by using the hand to feel the fullness for the fullness of muscles and the fat cover on

and around the vertebrae in the loin area. Skeletal checkpoints (loin area, brisket and tailhead) were observed by palpation.

Data collection focused on several aspects of the goat, including the body condition of the goat. Body condition is scored on five levels, including very poor, poor, medium, good and very good. The assessment of the body condition of the goat followed the indications given in the study of Villaquiran et al. (2004). For him, BCS indicates the available fat reserves in the body of the goat and the BCS can indicate the quality according to the study of Mugunieri et al., (2012).

3.7.3. Body measurements

Certain aspects of the conformation (size) can be easily perceived by means of a simple observation. Body conformation is the size and shape of symmetry of the different regions of an animal's body relative to each other or the general appearance of the animal depending on what is considered a desirable aspect.

Features of an animal that comprise the desirable appearance include:

- Big frame or skeletal size of the animal under this feature height and length as crucial elements to consider. Top quality animals are those that shall be tall with large body frame.
- Good muscling under this feature, thick and long muscling is preferred;
- Good appearance of feet and legs important features to consider here shall include a long and straight (level) rump; long and broad loin; long and straight, and well set and straight legs. Goat exhibiting a large heart girth in relation to overall body size (height and length of body) will attain a higher score.

The most common parameters used for body measurements in goat are body length, withers height, body depth, and heart girth. We then used two measurement tools (tape, scale) to objectively and quantitatively assess the size and shape of the goat frame.

In data processing, the various measures have been grouped into four subgroups of: under 40, from 41 to 50, from 51 to 60, from 61 to 70. After the grouping, the subgroups were considered as different samples arranged by increasing order from "1" to "4" with "1" the group for small size of goats and "4" for the large size.

After the grouping, the subgroups were considered as samples ranged by increasing order from "1" to "4" with "1" the group for small size goats and "4" for large size. Body measurements

were taken by a tape measure (Cattle-Weight-Measure-Tape) and body weight was taken using a digital scale (Brecknell model):

- Withers height was measured as the distance from the surface of a platform to the withers;
- Body length was measured as distance from the occipital joint to the first caudal vertebra;
- Heart girth was measured just behind the scapula by a tape measure;
- Chest depth was measured as vertical distance from sternum to withers.

3.7.4. Interaction of the characteristics considered to establish a grading system

The interactions of sex, age, body condition, and body conformation shall determine the goat grades as described in table 3. After determining the relationship between the price and the different parts of the goat, we then established a grading system based on the parts that have demonstrated a powerful link with the price.

Table 3: Grades and grading parameters for goats

Grade	Sex	Weight	Age	Body condition	Body conformation
1	Male uncastrated	Min kg	Max age	Excellent	Excellent
	Male castrated	Min kg	Max age	Excellent	Excellent
	Female	Min kg	Max age	Excellent	Excellent
2	Male uncastrated	Min kg	Max age	Good	Good
	Male castrated	Min kg	Max age	Good	Good
	Female	Min kg	Max age	Good	Good
3	All eligible	No limit	No limit	Poor	Poor

Source: Author

Some studies have shown that age is a factor influencing the body condition of goat and many others find a strong correlation between the weight of goat and body measurements. However, the maximum age was determined by the KW test and linear regression estimates in tables 28 and 33 and it determines the age level from which the relation between age and price becomes negative. There is a weight threshold from which the correlation with body measurements very is strong (tables 27&33).

In addition to the characteristics of body condition and conformation, sex, age is added factors such as the breed and the weight of the live goat. After establishing the grading system, we need to ascertain the validity of the grading system in a real market environment.

3.8. Data Processing and Analysis

The data collected from farmers, traders and goats were coded and summarized. The data recorded was done by phone using the ODK collect (Kobo Collect) computer program version v.1.25.1 before transferring to STATA for further analyses. The data were cleaned using Excel software to remove missing values and outliers. Both qualitative and quantitative analyses were carried out based on specific objectives of the study as describe in below. After collection the goat lives grading data was processed through editing, coding, classification and tabulation.

Quantitative methods emphasize objective measurements and the statistical, or numerical analysis of data collected through polls, questionnaires, and surveys using computational techniques. Following the distribution of the survey data, the study used non-parametric and parametric tests including Kruskal Wallis and Mann Whitney tests, ANOVA and multiple linear regression which are effective according to the theory.

3.8.1. Specification of Kruskal Wallis H and Mann Whitney tests

As indicated in section 2.3.1**, t**he H and U tests was used to specifying the independent variables and its different groups and the dependent variable. The H test will apply to several variables which have different classes and numbers and U when there are variables which have only two modalities.

Table 4: Variables included in the correlation, Kruskal Wallis and Mann Whitney tests

Variables	Description
H	Kruskal Wallis value
U	Mann Whitney value
Sex	Male=1 ; female=0
Breed	yes=1; no=0

Age	under 20, from 20 to 30, from 30 to 48, from 48 to 80
Tailhead	Score for thailhead: 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.
sc_loin	Score for loin: 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.
Brisket	Score for brisket: 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.
wh_sc	Withers height with classes under 40, from 41 to 50, from 51 to 60, from 61 to 70
b_length	Body length with classes under 40, from 41 to 50, from 51 to 60, from 61 to 70cm
c_depth	Chest depth with classes under 40, from 41 to 50, from 51 to 60, from 61 to 70 cm
h_girth	Heart girth with classes: under 40, from 41 to 50, from 51 to 60, from 61 to 70 cm
Live_wei	Under 15; from 15 to20; from 15 to20; from 30 to30, and from 30 to 50 kg
carca_wei	Carcass weight in kg
Fifth	Fifth quarter weight in kg

Source: Author

3.8.2. Data processing with the Kruskal Wallis H test

As already indicated in Section 2.3.1, the purpose of the Kruskal Wallis H test is to identify the quantitative variables most related to the qualitative variable passed in parameter, one must therefore identify the strongest variables Chi-square of Kruskal Wallis. The Kruskal Wallis file contains for each quantitative variable tested, three observations: one containing the value of the Chi-square, another containing the value of the degree of freedom of the Chi-square and a third containing the probability associated with the value of the Chi-square.

For each quantitative variable, we retrieve a line for each modality of the qualitative variable, with on this line we have:

- The variable name of the quantitative variable;
- Modality "class" of the qualitative variable. here the smallest modality of the target variable appears first, because it is it which is considered as reference;
- The mean rank "mean rank" of the explanatory variable of the modality of the variable.

Then, if the average rank of the second modality is higher than the average rank of the first modality, we say that this modality is positively linked to the explanatory variable.

After having gathered the results in a same file on the intensity (coming from kruskal) and the direction (coming from wilcoxon) of the binding of each quantitative variable with the target, we sort the results by increasing values "kwallis" of Khi-square. From these results, we can list the variables most related to the target.

If any of the given samples has less than five items then chi-square distribution approximation cannot be used and the exact tests may be based on table meant for it given in the book "Non-parametric statistics for the behavioral sciences" by Sidney, (1957).

To determine whether any of the differences between the medians are statistically significant, compare the p-value to the significance level to assess the null hypothesis. Before concluding on the Kruskal Wallis test, we must first check the significance of the test. This procedure consists of seeing if the probability associated with the test is less than 5% when the significance threshold is 0.05. Usually, a significance level of 0.05 works well. A significance level of 0.05 indicates a 5% risk of concluding that a difference exists when there is no actual difference.

3.8.3. Data processing with the Mann Whitney U-test

Data processing was performed using Stata 13.0 software on survey data comparing female and male goat, local and hybrid breed, slaughter and breeding target according to the influence that they have on price of goat. The rationale behind the Mann–Whitney test is that if the prices are equally effective, one would expect about half of each group to be below the median rank for the pooled sample.

For the Mann–Whitney test, the hypothesis testing steps are as follows:

- State research question. Do female and male goat, local and hybrid breed, slaughter and breeding target have similar influence for price of goat at market?
- State two mutually exclusive and exhaustive hypotheses with respect to the population medians (M_k).

$$H_0: M_1 = M_1 \text{ and } H_0: M_1 \neq M_1$$

  - The critical values for the Mann–Whitney test, with $\alpha = 0.05$
  - Make decision regarding H_0. $U_{obs} \geq U_{ctitical}$, thus, reject H_0.
  - Conclusion

For larger samples (i.e., when n_1 or $n_2$is greater than 20), a normal approximation can be used for the M-W test.

3.8.4. Data processing with the multiple linear regression

In this section, we explain the Data processing with the multiple linear regression in Stata 13.0 software, determining how well the model fits with data and how to make conclusion. There are assumptions that underpin multiple regressions that the dependent variable should be

measured at the continuous level and also it must also have two or more continuous or categorical independent variables.

The F-ratio tests whether the overall regression model is a good fit for the data. The coefficient of determination R_2, which is the proportion of variance in the dependent variable that can be explained by the independent variables and adjusted R_2 were used to determine how well a regression model fits the data. We conclude that the independent variables statistically significantly predict the dependent variable, (the regression model fits the data well) when the probability associated with F is less than 0.05.

Test for the statistical significance of each of the independent variables. This tests whether the unstandardized (or standardized) coefficients are equal to zero in the population. If $p < 0.05$, we conclude that the coefficients are statistically significantly different to zero. The *t*-value and corresponding *p*-value are located in the "t" and "$P > |t|$" columns, respectively.

After verifying for statistical significance (individual and global), we interpret the signs and the value of coefficients. The sign indicates the direction while the value of coefficient indicates the power of the relationship between the dependent variable and independent variables.

3.8.5. Determinants of goat farmers' Price Regression analysis

A Multiple linear regression model was used to analyze the determinants of goat farmers' price and was set as a function of other ten variables such as age, sex, live weight, chest depth, heart girth, experience of trader, reason of goat sold, loin area, goat target and access to market information. The model for price was specified as follows:

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \delta_1 D_1 + \delta_2 D_2 + \delta_3 D_3 + \delta_4 D_4 + \delta_5 D_5 + \delta_6 D_6 + \mu \quad \text{.....} \quad (6)$$

Whereby the details of the variables are presented in Table 5

Table 5: Variables included in the regression analysis model

Y	=	Price of goat
$B_1 - \beta_5$ and $\delta_1 - \delta_4$	=	Parameters to be estimated
X_1	=	Live weight expressed in kilogram
X_2	=	Body length expressed in centimeter
X_3	=	Chest depth expressed in centimeter
X_4	=	Heart girth expressed in centimeter

X_5	=	Experience of trader expressed in years
D_1	=	Sex of goat expressed as dummy (1= Female,0 = Otherwise)
D_2	=	Age of goat expressed as dummy (1= under 48 months, 0 = Otherwise)
D_3	=	Loin area expressed as dummy (1 = Very poor, 2 = Poor, 3=Medium, 4 = Good and 5 = Very good)
D_4	=	Reason for sold of goat expressed as dummy (1= Goat mature, 0 = cash constrained)
D_5	=	Goat target expressed as dummy (1=Slaughter, 2 Breeding)
D_6	=	Access to Market (prices) information (1= Yes, 0 = Otherwise)
μ	=	Error term

Source: Author

3.8.6. Data processing with ANOVA

Data processing with ANOVA is done using Stata software version 13.0. In this study, the dependent variable was "price of goat" (measured in BIF), whilst the independent variable was "score for loin", with five independent groups: "Very poor loin, Poor loin, Medium, Good loin and Very good loin". Note that score of loin was an ordinal variable split across five groups and the one-way ANOVA is used to determine whether there is a statistically significant difference in prices charged between the five independent groups.

The statistics to report in a one-way ANOVA are the F-statistic, degrees of freedom (df), the level of significance (the prob value: Prob<F), a statement of whether there were statistically significant differences between groups and the results from the post-estimation checks and their prob values. The value of F is to be compared to the F-limit for given degrees of freedom.

If the F-value is equal or exceeds the F-limit value, we may say that there are significant differences between the sample means.

3.9. Limitation of the study

In the study, information collected on goats destined for slaughter included live weight, carcass weight and fifth quarter weight. However, due to the length of time needed to process a carcass preparation takes, and the fact that some goats bought on market day may be slaughtered in next day, and then it could not save all their data. Therefore, the sample was small for these three factors due to this problem.

CHAPTER 4. RESULTS AND DISCUSION

4.0. Introduction

The research results specify the main findings or the evidence that helps substantiate and answer the research question or main hypothesis. Study results refer to direct answers of research questions that are generated from the survey data. The effective and convincing way of presenting the data require pictorial tools like graphs and tables that objectively depict the targeted data and the statistical analyses followed. The discussion part helps the reader with a

subjective explanation of significant ways by which the findings differ from or agree with those of similar research on the same issue.

4.1. Socio-economic Characteristics of Livestock Farmers

This section discusses the demographic characteristics of the sample farmers and traders in the study areas. The characteristics of the producers and traders have a significant socio-economic influence on production, marketing and the decision to market where and when to sell the products. According to Randela (2005), The demographic analysis is crucial since, to a considerable extent, demographic characteristics affect household 'economic behavior. The demographic analysis of the sample respondents is carried out for two categories, namely farmers and traders, to understand both the profile of producers and traders encountered on the Buganda goat market.

4.1.1. Respondents age categories

The findings show that a large number of farmers (46%) were between 26-35 years old. Unlike farmers, the most dominant (64.9%) age group for traders interviewed was 36-45 years.

Table 6: Age distribution of goat farmers and traders

	Farmers		**Traders**	
Age in years	**Frequency**	**Percentage**	Frequency	Percentage
[≤ 25]	5.0	6.8	6.0	8.1
[26 -35]	34.0	46.0	12.0	16.2
[36-45]	22.0	29.7	48.0	64.9
[46-65]	12.0	16.2	7.0	9.5
[≥ 66]	1.0	1.4	1.0	1.4
Total	**74**	**100.0**	**74**	**100.0**

Source: Author

However, 52.8% of the farmers' respondents and 24.3% of the traders' respondents were under 35 years. According to Nyaki. (2014) age can be an indicator of experience, extent of wealth accumulation and capacity of decision making which affect how one works and his / her productivity. Lapar et al. (2005) reported that, with farmers, age is an important factor that influence farm efficiency levels and this means that productivity can vary with age.

4.1.2. Respondents description by sex

In the two categories (farmers and traders), the results indicate that women represent only 12.5% of respondents. Women were almost absent in the goat trade, (only 3% of traders were women) respondents.

Table 7: Distribution of farmers and traders by sex

	Farmers		**Traders**		
Sex	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Average**
Male	58	78	72	97	87.5
Female	16	22	2	3	12.5
Total	74	100	74	100	100.0

Source: Source: Author

Sex should be considered as a tool for identifying and analyzing the differences characterizing the living conditions, status, function and position of men and women as attributed in society. The issue of women's participation in economic activity is nowadays a central question. In developing countries, when an activity becomes an income generator, it changes membership in terms of gender. The results of Diesse's study. (2011) confirm the inequalities between men and women in the exercise of economic activity according to the place of residence, the standard of living of the household, the age, the level of education and the marital status of the individual. Women are mostly involved in household duties, including housework and baby-sitting.

4.1.3. Education level of respondents

The results show that about 43.2% were farmer respondents who can neither read nor write. However, only 50% of farmer respondents reported having a formal education.

Table 8: Education level of respondents

Education level	**Frequency**	**Percentage**
No level education	32	43.2
Catechesis education	4	5.4
Primary education	28	37.8
Secondary education	6	8.1
Collegue education	4	5.4
Total	**74**	**100**

Source: Author

Education is a very important factor when it comes to use innovation, making decisions and understanding a business environment. According to Mather and Adelzadeh (1998) people with higher educational levels are more able to interpret information than those who have less education or no education at all. Also, Harmon *et al*. (2003). In addition, a study by Baltenweck & Staal. (2007) found a positive relationship between years of formal education and higher bargaining power for educated livestock producers, thereby negotiating for a higher price and have more sales rates.

4.1.4. Primary occupation of respondents

The findings show that 60.8% and 36.0% of the farmers' respondents depend respectively on crop production and business as their main primary occupation.

Table 9: Distribution of respondents by activity

Primary occupation	Frequency	Percentage
Wage employment	1.0	1.4
Business	27.0	36.5
Crop production	45.0	60.8
Goat keeping	1.0	1.4
Total	**74**	**100**

Source: Author

Even though most farmers integrated livestock production with cropping. livestock production was not a main activity, and this influenced livestock trade and income. Goats are usually considered as a walking bank and as insurance against climatic adversities.

Income raised from the sale of goats is used to pay for cropping activities, school fees, purchase of food or use for hospital fees, in case of illness.

Judging from this, it would also mean that the development of the goat trade will contribute significantly to the level of poor farming households.

4.2. Marketing Arrangements in the Study Area

This section describes how farmers access the Buganda market information, especially price and factors that determine the price (such as physical characteristics of the goats).

4.2.1. Market information

Results of the survey shown that only 25% of the respondents' state that they know the prices prevailing in neighboring markets and among of these, 55% state that they have received price information from their neighbors / colleagues. Only 38% of respondents get information from goat traders in the different markets in the area.

Table 10: Distribution of information channels

Source of information	Frequency	%
By_phone	3	4
From neighbor/collegue	41	55
Issued by traders	28	38
Others	2	3
Total	74	100

Source: Author

The transparency of the market is explained by the degree of availability of information relating to the price and the functioning of the market. Indeed, it is necessary to explain the main information channels on the market. Barrett et al. (2005) asserted that information networks suffice to generate and distribute adequately reliable and timely information about market conditions. Access to information allows better redistribution of income between actors along the chain**.**

4.2.2. Mode of price determination at market area

The findings show 73% of respondent stating that price is largely determined by buyer. On the other hand, the decision by the seller was merely small as it was only reported to be 5%.

Table 11: An analysis of distribution according to the person who decides the goat price

Factors	Frequency	%
Final decision of the buyer	54	73
Negotiation (both Producers & Buyer)	16	22
Final decision of the seller	4	5
Total	**74**	**100**

Source: Author

According to Ruhangawebare (2010), traders sometimes have an advantage over goats' breeders because of the lack of weighing stations, thus underestimating the live weight of the animal for sale in order to negotiate a price in their favor.

4.2.3. Factors considered by goat traders in pricing

The results indicate that the most important criteria for setting the price of a goat are quality, strength of demand and supply and observations of physical conditions with 38%, 36% and 22% of respondents, respectively.

Table 12: Factors considered by goat farmers in setting prices

Factors for pricing	Frequency	Percentage
quality grades	28	38
Supply and demand forces	27	36
Observations of physical conditions	16	22
Sex	1	1
Breed	1	1
Others (to identify)	1	1
Total	**74**	**100**

Source: Author

The identification of the main criteria considered by goat traders in determining the price is essential in the process of formalizing a grading system. The study shows that breed and sex factors are not taken into account when setting prices on the market. The results of this study confirmed that sex and breed are not necessary when traders determine the price of animals. These findings are in line with Ndumu *& al*. (2008) also found that farmers selected specific classes of animals with desired traits such as coat color, horns size and shape, fertility, milking history for breeding purposes thus offered higher prices.

The results also correspond perfectly with those of Homann et al. (2007) who indicate that in certain local African markets of sub-Saharan Africa, the price of goats depends on the physical conditions (goat size and fat cover) of the animal.

4.2.4. Identification of factors considered in setting the price of goats

The findings indicate that among the existing market alternatives, 77% of respondents prefer to sell their goats on the market place and only 23% would prefer to sell at butchers, intermediaries, the abattoir and at farm gate. Among the farmers interviewed, 38% of respondents say they prefer the market because it is nearby the livestock farmers, but 53% say

the market is a good environment for selling. Approximately 8% declare that they have no other choice and that they are forced to sell on one of the available markets.

Table 13: Distribution of Factors considered in setting prices

Selected factors	Percentage	Reason for choice	Percentage
Abattoir	1,4	It is nearby the livestock farmers	38
Midlemen	6,8	Good environment for selling	53
Market area	77	No other alternative market	8
Butchery	14,9	Reason no identified	1

Source: Author

The average distance traveled by farmers bringing the goats to the market is 4Km. Farmers prefer to sell at the market because the market provides an opportunity to select a buyer that has a better price and such competition tends to increase prices to an extent (assuming that buyers do not collude). On the contrary, sales outside directly to middlemen, abattoir or butchery or farm-gate) provide room for price speculation and they reduce competitiveness. Lack of alternative market options and the lack of competition between buyers have been shown to drive the price of goats in the market.

4.2.5. Factors triggering the sale of the goat.

The results show that a large proportion of farmers (63%) sell their goats when they are in financial difficulties. Only 35% of the producers raise goats as a form of business.

Table 14: Factors distribution of goat sales

Purpose of the sale	Frequency	Percentage
When animal is mature	26	35
When cash constrained	47	64
no_identify	1	1
Total	**74**	**100**

Source: Author

Finding the reason for the sale of the animal is very important as it has implications for the price received by the farmers. A person constrained by a cash crisis will easily sell his / her animal

at the wrong price in order to clear a cash need. This is confirmed by Homann & al. (2007) who reported that the urgency of a farmer's cash crisis will influence the price at which they are willing to let go of the animal.

4.2.6. Price appreciation by farmers

The results indicate that 86% of farmers' respondents are not satisfied with the price received. All the respondents declare that the perceived price is small compared to the physique of the animal.

Table 15: Distribution of farmers according to price appreciation

Appreciation	Frequency	Percentage
No satisfaction	64	86
Satisfaction	10	14
Total	**74**	**100**

Source: Author

It is necessary to describe the market participants in relation to satisfaction because in neoclassical consumer theory, the satisfaction is used to classify goods according to consumer preferences. In accordance with this theory, it can be said that consumer satisfaction confirms the goat quality on the market. Price appreciation by farmers has an influence on market participation and production. The literature (Mugunieri & al. 2012) has shown that good prices attract production, so this means that when the farmers appreciate the price received, they make effort to improve production. Since a large proportion of farmer frequent on the market are not satisfied with the price received, we can conclude that it is difficult to improve production if there are no reforms in setting prices for goats on the market.

Producer satisfaction is strongly related to the income farmers earn on the market according to neoclassical theory.

4.3. Market facilities

Each market has the necessary facilities to facilitate market operations. In this study, we will only talk about the abattoir facilities, the distance to be traveled between the abattoir and the market, thus the average distance between the different supply networks and the Buganda market.

4.3.1. Slaughter facilities

The study identifies 4 categories of facilities (slaughter at home, slaughter slab no roof and slaughter slab roofed with tales) which serve as abattoir in the study area. The findings indicate that 81% of surveyed goats are slaughtered in a roofed slaughter slab with tables.

Table 16: Distribution of goats according to the abattoir category

Facilities	Frequency	Percent
Slaughter at home	13	17.57
Slaughter slab (no roof)	1	1.35
Slaughter slab (roofed + tables)	60	81.08
Total	74	100

Source: Author

The roofed slaughter slab with tables is two kilometers from the market and the goats to be slaughtered are transported on motorcycles or bicycles. The abattoir is the private property who receives 300 BIF on each slaughtered goat under his abattoir. There is a person responsible for the slaughter of animals and who receives the 100 BIF for each goat slaughtered but the preparation of the intestines is not at his service. In short, at the abattoir, each goat pays 400 BIF for the slaughter service. This information relates only to the Buganda abattoir but there are other slaughterhouses not identified here which are in other localities far from the market.

4.3.2. Market access and market coverage

The Buganda market is largely occupied by Buganda farmers (81%) but participants from other districts Mugwi (11%), Rugombo (5) and Bubanza (3%) are also present on market day. The results of the study show that the local Buganda goat market covers a radius of 15 km.

The distance traveled by farmers to bring their animals to the market is on average 3km for farmers from Buganda; 8.25 Km for farmers from Mugwi, 5.75 Km for farmers from Rugombo and 13.5 for farmers from Bubanza.

Table 17: Distribution of farmers participants according to market coverage

Supply network	**Frequency**	**Percent**	**Average Km**
Buganda	60	81	3
Mugwi	8	11	8.25
Rugombo	4	5	5.75

Bubanza	2	3	13.5

Source: Author

Farmers do not have means of transport to bring their livestock to market. In this study, the findings indicate that distance influences farmers' participation on the market. Empirical research shows that distance influences the price of goods and farms are concentrated very close to outlet markets.

4.4. Assessment of the Goat in Trader's hand

4.4.1. Age of goat

Generally, the highest number of goats sold on the market (28% and 27%) were in the 1 – 7- and 17-26 months age groups, respectively. Approximately 76% of the goats on the market are less than 26 months old.

Table 18: Distribution of goat population by age group

Age structure	Frequency	Percent
Under 6 months	8	11
7months to 16 months	21	28
17months to 26 months	20	27
27months to 36 months	8	11
37months to 48 months	8	11
48 months and older	9	12
Total	74	100

Source: Author

Several studies have confirmed a relationship between age and factors such as the carcass, fat and body weight of the animal. At a certain threshold of maturity (age), the trend changes, and the goat loses fat reserves as it become older, as confirmed by certain authors.

A study by Ghosh (2019) show that as the goats become older, they lose their body fats very rapidly. Other studies such as those of Sebside (2008) and Santos et al. (2007) confirm that as animals mature, they normally gain weight, resulting in a heavier carcass. Much of the weight gain of a mature animal is from fat rather than muscle.

4.4.2. Sex

During the time of our study (February – April 2020) 70% of the goats sold at the market were females. Sex is an important factor which not only influences production but it is also the main

element on which the farmers think through when making decision for selling or buying a livestock.

Table 19: Distribution by sex of animal

Sex	Frequency	Percentage
Female	52	70
Male	22	30
Total	**74**	**100**

Source: Author

The dominance of female goats on the market gives various impressions. One is that there may be an abundance of population of female goat than male and looking at the table 20, 77% of them are sold for slaughter. According to Santos et al., (2007), sex has few effects on the composition of the dissected carcass, but females deposit more internal fat than males. Indeed, according to the studies by Scarpa et al. (2003) and Mugunieri & al, (2012), sex is a main factor influencing purchase of livestock and for Pesmen et Yardimci, (2008), body measurements differ according to sex. Depending on the object of the exchange operation (reproduction, meat), price of livestock may vary upwards or downwards depending on the sex.

4.4.3. Destination of the purchased goat

The findings show that a large part of the goats (77%) assessed are destined for slaughter, while 23% was destined for breeding. The female breeding stock consisted of kids less than 8 months and older

Table 20: Destination of the purchased goat

Destination	Frequency	Percentage
Own breeding	17	23.0
Slaughter stock	57	77.0
Total	**74**	**100,0**

Source: Author

As reported in table 19, 77% of goats recorded were females, means that most of the female goats (70%) on market were destined for slaughter. This has serious consequences for the goat population.

4.4.4. Live weight, goat price, carcass weight and fifth quarter weight

Table 20 shows the statistical summary of factors of goat price, live weight, carcass weight and fifth quarter weight. The average goat price, live weight, carcass weight and fifth quarter weight were calculated as 117547.30 FIB, 24.27, 15.32 and 4.23kg respectively.

Table 21: Summarize of Goat price, live weight, carcass weight and fifth quarter weight

Variable	Obs	Min	Mean	Max
Goat price	74	32000.0	117547.30	210000.0
Live weight	74	8.0	24.27	47.0
Carcass weight	21	7.0	15.32	32.0
Fifth quarter	21	1.8	4.23	8.0

Source: Author

Statistical summary is very important to facilitate comparisons of results between different similar studies. Table 21 allows to compare size, carcass composition and fifth quarter of Buganda local goats with breeds or hybrids from other regions in terms of live weight, carcass and fifth quarter.

4.4.5. Body condition scores

Results of body condition assessments on Brisket, loin and tailhead showed that that 33% of the goats were in good -very good condition while, approximately 32% were in poor- very poor condition.

Table 22: BCS frequency distribution

	Brisket		**Loin area**		**Tailhead**		
Scores	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**	**Average**
Very poor	1	1.4	1	1.4	0	0	**1**
Poor	28	37.8	28	37.8	14	18.9	**31**
Medium	14	18.9	23	31.1	32	43.2	**31**
Good	27	36.5	19	25.7	27	36.5	**33**

Very good	4	5.4	3	4.1	1	1.4	**4**
Total	**74**	**100**	**74**	**100**	**74**	**100**	**100.0**

Source: Author

Scoring is very important in determining the meat quality, the amount of muscle and fat over and around the vertebrae of the live goat. BCS is a simple but useful procedure, which can help producers make management decisions regarding the quality and quantity of feed needed to optimize production and reproduction thus can play an important role in goat marketing (Ghosh,2019). There is a positive relationship between BCS with live weight and quality of goat, and therefore BCS can influence the price of the animal on the market.

4.4.6. Body measurements

A summary of the body measurements is provided on Table 23, the means of withers height, body length, chest depth and heart girth were calculated as 56.76, 50.32, 67.99, 67.11 cm respectively. The table also indicates the averages, minimums and maximums of these different areas of the goat.

Table 23: Summarize of goat body measurements

Variable	Obs.	Min	Mean	Max	Std. Dev.
Withers height	74	37	56.76	68	5.74
Body lenght	74	23	50.32	63	6.82
Chest depth	74	41	67.99	86	9.53
Heart girth	74	32	67.11	83	9.38

Source: Author

The identification of body measurements likely to have a relationship with live weight is very necessary because it plays an important role in determining several characteristics of the farm animals especially the ones having an economical importance. Body weight estimates can be predicted using body measurements by different statistical analyzes (Gurcan, 2000). Body measurements differ according to the factors such as breed, sex, yield type and age. According to the results of the study of Pesmen & Yardimci (2008), the live weight can also be predicted

using some body measurements considering the correlation coefficients in goats. The variation of the body measurements is used as criteria in classification of the goats.

4.5. Correlation between variables

It is important to discover and quantify the degree to which variables in the dataset are dependent upon each other. The statistical relationship between variables is referred to as their correlation**.** The table 22 shows the relationship between goat price, live weight, carcass weight, fifth quarter, withers height, body length, chest depth and heart girth.

Table 24: Correlation coefficients between price, body measurements and live weight of Buganda goats

	goat_pric	live_wei	carca_wei	fifth_Q	with_hei	b_length	c_depth	h_girth
Goat_pric	1.0000							
Live_wei	0.8015	1.0000						
Carca_wei	0.7613	0.8847	1.0000					
Fifth_Q	0.7952	0.9262	0.9677	1.0000				
With_hei	0.4912	0.6242	0.3390	0.5008	1.0000			
B_length	0.7971	0.7519	0.5195	0.6317	0.7082	1.0000		
C_depth	0.6217	0.5014	0.2859	0.3340	0.4295	0.7937	1.0000	
H_girth	0.5064	0.3143	0.1517	0.2391	0.3690	0.6692	0.6446	1.0000

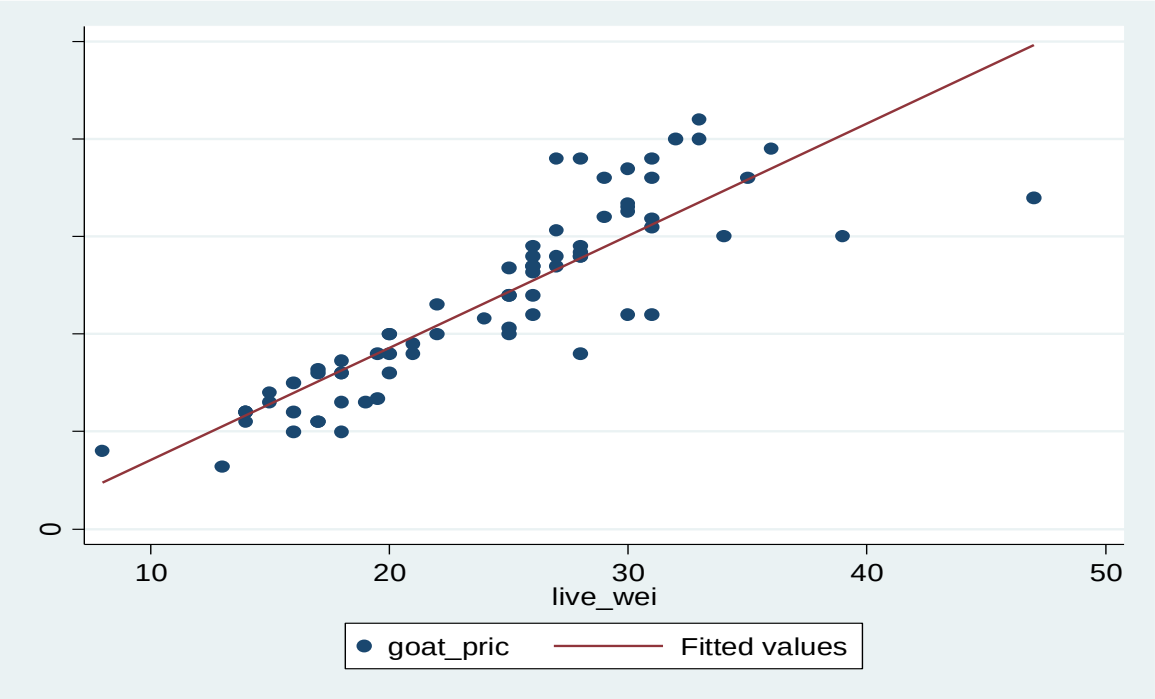
Source: Made by author using Stata 13.

The correlation coefficients between price and body measurements were ranged as live weight, body length, fifth quarter, carcass weight, chest dept, heart girth and withers height with the values of 0.80, 0.79, 0.79, 0.76, 0.62, 0.51 and 0.49 respectively. According to the results of this estimate, it could be concluded that the price of the goat can be determined using certain body measurements considering the higher correlation between variables in Buganda goats. The results of the survey show a close link between live weight, carcass weight and the fifth quarter. The correlation between these different measures confirms that carcass weight differs from one goat to another depending on the live weight and that this can be used in the goat marketing of goats.

Thus, the results correspond perfectly with those presented by Sebsibe, (2008) demonstrating that, the heavier the live weight, the more also the carcass of an animal will have lower proportions of muscles and bones and a higher proportion fat. For this purpose, it was necessary to present the link between these three dimensions. The results of this study also correspond to

those of Pesmen & Yardimci concluding that live weight can be predicted using some body measurements considering the correlation coefficients in goats. Since the correlation between the price and the live weight is very strong, it is important to illustrate it by a scatter plot.

Figure 3: Illustration of the relationship between live weight and price by a Scatter plot



Source: Made by author using Stata 13.

Scatter plot allows us to determine the model/test relationship that best fits the data. If the data seems to fit a model/test, you can study the relationship using regression analysis.

It is also used to determine the direction of the relationship (positive, negative or neutral) between variables. The graph below shows that there is a very important relationship between the price of the goat and its live weight. Therefore, the regression equation allows to accurately represent the data.

4.6. Assessment of the relationship between the grading system and the price

To assess the relationship between classes and price, the study uses nonparametric tests by Kruskal Wallis and Mann Whitney. The details concern the influence of different factors such as age, sex, breed, live weight, body measurement and BCS on the price of goats.

4. 6.1. Relationship between BCS and price

To explain the relationship between the grading system and the price, we used the nonparametric Kruskal Wallis test. The variable of body condition has 5 grades (classes) noted

from the smallest to the largest depending on the amount of fat reserves in the goat. Table 25 presents the mean rank of the different areas/parts of goat according to the grades, and the chi-square which respectively show direction and power of relationship.

Table 25: Results of Kruskal Wallis test of relative importance rankings for BCS

Body score	Mean ranks of Tailhead	Mean ranks of loin area	Mean ranks of brisket	Average
Very_poor		1.0	1.0	1.0
Poor	18.8	21.7	24.4	21.6
Medium	35.9	43.0	32.7	37.2
Good	47.9	51.0	50.9	49.9
Very good	69.0	69.3	65.1	67.8
Chi-squared	19.268 with 3 d.f.	33.514 with 4 d.f.	31.010 with 4 d.f.	
Probability	0.0002	0.0001	0.0001	

Source: Author

A Kruskal-Wallis test was performed to determine if the price of a goat on the market was different for five groups which were scored: (1) very poor; (2) poor, (3) medium; (4) good and (5) very good. A KW test showed that there was a statistically significant difference in price between the five groups, $X^2(1) = 19.268,\ \mathrm{p} = 0.0002\ ; X^2(2) = 33.514, \mathrm{p} = 0.0001\ ;$ and $X^2(3) = 31.010\ , \mathrm{p} = 0.0001.$ "*Chi-squared*, *Probability*" reports the chi-squared value and the degrees of freedom of the test.

The Chi-square demonstrates the power of the relationship between the response variable and the independent variables. We cannot compare the Chi-square because there are samples which do not reach 5 observations.

The test covers three essential area of goat (Brisket, Tailhead and loin area) with different ordinal classes ranging from 1.0 to 5.0. The results show that in all three cases, the test is significant at the 5% level. In the table above is displayed the K statistic of KW and the corresponding p-value. The p-value indicates that the probability of rejecting the null hypothesis although it is correct is about 0.0002 and 0,0001. In this case, we conclude that we can securely reject the null hypothesis that there is no difference between the classes.

The results can be analyzed by looking at the variation in the means rank relative to the groups. When the mean rank increases from the BCS 1.0 (very poor) to BCS 5.0 (very good), we conclude that there is a positive relationship between the dependent variable and the independent variables, and if not, it is a negative relationship. In the present case, we observe a positive relationship at all levels of the scoring because the average of the ranks increases from the lower level (very poor) to the upper level (very good) in all three cases.

From this we conclude that there are a price difference depending on grade of goat as shown in the above table. Average show the order of importance of ratings (BCS) based on a non-parametric comparison by multiple pairs. The results correspond perfectly to what was expected that there is a positive relationship between the price and the BCS

4.6.2. Relationship between price and body measurements

The use of the Kruskal Wallis test required that the data must be structured in groups or classes. When we have continuous variables, the procedure is to create group variables from continuous variables. The objective here is to compare the price and goat body size; the body size being a continuous variable, we have to divide it into a categorical variable with four groups. Body size have been grouped into the following four classes: under 40 cm, from 41 to 50, from 51 to 60 and from 61 to 70 cm.

Table 26: Results of KW tests of relative importance rankings for body measurements

	Heart girth		**Withers height**		**Body length**		**Chest depth**	
Body size	Freq.	Mean Rank	Freq.	Mean rank	Freq.	Mean rank	Freq	Mean rank
Under 40 cm	1	**13**	1	**13**	4	**6**		
From 41 to 50 cm	3	**4**	9	**15**	30	**22**	3	**12**
From 51 to 60 cm	13	**25**	43	**34**	38	**52**	13	**12**
From 61 to 90 cm	57	**42**	21	**56**	2	**58**	58	**44**
Chi-squared	15.602 with 3 d.f.		27.37 with 3 d.f.		43.79 with 3 d.f.		27.864 with 2 d.f.	
Probability	0.0014		0.0001		0.0001		0.0001	

Source: Author

A Kruskal-Wallis test was conducted to determine if the price of a goat on the market was different depending on the goat body size. The test results showed that the hypothesis that there is no statistically significant difference between the different samples should be rejected at the 5% level. The probabilities and chi-squares are respectively $X^2(3) = 15.602$, p =

$0.0014; X^2(3) = 27.37, \mathrm{p} = 0.0001$; $X^2(3) = 43.79, \mathrm{p} = 0.0001$; and $X^2(2) = 27.864, \mathrm{p} = 0.0001$ for heart girth, withers height, body length and chest depth.

The table above present the mean ranks which are a function of the body measurements and the price. The results show that the mean ranks vary with their corresponding body measurement class. The increasing order of means ranks for the different body size groups show a positive relationship between the dependent variable and the independent variables. This relationship is stronger for the body length where the chi-square is 43.79. Comparatively to the other parts (body length and chest depth) evaluated, the relationship between heart girth and price is low (chi-square =15.6) for the class Under 40 cm, and (from 41 to 50 cm).

Table 27: Results of KW tests of relative importance rankings for body weighting

Live_Weight	**Frequency**	**Rank Sum**	**Mean runk**
Under 15 kg	8	66.5	**8**
From 15 to 20 kg	19	321.5	**17**
From 20 to 30 kg	34	1575	**46**
From 30 to 50 kg	13	812	**62**
Chi_squered	*55.370 with 3 d.f.*		
Probability	*0.0001*		

Source: Made by Author using Stata 13.

The probability [p = 0.0014] indicates the statistical significance of the Kruskal-Wallis H test (i.e. the value of p). In this case, the probability is less than 0.05% which leads us to reject the null hypothesis according to which there is no price difference according to the live weight. The conclusion is that when an animal has a good live weight, it also has a good mean rank. The value of the high chi-square explains a strong positive relationship between the price and the live weight of goat.

4.6.3. Relationship between price and age, sex and breed

The condition for applying the Kruskal Wallis test stipulates that an input variable must have at least three subgroups while the age, sex and breed are binary variables. To get around this problem, we used the Mann Whitney U test. The following Mann Whitney U test results relate

to the role that sex and breed can play for setting the market price for goats. Some authors say that the quality of the animal can differ from one animal to another depending on the age, sex and breed, and the results have proved that the quality of the animal is directly linked to its price. Sebsibe (2008) and Casey & Webb (2010) confirm that the difference in meat quality between animals is due to different levels of sex hormones circulating in the blood. The following tables present the results of Mann Whitney's test on the importance of race and sex in the distribution of the price of goats.

Table 28: Results of Kruskal-Wallis tests of relative importance rankings for age

Age	**Frequncy.**	**Rank sum**	**Mean rank**
Under 20 months	42	1080	**26**
From 20 to 30 months	11	584,5	**53**
From 30 to 48 months	12	647,5	**54**
from 48 to 80 months and olders	9	463	**51**
Chi_squered	29.241 with 3d.f.		
Probability	0.0001		

Source: Made by author using Stata 13.

Looking at the probability (0,0001), we accept the alternative hypothesis that there is a statistically significant difference between the variables. Here, the test results show that the positive relationship between the price and the age of the goat holds up to the age of 48 months. At this level, the trend changes and the relationship gradually become negative. The results also indicated that goats under 48 months of age established a positive and strong link with the market price.

Table 29: Results of the Mann-Whitney U tests between price and sex

Sex of goat	obs.	Sum of ranks	expected
Male	22	625.5	825
Female	52	2149.5	1950
combined	74	2775	2775

unadjusted variance	7150.00
adjustement for ties	-8.68
adjusted variance	7141.32

H0: goat_price(sex_goat ==1) = goat_price(sex_goat ==2)

Z = -2.361

Prob > |Z| = 0.0182

Source: Made by author using Stata 13.

The p-value is less than 0.05: we can reject the hypothesis that the data for the two groups come from the same distribution at the threshold $\alpha = 0.05$. This means that sex has a significant influence on the price of the goat and the results have shown that females attract higher prices than males.

Table 30: Results of nonparametric Mann-Whitney U tests on breed and price

Breed_fact	Obs.	Sum of ranks	Expected
No	71	2644	2662.5
Yes	3	131	112.5
Combined	74	2775	2775

Unadjusted variance	1331.25
adjustement for ties	-1.62
Adjusted variance	1329.63

H0: Goat_price(breed_fact==0) = Goat_price(breed_fact==1)

Z = -0.507

Prob > |Z| = 0.6119

Source: Made by author using Stata 13.

Specification: "No" means that the trader does not take into account the breed of the animal when setting the price and "Yes" otherwise. The p-value is greater than 0.05: we cannot reject the hypothesis that the data for the two groups come from the same distribution at the threshold $\alpha = 0.05$.

The p-value is the probability to get U-values smaller than 1329,63 (or, equivalently, z-values below -0.507 or above +0.507, under the assumption that the values from both samples were taken from the same statistical population. The findings then indicate that there is no difference

in price awarded according to the breed of the animal. These results correspond perfectly to those of Scarpa et al. (2003) which show that the breed of animal does not play a major role in either buyer or seller preferences.

Table 31: Results of nonparametric Mann-Whitney test on goat-target and goat price

Goat_target	Obs.	Sum of ranks	Expected
Breeding	18	379.5	675
Slaughter	56	2395.5	2100.00
Combined	74	2775	2775
Unadjusted variance		6300.00	
adjustement for ties		-7.65	
Adjusted variance		6292.35	

H0: Goat_price(goat_target==0) = Goat_price(goat_target==1)
Z = -3.725
Prob > |Z| = 0.0002

Source: Made by author using Stata 13.

The results of the Mann Whitney test show that there is a difference in price depending on the purpose of the sale transaction. High prices are given for goats whose slaughter sales target.

4.7. Analyzing and documenting the rationale behind the identified grading system

For responding the second objective of this study, we must first identify the main characteristics considered on the Buganda market for setting the price of goats. We use the results of the Kruskal Wallis and Mann Whitney tests to classify the different characteristics of the goat according to the prices offered on the market.

4.7.1. Main characteristics considered in Buganda market for setting price

The most important traits identified by Kruskal Wallis and Mann Whitney tests as influencing the price of goats on the Buganda market are age; body condition (loin area, brisket); body measurements (withers height, body Length, chest dept, heart girth); and live weights. All the above characteristics identified as influencing the price do not establish the relationship at the same level. There are those who have a strong relationship and others who are weak. Indeed, we can classify the relative characteristics in relative order of importance in the following table.

Table 32: Classification of characteristics in relative order of importance

Ranked order	Body measurements	Body condition	Others traits
1	Body length ($X^2 = 43.79$)	Loin area ($X^2 = 33.5$)	Live weight ($X^2 = 55.3$)
2	Chest depth ($X^2 = 27.86$)	Brisket ($X^2 = 31.0$)	Age ($X^2 = 29.24$)
3	Withers height ($X^2 = 27.37$)	Tailhead ($X^2 = 19.26$)	
4	Heart girth ($X^2 = 15.6$)		

Source: Author

Body measurement provides information on the conformation of the animal and in this category, the most important trait strongly linked to price is the body length (table 24). For the body condition of the animal, it provides information on the quality of the goat (meat) and the study proved a strong link between price and loin area (table 25). Therefore, loin area is considered as important anatomical area/parts for the evaluation of the body condition. According to the results, live weight (table 32) is the first characteristic most strongly linked to the price of the animal among all the factors considered in this study. Weight is argued to be an attribute derived from other traits, namely body condition, age and conformation.

Indeed, an animal of good body condition, good conformation and advanced age would most likely be heavier than otherwise (Mugunieri & al, 2012).

Pesmen & Yardimci, (2008) in their study finds that live weight was found to be highly correlated with heart girth, withers height, body length and chest depth. Scarpa et al. (2003) reported sex, age, body condition, estimated weight and breed as some of the key traits influencing purchase of livestock in local markets in Kajiado district of Kenya. These results correspond perfectly with the results found in Tables 32, 27.28 and 29 which reveal the factors determining the price of goat in the market.

4.7.2. Estimation results of regression analysis

The overall quality of the regression analysis is assessed using Fischer statistics, which indicates whether the explanatory variables have an influence on the dependent variable. The Fisher statistic calculated by the Stata 13 software is F = 38.01 and the associated probability is less than 5% (0.000 < 0.05), however the statistic read in the Fisher table at (14 , 59) degrees of freedom at 5% threshold is 3.34: therefore the null hypothesis is rejected and the model is globally significant.

The regression analysis results in table 33, shows the variables that are contributing to 90% of the variation of goat price on Buganda goat market. It means the regression explained the dependent variable by 90%, while the remaining 10% is explained by error term. This result is consistent with the value of the adjusted R^2 statistic (0.8765) which also provides information on the quality of the econometric model (R^2 tends to unity). The model is globally significant and of good quality, there is at least one variable which explains the price.

To decide on the individual significance of the variables, we use the Student statistic directly provided by Stata 13 software. When at the threshold considered the value of the estimated Student statistic is higher than that tabulated by Student, then we assume the hypothesis of significance of the variable. The probability of rejection provided by Stata 13.0 at the selected threshold was used here. The results of the estimate show that only 8 variables are statistically significant at 5% level (goat_sex, age, live_weight, chest_depth, poor loin very_poor_looin, medium_loin and good_loin) and Reason for sold of goat at 10% level.

Table 33: Estimated regression model of factors influencing goat price

					Number of obs	= 74
Source	SS	df	MS		F (14, 59)	= 38.51
Model	1.4327e+11	14	1.0234e+10		Prob > F	= 0.0000
Residual	1.5679e+10	59	265741871		R-squared	= 0.9014
Total	1.5895e+11	73	2.1774e+09		Adj R-squared	= 0.8780
					Root MSE	= 16302
Goat_price	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]

Sex of goat	13381.52	5051.954	2.65	0.010	3272.587	23490.46
Age of goat	15128.46	6851.739	2.21	0.031	1418.164	28838.76
Live weight	3179.544	521.3293	6.10	0.000	2136.366	4222.721
Body length	952.0038	630.0123	1.51	0.136	-308.6479	2212.655
Chest depth	832.9966	420.4129	1.98	0.052	-8.247701	1674.241
Heart girth	-98.28912	424.9019	-0.23	0.818	-948.5158	751.9376
Very poor loin	-47532.85	11891.05	-4.00	0.000	-71326.79	-23738.91
Poor loin	-40560.81	21884.33	-1.85	0.069	-84351.25	3229.635
Medium loin	-35286.17	11094.57	-3.18	0.002	-57486.35	-13085.98
Good loin	-21370.19	10851.41	-1.97	0.054	-43083.81	343.4226
Reason for sold	8996.147	4816.504	1.87	0.067	-641.6561	18633.95
Access_ to_info	4144.908	6383.975	0.65	0.519	-8629.397	16919.21
Goat_target	3320.667	6245.833	0.53	0.597	-9177.215	15818.55
Trad_exper	527.6109	398.3376	1.32	0.190	-269.4608	1324.683
Constant	-51462.46	28134.93	-2.11	0.039	-115569.3	-2973.565

Source: Made by author using Stata 13.

The positive sign of the coefficients of sex, age, live weight and chest depth variables are consistent with expected results. Indeed, this suggests that farmers who sell female goats have higher chances of earning more money than those who sell male goats. This implies that a farmer who sell female have good chances of increasing his earnings by 13381.52 FIB per goat sold compared to that which sells a male.

In addition, the results show that a goat that is less than 48 months old has a good chance of increasing its price by 15,128.46 BIF per goat than a goat with an age greater than 48 months. Several authors Ghosh (2019), Sebside (2008) and Santos et al. (2007) have demonstrated that age has an influence on the livestock performance in terms of fat reserves.

As indicated in table 31, the direction of relationship changes at 48 months old and this corresponds perfectly to the results found in table 33 that the relationship between age and price becomes negative.

Moreover, live weight is positively related to price as shown in table 33. This suggests that goats with heavy weight have higher chances of earning larger income than those with lower weight. Controlling the effects of other variables, an increase in one unit (kg) of live weight leads to increase in income of 3179.544 FIB per livestock.

The study also found that chest depth positively influences price of goat. This implies that goats which have good chest depth have higher chances of getting a larger price than those with poor chest depth. This means that a unit (cm) increase in the size of chest depth increase price by 832.9966 FIB.

The reason for the sale of goat is indicated by the estimation as influencing the price, and the more a goat is sold for a reason of maturity, the more it is likely to earn more money than those sold for cash constraints. Controlling the effects of other factors, for the same goat, the results of study show that a person who sells his animal following maturity earns 8996.147 FIB more than seller under cash constraint (cash for school fees, sick, food, ...).

A negative sign of loin area variable is consistent with expected results. The results of table 33 prove that a good scoring is relatively linked to the price of goat on market and this means that a goat of grade 1 (very poor) does not have the same price as that of grade 2 (poor). The findings also show that a goat that is scored "very good" earns 21370.19 FIB more than a goat scored "good", 35286.17 FIB more than a goat scored “medium”, 40560.81 FIB more than a goat scored "poor", and 47532.85 FIB more than the goat scored "very poor".

Here, the results converge on the similar conclusions to those of Mugunieri & al. (2012) which confirm that the superior qualities of the goat attract higher prices.

4.7.3. One-Way Analysis of Variance (ANOVA)

The *p*-value (Prob>F=.0000) is less than the .05 alpha level. The value of $F = 15.78$ exceeds the *F*-limit value ($F_{(4,69)} = 2.52$), this means there is a statistically significant difference between the means of the different grades of the loin variable. The significant F statistic tells that prices differ between these five grades i.e. the means are not equal. In line with table 33, the means show that a higher price is accorded to a goat with high quality (score for loin), it means that price of goat increases according to the grade (quality of goat).

Table 34: Results of Analysis of Variance

	Summary of goat of Price		
Score for loin	**Mean**	**Std.Dev.**	**Freq.**
Very poor loin	32000.00	0.00	1
Poor loin	83571.429	31564.664	28
Medium loin	128565.22	38168.081	23
Good loin	146815.79	36203.595	19
Very good loin	193333.33	15275.252	3

Total	**117547.30**	**46662.455**	**74**

Analysis of Variance

Source	**SS**	**df**	**MS**	**F**	**Prob>F**
Between groups	7.5939e+10	4	1.8985e+10	15.78	0.0000
Within groups	8.3010e+10	69	1.2030e+09		
Total	**1.5895e+11**	**73**	**2.1774e+09**		

Bartlett's test for equal variances: chi2(3) = 2.4476 Prob>chi2 = 0.485

note: Bartlett's test performed on cells with positive variance:

1 single-observation cells not used

Source: Made by author using Stata 13.

After having determined the part/area of the goat (tables 27 and 33) which establishes a strong relationship with price of goat, it is important to estimate the means prices for each grade. The table 34 confirms the results of table 33 that mean price varies from Grade I from far (very poor) with 32000 BIF to Grade IV from far (Very good) with 193,333.33 BIF.

4.7.4. Skewness/Kurtosis tests for Normality

We applied the Skewness/Kurtosis tests to test the normality of the sample including the variables such as price, age, live weight, body length, chest depth, heart girth of goat and expediency of trader.

Table 35: Results of Skewness/Kurtosis tests for Normality

Variable	Obs.	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
myresiduals	74	0.4172	0.3163	1.72	0.4236

Source: Made by author using Stata 13.

As the computed p-value is greater than the significance level alpha=0,05, one cannot reject the null hypothesis H0. The risk to reject the null hypothesis H0 white it is true is 0.4236.

The value of Pr (Skewness) is 0.4172 (between -1,1) and that of Pr (Kurtosis) is 0.3163 (between -2,2) as indicated in section 2.3.8. We conclude that the data of price, age, live weight, body length, chest depth, heart girth of goat and expediency of trader variables follow a normal distribution.

4.7.5. Multicollinearity test

The multicollinearity test using the calculation of VIFs (Variance Inflation Factors) consists in regressing each of the explanatory variables on the others. By performing the calculation (1-

R_2) from each of the regressions operated, it is then possible to know what part of the variance of an explanatory variable is independent of the other explanatory variables, the calculation ($1/(1-R_2)$) then allowing to obtain a "VIF" statistic for each variable.

Table 36: Results of multicollinearity test

Variable	VIF	1/VIF
poorlo	9.26	0.107978
mediumlo	7.34	0.136199
goodlo	6.26	0.159810
b_length	5.08	0.196904
Chest depth	4.41	0.227015
Heart girth	4.36	0.229373
Live weight	3.72	0.268463
Target1	2.00	0.500093
Very poor loin	1.78	0.562474
trad_exp	1.74	0.574274
Sex of goat	1.48	0.673514
goat_mature	1.47	0.679224
prce_adv	1.44	0.696267
monthsage48	1.40	0.716035
Mean VIF	3.70	

Source: Made by author using Stata 13.0.

Under STATA, the VIFs are obtained using the post-regression command "VIF". A multicollinearity problem is identified when a VIF has a value greater than or equal to 10 (Chatterjee, Hadi and Price, 2000). If the value is reached, the impact of multicollinearity, according to these authors, not worrying and all the explanatory variables can therefore be kept for the analysis, the latter then not being "distorted. "Cripplingly by the level of existing multicollinearity. If, on the contrary, these values were reached, then the multicollinearity problem would have to be addressed by the experimenter.

The above literatures lead to the conclusion that there is not a multicollinearity problem in the following variables: age, live weight, body length, chest depth, goat heart circumference and the expediency of the trader's variables follow a normal distribution.

4.8. Interactions of characteristics in composition of goat grades

The interactions between different characteristics such as sex, age, body condition and body conformation will determine the grades of goat. In addition to these features, there is the live weight which has demonstrated a powerful relationship with the price.

The regression equation was established as followed:

$$\text{Goat_Price} = -51462.46 + 13381.52\ \text{Fem_Sex_Goat} + 15128.46\ \text{Under_48_months} + 3179.544\ \text{Live_Wei} + 832.9966\ \text{Chest_Depth} - 47532.85\ \text{Very_Poor_Loin} - 40560.81\text{Poor_Loin} - 35286.17\ \text{Medium_Loin} - 21370.19\ \text{Good_Loin} + 8996.147\ \text{Goat_mature}.$$

It is concluded that Goat price could be predicted by statistical methods using several body measurements (live weight, body length), body condition (loin area), goat sex and age on Buganda goat market.

However, the estimates show that in both cases (Multiple linear regression and Kruskal Wallis test), loin area is essential in determining of price and it can be used in goat commercialization, since the price varies according to grade (quality) of goat as indicated in both tables 25 & 33. Sex, age and live weight have also been shown to be important factors determining the price of goats given the size of their coefficients (tables 27, 28, 29& 33).

To facilitate live grading at the market, we have reduced the rating levels of the different parts of the goat from five to three.

Table 37: New scoring of the goat limited to three levels

Score	Very good	Good	Medium	Poor	Very poor
New score	Excellent		Good	Poor	

Source: Author

The descriptive analysis shows that the total number of goats which were scored very poor and very good represents on average only 5% of all the livestock surveyed and that's why we reformed the scoring level.

Despite the performances demonstrated by the body conformation, we will not keep body measurements in the grading because this will be replaced by the live weight more efficient than this one.

Table 38: Grades of goats marketed on the Buganda market

Grade	Sex	Live weight	Age	Loin area	Sample Price (BIF)
I	Male uncastrated/castrated	[30 & elder]kg	Max 48 months	Excellent	146,815.79 – 193,333.33

	Female	[30 & elder]kg	All age	Excellent	146,815.79 – 206,714.85
II	Male uncastrated/castrated	[15 - 30]kg [30 & elder [kg	Max 48 months	Excellent Good	83,571.42 – 146,815.79
	Female	[15 - 30]kg [30 & elder [kg	All age	Excellent Good	83,571.429 – 160,197.31
III	All eligible	No limit	No limit	Poor	32,000 – 83,571.429

Source: Author

This suggested grading system is applicable for goats in all body conditions. Indeed, goats that are in the same grade will have the same unit price and the only difference will appear in terms of live weight. Sample price were obtained from the ANOVA results presented in table 33 and the multiple regression in table 34. The question that can be asked is who will determine the grade and the price of the goat? On what criteria will the price be fixed?

4.9. Institutions that can support the grading system

Currently in Burundi there are no institutions or entities responsible for the classification of animals, control and monitoring of prices on the livestock markets. After formalizing a grading system, it will, therefore, be important to propose an institution that will be responsible for the implementation of this system and to clearly define their Terms of reference (TOR).

According to the results of this study, we recommend two services in the implementation of the proposed classification system. it is a Meat graders service for goats and a Market Information service (MIS). This is discussed in the next section.

4.9.1. Meat Graders

The main activity of the Meat Graders is the classification of animals into three classes according to the above proposed grading system. The service team will be set up by the Ministry of Livestock and will also be made up by qualified veterinarians. In the case of the Buganda market, this service could work in frank collaboration with the municipal veterinary.

The number of members of the classification team will be proportional to the quantity of animals frequent on the market and should not in principle be less than two qualified persons. The service will also be responsible for weighing live animals.

4.9.2. Market Information service (MIS)

Access to important for producers and traders of livestock. It will encourage farmers to participate at livestock markets. Therefore, it will be important to set up a goat market information system (MIS). The MIS will provide weekly updates market prices (e.g. price per kg liveweight for each goat category) and other information through the national or local radio and in regular price bulletins. The MIS will be housed in the livestock statistics and documentation service (ISTEEBU).

CHAPTER 5. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusions

Results of this study show that goat market prices on the Buganda market are influenced by body condition, conformation (including, live weight, sex and age of the goat). Breed type did not influence pricing. A simplified live (or on-hoof) grading system which takes into consideration these five attributes is proposed. Using this system, goats will be graded into three grades (I, II and III) and price per kilogram will be the same for each grade. Since live weight was found to be highly correlated with many other body measurements taken during this study (heart girth, withers height, body length and chest depth) and through regression analysis

it was also discovered that all the above attributes were positively correlated with goat price, pricing on the proposed scheme will be mainly based on goat's liveweight. Therefore, it is suggested that goats are weighed and graded first before price negotiations start between buyer and seller. Research found that farmers who sell female goats are more likely to earn more money than those who sell males. It is anticipated that the grading system will persuade farmers to put investment efforts into improving the quality of the goat that are brought to the market.

5.2. Suggestions

The goat marketing as an activity for the promotion of livestock products plays a very important role in the economy of Buganda district. The goat trade as a place where most of the actors involved in this activity are found contributes significantly.

To improve this contribution and strengthen the role of goat markets for the promotion and revitalization of the livestock sector, the following suggestions are very important. Study suggestions target policy makers, Market information dissemination, Suggestions to the intermediaries and research, training and advisory institutions.

5.2.1. Suggestions to the policy makers

Suggestions from this study advise policy makers to construct adequate marketing and slaughter infrastructure for the rural livestock markets, especially for goats. Government will be responsible for establishing the laws and directives governing this new system in order to stimulate and strengthen the effective participation of stakeholders, in particular breeders and small agents. It will also be responsible for linking and developing an indicative relationship between the grades developed and the effective quality of the carcass.

The study also suggests the establishment of a known service that could take care of goats not sold on market day while waiting for the next market, which would allow traders and producers from far regions not to sell at poor prices their livestock.

5.2.2. Market information dissemination

The study suggests the implementation of the different steps towards formalizing and recognizing the grading system be supported by a powerful information system. The lack of information prejudices the quality and prices in force for goat producers and traders and can also be a source of weak presence of certain market players. This is why we suggest setting up a robust market information system (MIS) for goat. As the frequency of most livestock markets in Burundi is weekly, it is much easier to process the data collected and make it available to all

interested stakeholders. The ISTEEBU (Burundi Institute of Statistics and Economic Studies) would be a good framework to collect and disseminate prices every week.

5.2.3. Suggestions to the intermediaries

For intermediaries (brokers), special attention must be paid to the work they do in order to train them in the brokerage profession. The improvement of their knowledge, their working conditions in addition to the security which they are supposed to bring, during the transactions can bring a new dynamic on goat market.

5.2.4. Suggestions for further research

This study conducted research on the grading system in goat marketing on the Buganda market, therefore separate studies on value chain and classification of livestock (cattle, sheep) can be conducted to provide further analysis livestock in the study area.

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APPENDICES

I. GOAT FARMERS' MARKETING INFORMATION

1) Full name of the commune of Respondent? ……..
2) What is the sex of the respondent? 1= male, 0= Female
3) What is the age of the respondent? ……..
4) What is the marital status? 1=married, 2=single, 3= widower/widow, 4=separated/divorced
5) What is the educational level of the respondents? 0= No level, 1=catechesis, 2= Primary, 3= Secondary, 5= College, 6= University, 6=Other (identify)
6) What is your primary occupation? 1= Wage employment, 2= Goat keeping, 3= Business, 4= Crop production
7) How far is the market place from you farm gate? Km /__/ /__/
8) On average how many goats do you sell per month? /__//__/

9) How many goats did you sold each month from Jan 2019 to Dec 2019 (write figure for each month)?

Month	Jan	Feb	Mar	Apr	May	jun	jul	Aug	Sep	Oct	Nov	Dec
Number (goats)												

10) Which market do you prefer among the following? 1= Abattoirs, 2= Middlemen, 3= Traders, 4=Butchery 6=other (identify).
11) Why do you prefer that market? 1=use of weighing facilities, 2=It is nearby the livestock farmers, 3=Good environment for selling, 4=No other alternative market, 5= other (identify).
12) When do you decide to sell a goat?1= When animal is mature, 2=Sick animal, 3= When cash constrained, 4= Other (identify).
13) Is goat the principal source of income that you sell? **1**=Yes, **0**=No
14) Are you aware of prices prevailing in the nearby markets? 1=Yes, 2=No
15) How do you get information on prices at the other markets? 1=by phone, 2= from neighbor / colleagues 3= by radio; 4= Issued by traders, 5=Farmers Association 6 =Government Extension Services 7=Other (identify).
16) Do you know prices in advance before taking your consignment to the market? 1= Yes, 2=No
17) Are you satisfied with the current goat prices at this market? 1= Yes, 2= No
18) If no why 1=price is low, 2=bad period, 3=No unit of measure the weight of goat, 4=buyers offer price which are in their favour, 5= others (identify)

II. TRADERS QUESTIONNAIRE

19) What is the sex of the trader? 1= male, 0= Female
20) What is the age of the trader? ……..
21) How many people do you employee on this goat business? /__/__/
22) What category of trading business do you belong to 1=Wholesaler, 2=Middlemen, 3=Retail, 4=Butchers 5=other (identify)?
23) How many years have you been in this business? /__/
24) Who provided the start-up capital? **1**= Own capital, **2**= Financial aid of relative, **3**= Loan, **4**= other (identify).
25) Is there any variability in the volume of goat you buy between seasons? 1=yes; 2=No

26) If yes, which month (s) do you buy the most goats? /__/__/

27) Which month (s) do you buy the least number goats? /__/__/

28) What factors are considered in setting the price? 1=Supply and demand forces, 2= Quality grades, 3= observation of the physical condition, 4=Sex, 6=Breed, 5=Weight, 6=Others

29) Who sets the goat prices? 1=Seller, 2= Buyer, 3= both buyer and seller 4= other (identify)

30) How many days in a week do you usually devote to buying goats? /__/

31) How far is your preferred slaughter facility from the market? /__/ /__/ Km

32) What kind of a slaughter facility do you use? (i) Trader's home (ii) commune Slaughter slab (no roof), (iii) Slaughter slab (roofed + tables) iv. Proper abattoir

II.0. Assessment of the Goat in Trader's hand

33) What is the price of the goat in your hand / FIB /__//__//__//?

34) What is the destination of the goat? (1) =Domestic consumption (2) =Own breeding, (3) =slaughter stock. (4) = (iv Other)

II.1. Sex

35) What is the sex**?** Male=1; female=0

36) If it is male, it's castrated or uncastrated /__/ /__/ uncastrated = 0; castrated=1

II.2. Age

37) How old is this goat? /__/ /__/ months

38) Is the goat targeted for slaughter? /__/ /__/ yes=1, no=0

II.3. Body condition

Classification of body condition/ Body score: 1 – 5 scale (1 =very poor 2 =poor 3=medium 4=good and 5=very good

39) Score for the hind leg? 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.

40) Score for the loin? 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.

41) Score for the Brisket area? 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.

42) Score for rip cage? 1 =very poor; 2 =poor; 3=medium; 4=good; and 5=very good.

II.4. Body measurements

43) Withers height (WH): What is the distance from the surface of a platform to the withers? cm /__/ /

44) Body length (BL) (Withers to tail head) cm/__/ /

45) Chest depth (CD) cm__/ /

46) Measurement of Heart girth (HG) cm/ /__/ /

III. Weight (the goats are weighed at the time of the transaction)

47) What are the live weights of the goat? Kg /__/ /

48) What are the carcass weights of the goat (excluding kidneys)? Kg /__/ /

49) Weight of fifth quarter (Intestines and head). Kg /__/ /

IV. Breed

50) Is breed a factor in grading? /__/ /__/ yes=1; no=0

51) If yes, which are the preferred breeds? /__/ / local=1; hybrid=2 & foreign breed

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