PHENOTYPIC TRAITS OF INDIGENOUS SHEEP BREEDS IN KANO STATE

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DEGREE OF MASTER OF SCIENCE IN ANIMAL SCIENCE

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DECLARATION

I hereby declare that this work is the product of my own research efforts undertaken under the supervision of Professor T. Ibrahim, and has not been presented and will not be presented elsewhere for the award of degree or certificate. All sources have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation entitle “Phenotypic traits of indigenous sheep breeds in Kano State”and subsequent preparation of this dissertation (Isma’ilYakubuSPS/11/MAS/00009) were carried out under my supervision, meets the regulations governing the award of Master of Science of Bayero University Kano, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to my late father, Alh. Yakubu Ismail.

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ABSTRACT

The Study was conducted to phenotypically characterize indigenous sheep bread in selected locations of Kano State, namely Bunkure-Kibiya, Rogo-Kiru, Madobi-Kumbotso and Bebeji-Tudunwada, to assess qualitative and quantitative traits from four hundred sheep comprising of two hundred and seventy two ewes and one hundred and twenty eight rams. Multi stage sampling techniques were used in the study, qualitative traits were recorded after visual inspection. For quantitative traits, body weight was taken using a weighing scale, while linear measurements were measured using flexible measuring tape calibrated in centimeters, the data collected was analyzed using SPSS version 16. The results showed that Yankasa was the most predominant (71.25%) breed reared in the study area. White dominant coat color pattern (47%), plain coat color type(68.5%), short and smooth hair coat type(72.5%), long thin tail type(88.25%), straight tip tail form(97.5%), concave head profile(51.5%), horizontal ear form(100%), straight horn shape(49.64%), absence of wattle(82.75%) and horn(65.75%) were the most observed categorical traits in the study area. It also revealed that between the three breeds, Balami had the highest mean for body weight (35.16 kg) as well as for most of the linear body measurement. There was sexual dimorphism in body weight (35.27kg vs 28.09kg for rams and ewes, respectively) and other linear traits measured, all in favour of males except in pelvic width (11.63±0.4 cm vs 9.34±0.8 cm). Positive correlations existed between body weight and most linear body measurements, irrespective of sex of sheep. Thus, coat color pattern, hair coat type, tail form, heart girth, head profile, shoulder width, body length, body weight, ear length and coat colour type should be considered in breed identification. In addition, linear body traits could be used as selection criteria for increased body weight.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND INFORMATION

Characterization of small ruminant population in developing countries will play a major role in the maintenance of the genetic resources as the basis for future improvement in livestock production (Birteeb *et al*., 2012).

A number of factors have contributed to the severe erosion of indigenous genetic resources and even extinction of indigenous breeds. These include the use of exotic breeds, changes in breeders preferences due to short-term socio-economic influences, degradation of the ecosystem in which the breeds were developed as well as natural disasters such as drought and diseases (FAO,1998;FAO, 2000). Therefore, there is a need to characterize indigenous breeds in order to understand the existing diversity to facilitate the development of rational utilization and conservation strategies for these breeds (Hanotte and Jianlin, 2005).

Livestock play a very important role in Nigerian Agriculture contributing about 12.7% of all the total agricultural gross domestic product (CBN, 1999). Nigeria is one of the four leading livestock producers in Sub– Saharan Africa. In 1990 the livestock population comprised about 14 Million cattle, 23 Million goats and 13 Million sheep (RIM,1990). However, estimates from the Federal Livestock Department (FLD) by Federal Ministry of Agriculture in 2010 (Yemi, 2010) showed that there are 16,577,962 cattle, 56,524,075 goats, and 35,519,759 sheep, in the country

Sheep belong to the sub – family *bovidae*. The genus *Ovis* includes all sheep, while domesticated sheep belongs to the species *Ovis aries*. Their original center of domestication seems to be the Arlo Caspian Steppes, including the area occupied by present day Iran and Iraq (McLeoroy, 1961). Sheep play an important role in the socio - economic life of the people of Nigeria. They also make a significant contribution to the national economy. Sheep rearing is one the most important means of livelihood and food security for the majority of rural populace, especially in the developing countries (Amadou *et al*., 2012).

There are four main breeds of sheep native to Nigeria and these are: Balami, Uda, Yankasa and West African Dwarf (WAD).

These four breeds differ considerably in size, coat colour and other characteristic (Adu and Ngere, 1979). All indigenous sheep are hairy and can be broadly grouped into large, long – legged types and the dwarf type. Sheep reared by a community may be isolated from other types because of the isolation of traditional culture barriers. Some communities attach special cultural values to their sheep and exclude the use of breeding stock from other populations resulting in cultural barrier flow (Gizaw *et al*., 2007).

Information on morphological characteristics is a prerequisite to sustainable breed improvement, utilization and conservation. This is also a prelude to community-based breeding strategies which warrant that the breed have to be well studied beforehand, and traits which make them unique, be characterized both at phenotypic and genetic levels. The identification and proper use of local sheep types will further contribute to improved food security of the developing countries by reducing the pressure on the environment and provide a long term and sustainable source of income and thereby arresting migration of human population to the urban areas (FAO, 2012). To meet their personal preferences, individuals and communities commonly have their own preferences rankings for visual traits. However, showing an incline type of preference towards some variants of morphology is not uncommon. This type of selective breeding practice has been used to maintain and increase the frequencies of particular phenotype for the preferred traits (Bartels, 2003). Smallholder farmers usually have broad breeding objectives to fulfill their versatile needs through keeping flocks of diverse phenotypes (Dana *et al.,*2010).

1.2 PROBLEM STATEMENT

The erosion of domestic animal diversity due to natural causes and creative human activity is serious concern if current production levels are to be sustained and the changing demands of future markets are to be addressed. There are more than 1,400 modern domestic sheep breeds. However, FAO estimated that at least one breed of traditional livestock becomes extinct every week (FAO, 2006). Extinction of livestock breeds to gradual dilutions is due to limited awareness of the adaptive characteristics of indigenous livestock breeds owing to a lack of proper scientific documentation which is one of the key reasons for such dilution (Hassan *et al.,* 2007, Kohler-Rollefson *et al*.,2009).

The greatest challenge being faced by these populations is indiscriminate cross breeding with exotic breeds and causing increasing threat to these breeds, with possibility of extinction (Baker *et al.*, 2002). In sub-Saharan Africa, it has been estimated that 30% of the indigenous genetic resources are at risk of becoming extinct before they are characterized and documented (Rege *et al.*, 1996). The indigenous sheep breeds of Nigeria (Yankasa, Balami, Uda and West African Dwarf) are faced with many challenges including persistent droughts, diseases, conflicts and poor nutrition (Kosgey *et al*., 2008). Their ability to walk long distances in search of pasture and adaptability to the harsh environmental conditions (Owen *et al*., 2005) and together with some unique traits, like resistance to gastrointestinal nematodes increases their importance to resource-poor farmers and pastoralists(Baker *et al.*, 2002).

There are quite a number of indigenous livestock breeds that still need to be scientifically documented and characterized to enable their conservation (Bhatia and Arora, 2005).To make the conservation of the indigenous breeds a reality and ensure sustainable use of their genetic diversity, it is particularly desirable that their phenotypic characteristics and performance be evaluated in their home tracts and under traditional management conditions (Zarate, 1996). Identification of specific breed attributes can also contribute to better use of these genetic resources by farmers (Mwacharo *et al*., 2006). Phenotypic distribution of sheep and goats in Southern parts of Kaduna State, Nigeria was carried out by Wamagi *et al*., (2013), but information on distinct sheep populations, selection criteria and breeding practices of farmers were not considered. Whereas within Kano there were neither phenotypic distribution of sheep nor information on distinct sheep populations, selection criteria and breeding practice of farmers.

1.3 JUSTIFICATION OF THE STUDY

Indigenous livestock breeds of Africa are well adapted to the local environment even though their productivity is generally lower when compared to other parts of the world. Attempts by breeders and farmers to improve the performance of the indigenous African breeds involve the introduction of exotic animal and cross breeding practices, which is gradually leading to the erosion and complete masking of important survival traits, such as disease resistance associated with indigenous livestock as well as the extinction of certain breeds (Gizaw *et al*., 2011). The characterization of Sheep populations will play a major role in the maintenance of these genetic resources as the basis for future improvement at both the production and the genetic levels.

1.4 OBJECTIVES OF THE STUDY

The broad objective of the study is to phenotypically characterize indigenous sheep breeds in Kano state, while the specific objectives are:

1. To determine the influence of location, breed and sex on qualitative traits of sheep.
2. To determine the effect of location, breed, sex and age on quantitative traits of sheep.
3. To estimate phenotypic relationships among body measurements.

CHAPTER TWO

LITERATURE REVIEW

2.1 History of Domestic Sheep

Sheep entered the African continent not long after their domestication in Western Asia (Blench and Kelvin, 1999). A minority of historians once posited a contentious African theory of origin for Ovis aries (Blench and Kelvin, 1999). This theory is based primarily on rock art interpretation and osteological evidence from Barbary sheep. The first sheep entered North Africa via Sinai, and were present in ancient Egyptian society between eight and seven thousand years ago. Sheep have always been part of subsistence farming in Africa, but today the only country that keeps an influential number of commercial sheep is South Africa. South African producers, in an attempt to deal with the numerous predators of Africa, invented the livestock protection collar, which holds poison at the jugular to sicken or kill predators (Ensminger and Parker, 1986).

Domestic sheep (*Ovis aries*) are ruminant mammals typically kept as livestock. Like all ruminants, sheep are members of the order Artiodactyla, the even-toed ungulates (hoofed mammals). Although the name "sheep" applies to many species, in everyday usage, it almost always refers to *Ovis aries*. Numbering a little over 1 billion, domestic sheep are the most numerous species in their genus (Blench and Kelvin, 1999).

Sheep most likely descended from the wild mouflon of Europe and Asia. One of the earliest animals to be domesticated for agricultural purposes, sheep is raised for fleece, meat (Lamb or mutton) and mille Sheep wool is the most widely used of any animal, and is usually, harvested by shearing. Sheep continued to be important for wool and meat today, and are also occasionally raised for pelts, as dairy animals, or as model organisms for science, Sheep husbandry is practiced throughout the majority of the inhabited world, and has been fundamental to many civilization. In the modern era, Australia, New Zealand, the southern and central South American nations and the British Isles are most closely associated with sheep production. Use of the word sheep began in Middle English as a derivation of the Old English word sceap; it is both the singular and plural name for the animal (Blench and Kelvin, 1999).

A group of sheep is called a flock, herd or mob. Adult female sheep are referred to as ewes, intact males as rams or tups, castrated males as withers, and younger sheep as lambs. Many other specific terms for the various life stages of sheep exist, generally related to lambing, shearing, and age. Being a key animal in the history of farming, sheep have a deeply entrenched place in human culture, and find representation in much modern language and symbology. As livestock, sheep are most-often associated with pastoral and Arcadian imagery. Sheep figure in many mythologies such as the Golden Fleece and major religions, especially the Abrahamic traditions. In both ancient and modern religious ritual, sheep are used as sacrificial animals. In contemporary English language usage, people who are timid, easily led, or stupid are often compared to sheep (Blench and Kelvin, 1999).

Domestic sheep are relatively small ruminants, usually with a crimped hair called wool and often with horns forming a lateral spiral. Domestic sheep differ from their wild relatives and ancestors in several respects, having become uniquely neotenic as a result of man's influence (Ensminger and Parker, 1986; Budiansky, 1999). A few primitive breeds of sheep retain some of the characteristics of their wild cousins, such as short tails. Depending on breed, domestic sheep may have no horns at all (polled), or horns in both sexes (as in wild sheep), or in males only.

Most horned breeds have a single pair but a few breeds may have several (Simmons and Ekarius, 2001).

Another trait unique to domestic sheep (as compared to wild ovines, not other livestock) is their wide variation in color. Wild sheep are largely variations of brown hues, and variation with species is extremely limited. Colors of domestic sheep range from pure white to dark chocolate, brown and even spotted or piebald (Smith *et a*l., 1997; Weaver, 2005). Selection for easily dye able white fleeces began early in sheep domestication, and as white wool is a dominant trait it spread quickly. However, colored sheep do appear in many modern breeds, and may even appear as a recessive trait in white flocks (Smith *et a1*., 1997); Weaver, 2005). While white wool is desirable for large commercial markets, there is a niche market for colored fleeces, mostly for hand spinning (Wooster and Hansen, 2005). The nature of the fleece varies widely among the breeds, from dense and highly crimped, to long and hair-like. There is variation of wool type and quality even among members of the same flock, so wool classing is a step in the commercial processing of the fiber.

Dentition: The dental formula: mature sheep have 32 teeth, either (I:0/4 C:O/O P:3/3 M:3/3) or (I:0/3 C:0/1l P:3/3 M:3/3). As with other ruminants, the eight incisors are in the lower jaw and bite against a hard, toothless pad in the upper jaw; picking off vegetation. There are no canines; instead there is a large gap between the incisors and the premolars. Until the age of four (when all the adult teeth have erupted), it is possible to see the age of sheep from their front teeth, as a pair of incisors erupts each year (Melinder, 2004). The front teeth are gradually lost as sheep age, making it harder for them to feed and hindering the health and productivity of the animal. For this reason, domestic sheep on normal pasture begin to slowly decline from four years on, and the average life expectancy of a sheep is 10 to 12 years, though some sheep may live as long as 20 years (Ensminger and Parker, 1986; Smith *et al.,* 1997; Schoenian, 2007).

Sheep have good hearing, and are sensitive to noise when being handled (Smith *et al.,* 1997). Sheep have horizontal slit-shaped pupils, possessing excellent peripheral vision; with visual fields of approximately 270° to 320°, sheep can see behind themselves without turning their heads (Weaver, 2005; Shulaw, 2006). However, sheep have poor depth perception; shadows and dips in the ground may cause sheep to balk. In general, sheep have a tendency to move out of the dark and into well-lit areas (Brown and Meadowcroft, 1996), and prefer to move uphill when disturbed. Sheep also have an excellent sense of smell, and, like all species of their genus, have scent glands just in front of the eyes, and interdigitally on the feet. The purpose of these glands is uncertain (Smith *et al*., 1997), but those on the face may be used in breeding behaviors (Simmons and Ekarius, 2001). The inter digital glands might also be used in reproduction (Simmons and Ekarius, 200 1) but alternative reasons, such as secretion of a waste product or a scent marker to help lost sheep find their flock, have also been proposed (Smith *et al*., 1997).

Sheep and goats are closely related (both are in the subfamily Caprinae), and it can be difficult to distinguish them by their appearance. However, they are separate species, so hybrids rarely occur, and are always infertile. A hybrid of a ewe and a buck (a male goat) is called a sheep-goat hybrid, and is not to be confused with the genetic chimera called a geep. Visual differences between sheep and goats include the beard and divided upper lip unique to goats. Sheep tails also hang down, even when short or docked, while the short tails of goats are held upwards. Sheep breeds are also often naturally polled (either in both sexes or just in the female), while naturally polled goats arc rear (though many are polled artificially). Males of the two species differ in that buck goats acquire a unique and strong odor during the rut, whereas rams do not (Smith *et al*., 1997).

The domestic sheep is a multi-purpose animal, and more than 200 breeds now in existence were created to serve these diverse purposes (Ensminger and Parker, 1986). Almost all sheep are classified as being best suited to furnishing a certain product: wool, meat, milk, hides, or a combination in a dual-purpose breed. Other features used when classifying sheep include face color (generally white or black), tail length, presence or lack of horns, and the topography for which the breed has been developed. This last point is especially stressed in the UK, where breeds are described as upland (hill or mountain) or lowland breeds. A sheep may also be of a fat-tailed type, which is a dual-purpose sheep common in Africa and Asia with larger deposits of fat within and around its tail (Brown and Meadowcroft, 1996)

Breeds are also grouped based on how well they are suited to producing a certain type of breeding stock. Generally, sheep are thought to be either "ewe breeds" or "ram breeds". Ewe breeds are those that are hardy, and have good reproductive and mothering capabilities, they are for replacing breeding ewes in standing flocks. Ram breeds arc selected for rapid growth and carcass quality, and are mated with ewe breeds to produce meat lambs. Lowland and upland breeds are also crossed in this fashion, with the hardy hill ewes crossed with larger, fast-growing lowland rams to produce ewes called mules, which can then be crossed with meat-type rams to produce prime market lambs. Many breeds, especially rare or primitive ones, fall into no clear category (Brown and Meadowcroft, 1996).

Breeds are categorized by the type of their wool. Fine wool breeds are those that have wool of great crimp and density, which are preferred for textiles. Most of these were derived from Merino sheep, and the breed continues to dominate the world sheep industry. Downs breeds have wool between the extremes, and are typically fast-growing meat and ram breeds with dark faces (D'Arcy, 1986). Some major medium wool breeds, such as the Corriedale, are dual purpose crosses of long and fine-wooled breeds and were created for high production commercial flocks. Long wool breeds are the largest of sheep, with long wool and a slow rate of growth. Long wool sheep are most valued for crossbreeding to improve the attributes of other sheep types. For example: the American Columbia breed was developed by crossing Lincoln rams (a long wool breed) with fine-wooled Rambouillet ewes (D'Arcy, 1986).

Coarse or carpet wool sheep are those with a medium to long length wool of characteristic coarseness. Breeds traditionally used for carpet wool show great variability, but the chief requirement is a wool that will not break down under heavy use as would that of the finer breeds. As the demand for carpet-quality wool declines, some breeders of this type of sheep are attempting to use a few of these traditional breeds for alternative purposes. Others have always been primarily meat-class sheep (Wooster and Hansen, 2005).

Sheep follow a similar reproductive strategy to other herd animals. A group of ewes is generally mated by a single ram, which has either been chosen by a breeder or has established dominance through physical contest with other rams in feral populations (Wooster and Hansen, 2005).Most sheep are seasonal breeders, although some are able to breed year-round (Wooster and Hansen, 2005). Ewes generally reach sexual maturity at six to eight months of age, and rams generally at four to six months (Wooster and Hansen, 2005). Ewes have estrus cycles about every 17 days, during which they emit a scent and indicate readiness through physical displays towards rams. (Wooster and Hensen, 2005)

Without human intervention, rams fight during the rut to determine which individuals may mate with ewes. Rams, especially unfamiliar ones, will also fight outside the breeding period to establish dominance; rams can kill one another if allowed to mix freely (Wooster and Hansen, 2005). During the rut, even normally friendly rams may become aggressive towards humans due to increases in their hormone levels (Simmons and Ekarius, 2001).

2.2 CHALLENGES FACED BY INDIGENOUS SHEEP BREEDS

The greatest challenge being faced by these populations is the indiscriminate cross breeding with exotic breeds and causing increasing threat to these breeds, with possibility of extinction (Baker *et al.*, 2002). In sub-Saharan Africa it has been estimated that 30% of the indigenous genetic resources are at risk of becoming extinct before they are characterized and documented (Rege *et al.*, 1996). The indigenous sheep breeds of Nigeria (Yankasa, Balami, Uda and West African Dwarf) are faced with many challenges including persistent droughts, diseases, conflicts and poor nutrition (Kosgey *et al.*, 2008).

Sheep rearing is one of the most important means of livelihood and food security for majority of the rural populace, especially in developing countries (Amadou *et al.* 2012). Indigenous livestock breeds of Africa are well adapted to the local environment even though their productivity is generally lower when compared to other parts of the world. Attempts by breeders and farmers to improve the performance of the indigenous African breeds involve the introduction of domestic animal diversity is a term that has been used to mean the genetic differences among and within breeds of species used for food and Agriculture. Exotic animals and crossbreeding practices, which is gradually leading to the erosion and complete masking of important survival traits, such as disease resistance associated with indigenous livestock as well as the extinction of certain breeds (Gizaw *et al.*, 2011). Movements by Fulani pastoralists and trading of livestock between Southern and Northern Nigeria have encouraged introgression. This genetic exchange between different ecological zones in Nigeria has made breed identification a difficult task in animal husbandry as any of the breeds can be mistaken for another (Yunusa *et al*; 2013).

Indigenous breeds in general demonstrate low production figures when compared to commercial stock, however they may hold potential due to years of adaption to the pressures of specific local environment. Adaptive traits that are usually associated with indigenous breeds include: tolerance to various diseases, tolerance to extreme temperatures and humidity, tolerance to change in availability of feeds, adaptation to low capacity management and ability to survive, produce and reproduce for long period of time (Scherf, 2000). The Food and Agricultural Organization of the United Nations (FAO) have reported that about 690 (9%) of the wolrd's 7500 documented breeds of livestock had become extinct within the past 150 years (FAO, 2007).

2.3 QUALITATIVE TRAITS

It has been observed that, morphological characteristics of indigenous sheep in southern regional state of Ethiopia revealed the major qualitative characters of both sexes that plain coat colour pattern observed in all zones with sheep in Kembata Tembaro-Hadiya (KTH), having significantly higher proportion than those of Sidama – Gedeo (SIG), Gurage- Silte (GUS) and Wolaita (WOL). The sheep in Gamogofa (GAG) were characterized by having significantly larger number with patchy coat colour pattern than those found in other zones. The brown colour with brown dominant type was commonly observed among the sheep reared in SIG. The most common hair coat colour in the area was brown dominant followed by white dominant. The dominant hair colour of sheep in the other location, was black, followed by red. The red hair coat colour predominates in the sheep. The commonly observed hair coat colour of sheep was primarily white followed by red and brown dominant, Aberra *et al*., (2013) Sheep distribution by breed, age, sex, and beards/wattles/manes around Southern part of Kaduna state, Nigeria was studied by Wamagi *at al.,* (2013) and reported that Yankasa (sported black) were the most dominant breed followed by Uda; The Yankasa has lowest in number. Sheep above 3 years of age were more in number than those between the age of 2.5 and 3 years and below 2.5 years of age. In term of sex, males accounted for of the sheep population while females made up the remaining, but the difference was not significant. Most of the sheep in the study area had neither beards, wattles, nor manes that is normal.

2.4 QUANTITATIVE TRAITS

Yakubu *et al*., (2010) pointed out that rump height, body length, horn length, face length, chest girth, neck circumference and head width are the most discriminant variables separating Djallonke and Red Sokoto goats that yielded 100 % correct classification in his work Discriminant analysis of morphometric differentiation in west African Dwarf and Red Sokoto goats.

The work of Yunusa *et al.,* (2013) on morphometric characterization of Nigerian indigenous sheep displayed that out of 17 variables considered, 8 were included in the analysis. Tail length (TL) was found to be the most discriminating character followed by ear length (EL), rump width (RW), hock length (HOL), rear leg length (RLL), heart girth (HG), wither height (WH) and shoulder width (SW) in decreasing order of discriminating power. This result was in harmony with Salako and Ngere (2002) where tail length was obtained to be the most discriminating variable between Yankasa and WAD.

The population variability of three breeds of Nigerian sheep was investigated by Abdulmojeed and Isa (2011), a total of ten morphological traits (withers height, rump height, body length, face length, rump length, tail length, chest circumference, head width, shoulder width and rump width) were collected on each animal. The body measures of Balami sheep were significantly higher than the others with the exception of tail length. Uda sheep also had comparative advantage over their Yankasa counterparts in all the morphological traits analyzed. The stepwise discriminant analysis revealed that head width chronologically followed by tail length, chest circumference and body length were more discriminating in separating the three populations. The Mahalanobis distance between Yankasa and Balami sheep was highest (4.83) while the least differentiation was observed between Uda and Yankasa sheep (1.79). Nearest neighbour discriminant analysis showed that most Balami sheep (61.45%) were classified into their source genetic group. While 41.22% of Uda sheep were misclassified as Yankasa sheep, 35.35% of Yankasa were wrongly assigned as Uda sheep, showing the level of genetic exchange that has taken place between the two breeds overtime.

CHAPTER THREE

MATERIALS AND METHODS

3.1 DESCRIPTION OF THE STUDY AREA

The study was conducted in selected local government areas (LGAs) of Kano state, from October 2014 to January 2015. Kano state is located between latitude $9^{0}30^{'}$ and $12^{0}30^{'}$ North and Longitude $9^{0}30^{'}$ and $8^{0}42^{'}$ East. The area is characterized by tropical wet and dry climate; a wet season (May to September) and dry season (October – April) with annual rainfall that ranges between 600 – 1000 mm and temperature regimes between 20^{0}C and 40^{0}C in the months of September to February (KNARDA, 2006).

The populations of cattle, sheep and goat as of 2011 in Kano state were 1,074,667; 2,712,370; and 3,043, 895, respectively (Kano State Ministry of Agriculture, 2014).

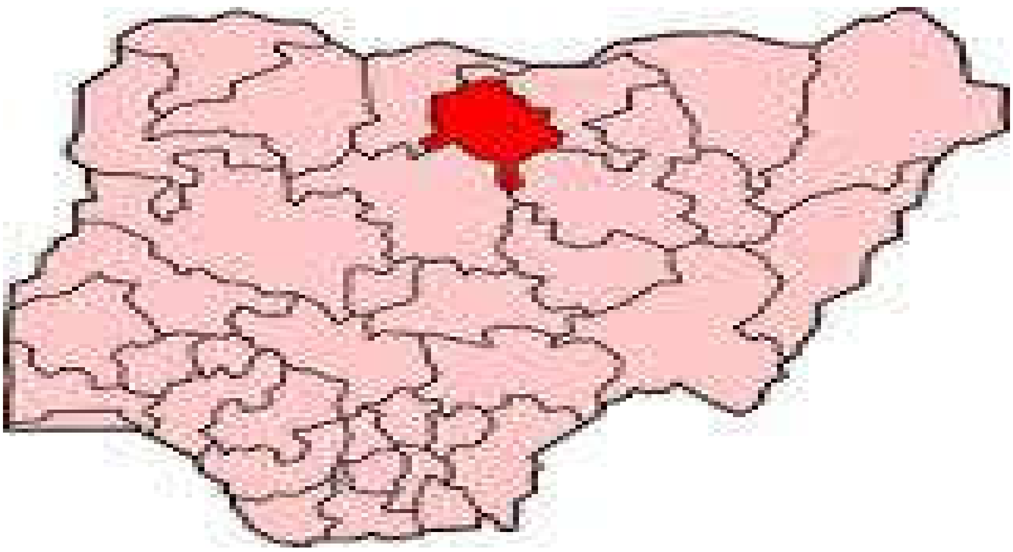

Figure 1: Map of Nigeria showing the location of the study area

3.2 SAMPLING PROCEDURE

A reconnaissance tour was carried out before the commencement of the research. Multistage sampling technique was used in the study. First stage involved eight local government areas (LGAs) which were purposively selected and clustered into four groups based on their closeness in geographical terrain and similarity in social and cultural values of human population. The groups were described as Bunkure-Kibiya (BNK-KBY), Rogo-Kiru (RGG-KRU), Madobi-Kumbotso (MDB-KBT) and Bebeji-Tudun-wada, (BBJ-TWD).

The second stage involved selection of two (2) villages from each of the local government areas giving a total of sixteen (16) villages. The third stage involved identification and allocation of numbers to five (5) households in the selected villages giving a total of eighty households. The households were selected based on at least three years' experience in sheep husbandry.

The fourth stage involved random selection of five sheep from each of the selected households giving a total of four hundred (400) sheep.

3.3 HERD MANAGEMENT

The sheep were managed semi intensively management. They were normally allowed to roam freely in the day time and return home in the evening for the dietary supplementation and shelter against predators and harsh weather conditions.

3.4 DATA COLLECTION PROCEDURES

3.4.1 Traits studied:

Both qualitative and quantitative traits were assessed on 128 rams and 272 ewes from 80 households.

3.4.2 Qualitative traits

The description of the traits was carried out as outlined by Aberra *et al*., (2013). The traits assessed include coat color pattern, coat color type, hair coat type, tail type, head profile, ear form, horn shape and presence or absence of wattle, horn and ruff were observed visually.

Coat color pattern: Different coat color pattern was observed as plain, patchy and spotted.

Coat color type: The color of the coat was identified as either white, black, brown, white dominant, black dominant or brown dominant.

Hair coat type: Different hair coat type was observed as short and smooth, long and coarse, and short and coarse.

Tail type: This was identified as either short fat, long fat, short thin, long thin or docked.

Tail form: This was examined and recorded as either curved tip, straight tip or docked.

Head profile: The head profile was observed as straight, biconcave or biconvex.

Ear form: This was identified as either erect, horizontal, semi pendulous or rudimentary.

Horn shape: Horn shape was observed from the animals as either straight, curving upward, curving downward or rudimentary.

Horn, Wattle and Ruff: These were assessed by seeing and confirming its presence or absence.

3.4 Quantitative traits

Body weight and sixteen (16) morphometric traits were measured on the animals. The anatomical reference points were as described by Macjowski and Zieba (1982). The body parts measured were heart girth, withers height, shoulder width, pelvic width, body length, ear length, head length, tail length, tail circumference, testis length, scrotum circumference, udder length, udder circumference, and distance between two testicles. Weighing band calibrated in centimeters (cm) was used for the linear traits. Body weight was measured using weighing balance. All measurements were taken by same personnel to avoid error.

Heart girth (chest circumference): A circumferential measure around the chest just behind the front legs and withers

Withers height: The distance from the surface of a platform on which the animal stands to the withers

Pelvic width: This is the distance from pin bone to the point of attachment of the thoracic bone.

Body length: Refers to the distance from the base of the ear to the base of the tail (where it joins the body).

Ear length: Distance from base to tip of ear

Head length: This is the distance from external occipital protuberance to the tip of the nasal bone.

Horn length: This is the distance from the point of horn attachment to the tip of the horn.

Tail length: It was measured from the coaxial bone to the end of the tail.

Tail circumference: This is the circumferential measure of the tail.

Scrotal circumference: This is the circumferential measure of individual testis.

Scrotal length: This was obtained by measuring the length from the to the tip of the scrotum of the testis.

Udder length: This is the distance from the base of the udder to the tip of mammary gland teat.

Udder circumference: This is the circumferential measure of the udder.

Body weight measurement: Prior to weighing the animals, the weight of the observer was taken and recorded. Then the body weight of each animal was taken by carrying the animal individually and standing on a weighing scale. The difference between this weight and observer's weight was taken as the weight of the animal (Akpa *et al*., 1998).

3.5 AGE DETERMINATION

The ages of the animals were determined using the dentition estimation of permanent teeth as outlined by Shoenian, (2007).

Table 1: Age Determination in Sheep

AGE	SHEEP	NUMBER OF TEETH
Birth to 12 Months	Lamb	8 milk teeth, all temporary teeth
12 to 24 Months	Yearling, Two teeth,	2 central incisors, 6milk teeth
24 to 36 Months	Four teeth	2central incisors, 2middle incisors,4milk teeth
36 to 48 Months	Six teeth	2 central incisors, 2 middle incisors, 2 lateral incisors
Over 48 months	8 teeth, Full mouth,	2 central incisors, 2 middle incisors,
Solid mouth	2 lateral incisors,	2 corner incisors

Source: Shoenian, (2007).

3.6 DATA ANALYSIS

Data collected were entered in to Microsoft excel (2007). Association between locations, breeds, sex and age in sheep were determined by subjecting categorical data to the cross tab procedure of SPSS 16.0. Since the expected values were less than 5, chi-square test was carried out using Monte-carlo 9 & 10 confidence interval method based on 10,000 sampled tables with starting seed of 2,000,000.

The effects of location on continuous morphometric variables in sheep were determined by subjecting data to multivariate analysis of variance (MANOVA). The data was subjected to normality test using SPSS (2007) version 16.0, prior to the analysis and where there is violation of normality MANOVA on ranked transformed data was carried out. The GLM multivariate procedure of SPSS 16.0 was used throughout the analysis using the model below.

$$Y_{ijkl}=\mu+L_i+B_j+S_k+A_l+(LxB_{ij})+(L_xA_i)+(LxS_{ik})+(B_xA_{jk})+(BxS_{jk})+(SxA_{kl})+(LxBxSxA)\ (_{ijkl})+E_{ijk}$$

Where,

Y_{ijkl} = parameter of interest

μ = population mean

L_i =Effect of the i^{th} location

B_j = Effect of the j^{th} breed

S_k =Effect of the k^{th} sex

A_l = Effect of the l^{th} age group

L_i xB_i= Location by breed interaction

$L_{i\,x}A_i$ = Location by age interaction

$L_i\,xS_k$ = Location by sex interaction

$B_j\,xA_l$ = Breed by age interaction

$B_j\,xS_j$ = Breed by sex interaction

$S_k\,xA_l$= Sex by age interaction

$L_i\,xB_j\,xS_k\,xA_l$ = Location by breed by sex by age interaction

E_{ijkl} = Experimental error

Pearson correlation analysis was used in determining the relationship between morphometric variables using SPSS version 16.0

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 RESULTS

4.1.2 Distribution of Sheep Breeds in the Study Area

The predominant breed was Yankasa accounting for 71.25% of the total sheep population, followed by Balami (19.25%) and Uda the least with 9.5%, as shown in Table 2. Yankasa breed was commonly observed in all the four (4) locations with RGG-KRU (Rogo) having the highest proportions (27.37%), followed by BNK-KBY (25.26%), MDB-KBT (Madobi, 24.65%)) and BBJ-TWD with the least proportion (22.80%). Balami Breed was also observed in all the locations with BNK-KBY (Bunkure) having the highest proportion (29.87%), followed by MDB-KBT (28.57%), BBJ-TWD ((Bebeji 25.97%)), while the least proportion comes from RGG-KRU (15.58%). Similarly, Uda breed was observed in all the locations with BBJ-TWD having the highest proportion (39.47%), followed by RGG-KRU (26.32%), MDB-KBT (21.05%) and BNK-KBY recorded the lowest proportion (13.16%).

Table 2.Distribution of Sheep Breeds in the Study Area (N=400)

Location	Breed

	Uda	Balami	Yankasa
BNK-KBY (n=100)	5(13.16)	23(29.87)	72(25.26)
RGG-KRU (n=100)	10(26.32)	12(15.58)	78(27.37)
MDB-KBT (n=100)	8(21.05)	22(28.57)	70(24.56)
BBJ-TWD (n=100)	15(39.47)	20(25.97)	65(22.80)
TOTAL(N=400)	38(9.5)	77(19.25)	285(71.25)

Bnk-Kby = Bunkure-Kibiya, Rgg-Kru = Rogo-Kiru, Mdb-Kbt = Madobi-Kumbotso, Bbj-Twd = Bebeji-Tudunwada, percentages in parantheses

4.1.3 Effect of location on the Distribution of Qualitative Traits in sheep population

The distribution of qualitative traits in sheep breeds population based on location is presented in Table 3.White dominant coat color pattern was the most abundant with 47% followed by white (38%), brown dominant (9%), black dominant (2.75%), brown (2.5%) and black coat color pattern (0.75%). There was a significant association (P<0.01) between location and coat colour pattern. White dominant coat color pattern was observed in all the locations with BNK-KBY having the highest proportion (58%), followed by RGG-KRU (53%), BBJ-TWD (41%) and MDB-KBT having the lowest proportion (36%). While coat color pattern was observed across all the locations with MDB-KBT having the highest proportion (48%), followed by BBJ-TWD (39%), RGG-KRU (38%) and BNK-KBY (27%). Brown dominant coat color pattern was observed in all the locations with BBJ-TWD having the highest proportion (13%), followed by BNK-KBY (12%), RGG-KRU (7%) and MDB-KBT having the lowest proportion (4%). Black dominant coat color pattern was observed in three locations with MDB-KBT having the highest proportion (7%), BBJ-TWD with equal proportion of (3%), followed by BNK-KBY (1). Brown coat color pattern was observed in all locations MDB-KBT having the highest proportion (4%) and BBJ-TWD (3%), RGG-KRU (2%), while the lowest proportion was obtained at BNK-KBY (1%). While, black coat color pattern was observed in three locations with equal proportion as BNK-KBY (1%), MDB-KBT (1%), BBJ-TWD (1%).

Plain coat color type was the most numerous accounting for 68% of the total sheep population, followed by patchy color (18%) and spotted (13.5%).There was no significant association (P<0.05) between location and coat colour type. Plain coat color type was observed in all locations with BBJ-TWD having the highest proportion (73%), followed by RGG-KRU(69.0%), MDB-KBT, (68.0%) and BNK-KBY having the lowest proportion (64.0%). Patches coat color type was observed in all locations with BNK-KBY having the highest proportion (21.0%), followed by RGG-KRU (20.0%), BBJ-TWD (17.0%) and MDB-KBT having the lowest proportion (14.0%). Spotted coat color type was also observed in all the locations with MDB-KBT having the highest proportion (18.0%), followed by BNK-KBY (15.0%), RGG-KRU (11.0%) and BBJ-TWD having the lowest proportion (10.0%).

Short and smooth coat hair type was predominant with 72.5% followed by short and coarse hair coat type (13.75%), long and smooth hair coat type (11.25%) and long coarse hair coat type(2.5%).There were significant (P<0.01)differences between locations in frequencies of was coat hair type. Short and smooth hair coat type was observed in all the locations with RGG-KRU having the highest proportion (85.0%), followed by BBJ-TWD (73.0%) and MDB-KBT, BNK-KBY has the least proportion (66.0%) each. Short and coarse hair coat type was observed in all locations with BNK-KBY having the highest proportion of (20.0%) each, followed by MDB-KBT (14.0%), BBJ-TWD (11.0%) and RGG-KRU having the lowest proportion (10.0%). Long and smooth hair coat type was observed in all locations with MDB-KBT having the highest proportion (15.0%), followed by BNK-KBY (14.0%), BBJ-TWD (11.0%) and RGG-KRU has the least proportion (5.0%). Long and coarse hair coat type was observed in only two locations MDB-KBT and BBJ-TWD having the same proportion (5.0%) each.

Long thin tail type was the most common(88.25%), followed by long fat tail type (6.25%), short thin tail type (4.75%) ,whereas short fat tail type was the least common (0.75%).A considerable (P<0.01) variation was observed between locations in preponderance of tail types. Long thin tail type was observed in all the locations with the highest proportions from RGG-KRU (91.0%), followed by BBJ-TWD (89.0%), MDB-KBT (87.0%) and BNK-KBY having the lowest proportion (86.0%). Long fat tail type was also observed across all locations with BBJ-TWD having the highest proportion (11.0%), followed by MDB-KBT and BNK-KBY (5.0%)

each and RGG-KRU having the lowest proportion (4.0%). Short thin tail type was observed in three locations with BNK-KBY and MDB-KBT having the highest proportion (8.0%) each, followed by RGG-KRU having the lowest proportion (4.0%). Short fat tail type was observed in only two locations with RGG-KRU having the highest proportion (2.0%) and BNK-KBY had the lowest proportion (1.0%).

In terms of tail tip form, most (97.5%) of the animals had straight tips , while only a few had curved and docked and blunt tail forms, accounting for 1.5% and 0.5% ,respectively. Tail form had no significant dependence on location. Straight tip tail form was recorded in all the locations with the highest proportion from MDB-KBT and RGG-KRU (99.0%) each, followed by BNK-KBY (97.0%) and BBJ-TWD with the lowest proportion (95.0%). Curved tip tail form was observed in three locations with BBJ-TWD having the highest proportion (3.0%), followed by BNK-KBY (2.0%) while RGG-KRU having the lowest proportion (1.0%). Docked tail form was observed in two locations BNK-KBY and BBJ-TWD with equal proportion of (1.0%) each. While blunt tail form was also observed in two locations MDB-KBT and BBJ-TWD with (1%) proportion each.

Bibiconcave head profile was predominant with 51.5%, followed by bibiconvex head profile (34.5%) and straight head profile (14%). There was significant association between location and head profile. bibiconcave head profile was observed in all the locations with BNK-KBY having the highest proportion (68.0%), followed by MDB-KBT and BBJ-TWD (48.0%) each and RGG-KRU with the least proportion (42.0%). bibiconvex head profile was observed in all locations with BBJ-TWD having the highest proportion (43.0%), followed by RGG-KRU (42.0%), MDB-KBT (39.0%), and BNK-KBY with the least proportion (16.0%). Straight head profile was also observed in all locations with RGG-KRU and BNK-KBY having the highest proportion (16.0%) each, followed by, MDB-KBT (13.0%) and BBJ-TWD with the lowest proportion (9.0%). It was also observed all the sheep's were having a horizontal ear form (100%). Horizontal ear form (100) was observed in all locations without erect ear form was not observed in all locations.

A large percentage (82.75%) of the sheep population lacked wattles. There was no significant relationship between location and possession or absence of wattle. Presence of wattles was observed in all locations with the highest proportion from BNK-KBY (21.0%), followed by BBJ-TWD (19.0%), RGG-KRU (16.6%) and MDB-KBT having the least proportions (13.0%). Similarly, absence of wattles was observed across all locations with MDB-KBT having the highest proportion (87.0%), followed by RGG-KRU (84.0%), BBJ-TWD (81.0%) and BNK-KBY having the lowest proportions (79.0%).

Straight horn shape was most common (49.64%), followed by curving downward horn shape (26.28%) and curving upward horn shape (24.09%).Location was not significantly associated with horn shape. Straight horn shape was observed in all locations with MDB-KBT having the highest proportions (63.9%), followed by BBJ-TWD (50.0%), BNK-KBY (47.2%) and RGG-KRU with the least proportion (33.33%). Curving downward horn shape were observed in all locations with BNK-KBY having the highest proportions (36.1%) followed by RGG-KRY (21.93%), MDB-KBT (22.2%) and BBJ-TWD having the least proportion (21.05%). Curving upward horn shape was observed in all locations with RGG-KRU having the highest proportion (40.74%), followed by BBJ-TWD (28.95%), BNK-KBY (16.7%) and MDB-KBT having the least proportion (13.9%).

Possession of ruff was only observed in 8.75% of the populations and was not influenced by location. Presence of ruff was observed in allocations with BBJ-TWD having the highest proportion (12.0%), followed by MDB-KBT (11.0%), BNK-KBY (8.0%) and RGG-KRU having least proportion (4.0%) each.

Table 3: Effect of Location on the Distribution of Qualitative Traits in Sheep N=400

Traits	Location					
	BNK-KBY	**RGG-KRU**	**MDB-KBT**	**BBJ-TWD**	**TOTAL**	CHI-SQUARE
	(n=100)	(n=100)	(n=100)	(n=100)	(N=400)	VALUE
Coat color pattern						
Black	1	0	1	1	3(0.75)	
Brown	1	2	4	3	10(2.5)	
Black Dominant	1	0	7	3	11(2.75)	35.036**
Brown Dominant	12	7	4	13	36(9.0)	
White Dominant	58	53	36	41	188(47.0)	
White	27	38	48	39	152(38.0)	
Coat Color Type						
Spotted	15	11	18	10	54(13.5)	
Patches	21	20	14	17	72(18.0)	5.302^{ns}
Plain	64	69	68	73	274(68.5)	
Hair Coat Type						
Long Smooth	14	5	15	11	45(11.25)	
Short Coarse	20	10	14	11	55(13.75)	23.142**
Long Coarse	0	0	5	5	10(2.5)	
Short Smooth	66	85	66	73	290(72.5)	
Tail Type						
Short Fat	1	2	0	0	3(0.75)	
Long Fat	5	4	5	11	25(6.26)	18.596*
Short Thin	8	3	8	0	19(4.75)	
Long Thin	86	91	87	89	353(88.25)	
Tail Form						
Docked	1	0	0	1	2(0.5)	
Blunt	0	0	1	1	2(0.5)	9.715^{ns}
Curved Tip	2	1	0	3	6(1.5)	
Straight Tip	97	99	99	95	390(97.5)	
Head Profile						
Biconvex	16	42	39	43	138(34.5)	
Biconcave	68	42	48	48	206(51.5)	23.959***
Straight	16	18	13	9	56(14.0)	
Ear Form						
Erect	0	0	0	0	0	
Horizontal	100	100	100	100	100(100)	
Wattle						
Present	21	16	13	19	69(17.24)	2.575^{ns}
Absent	79	84	87	81	331(82.75)	
Horn						
Present	36	27	36	38	137(34.25)	3.231^{ns}
Absent	64	73	64	62	263(65.75)	
Horn shape						
Straight	17(47.2)	9(33.33)	23(63.9)	19(50)	68(49.64)	13.361^{ns}
Curving downward	13(36.1)	7(25.93)	8(22.2)	8(21.05)	36(26.28	
Curving upward	6(16.7)	11(40.74)	5(13.9)	11(28.95)	33(24.09)	
Ruff						
Present	8	4	11	12	35(8.75)	4.853^{ns}
Absent	92	96	89	88	365(91.25)	

Bnk-Kby = Bunkure-Kibiya, Rgg-Kru = Rogo-Kiru, Mdb-Kbt = Madobi-Kumbotso, Bbj-Twd = Bebeji-Tudun-wada, percentages in parantheses NS= not significant. *= (P<0.05). **= (P<0.01), ***= (P<0.001)

4.1.4 Effect of Breed on the Distribution of Qualitative Traits in Sheep

The distribution of qualitative traits in sheep population based on breed is presented in Table 4. There was significant association between breed and coat colour pattern. White dominant coat color pattern was commonly observed in all the breeds with Yankasa having the highest proportion (52.6%), followed by Balami (40.3%) while Uda had the least (21.1%). White coat color pattern was observed in all the breeds with Yankasa having the highest proportion (39.6%), followed by Uda (39.9%) and Balami having the least proportion (29.9%). Brown dominant coat color pattern was also observed in all the breeds with Uda having the highest proportion (39.5%), followed by Balami (19.5%) and Yankasa (2.5%). Black dominant coat color pattern was observed in only two breeds Balami (5.2%) and Yankasa (2.1%). Brown coat color pattern was observed in only Yankasa and Balami breeds with Yankasa having the higher proportion (2.8%) than Balami (2.6%). Black coat color pattern was also observed among the Balami(2.6%) and Yankasa (0.4%) breeds.

The association between location and coat colour type was significant .Plain coat color type was observed in all the breeds with Yankasa having the highest proportion (72.6%), followed by Balami (63.6%) whereas the Uda had the least proportion (47.4%). Patched coat color type was observed in all the breeds with Uda having the highest proportion (28.9%), followed by Balami (23.4%) and Yankasa (15.1%). Spotted coat color type was also observed in all the breeds with Uda having the highest proportion (23.7%), followed by Balami (13%) and Yankasa (12.3%).

There was significant ($P<0.01$) relationship between breed and hair coat type. Short and smooth hair coat type was observed in all the breeds with Uda having the highest proportion (86.8%), followed by Balami (71.4%) and Yankasa (70.9%). Long and smooth hair coat type was observed in all the breeds with Yankasa having the highest proportion (14.7%), followed by Uda (13.2%) and Balami having the least proportion (10.4%). Short and coarse hair coat type was observed in only two breeds with Yankasa having the higher proportion (12.3%) than Balami (11.7%). Long and coarse coat color type was only observed among the Balami (6.5%) and Yankasa (1.2%) breeds.

The effect of breed on tail type was significant (P<0.01). Long thin tail type was observed in all the breeds with Yankasa having the highest proportion (93.3%), followed by Balami (87%) and Uda (52.6%). Long fat tail type was observed in all the breeds with Uda having the highest proportion (28.9%), followed by Balami (9.1%) and Yankasa (2.5%). Short thin tail type was observed in all the breeds with and Yankasa having the highest proportion (15.8%), followed by Balami (3.9%) and Yankasa (3.5%). Short fat tail type was only observed in Uda (2.6%) and Yankasa (0.7%) sheep.

There was a significant (P<0.01) association between breed and head profile. Biconcave head profile was observed in all the breeds with Yankasa having the highest proportion (54%), followed by Balami (46.8%) and Uda (42.1%). Biconvex head profile was observed in all the breeds with Uda having the highest proportion (55.3%), followed Balami (42.9%) and Yankasa (30.7%). Straight head profile was observed in all the breeds with Yankasa having the highest proportion (15.8%), followed by Balami (10.4%) and Uda (2.6%).Horizontal ear form was observed in all the breeds with Uda and Yankasa having the highest proportion (100% each) followed by Balami (94.8%). Erect ear form was observed in only Balami breed with a 5.2% proportion.

A significant (P<0.01) association between breed and presence of horn was observed. Horns were observed in all the breeds with Balami having the highest proportion (48.1%), followed by Uda (34.2%) and Yankasa having the least proportion (30.5%). Absence of horn was also observed in all the breeds with Yankasa having the highest proportion (69.5%), followed by Uda (65.8%) and Balami having the least (51.9%).

Breed was significantly ($P<0.01$) associated with horn shape. Straight horn shape was observed in all the breed with Uda having the highest proportion (76.9%), followed by Yankasa (50.6.9%) and Balami (35.1%). Curving downward horn shape was observed in all the breeds with Balami having the highest proportion (51.4%), followed by Yankasa (20.7%) and Uda (7.7%). Curving upward horn shape was also observed in all the breeds with Yankasa having the highest proportion (28.7%), followed by Uda (18.4%) and Balami which had 13.5%.

There was a significant ($P<0.01$) association between breed and presence of ruff. Presence of ruff was observed in all the breeds with Uda having the highest proportion (15.8%), followed by Balami (15.6%) and Yankasa

TABLE 4: Effect of Breed on the Distribution of Qualitative Traits (N=400)

TRAITS	**BREEDS**				
	UDA (n=38)	**BALAMI (n=77)**	**YANKASA (n=285)**	**TOTAL (N=400)**	**CHI-SQUARE**
Coat color pattern					
Black	0	2(2.6)	1(0.4)	3(0.75)	
Brown	0	2(2.6)	8(2.8)	10(2.5)	
Black Dominant	0	4(5.2)	7(2.5)	11(2.75)	81.774***
Brown Dominant	15(39.5)	15(19.5)	6(2.1)	36(9.0)	
White Dominant	15(39.5)	31(40.3)	149(51.56)	188(47.0)	
White	8(21.1)	23(29.9)	114(39.45)	152(38.0)	
Coat Color Type					
spotted	9(23.7)	10(13)	35(12.3)	54(13.5)	
Patches	11(28.9)	18(23.4)	43(15.1)	72(18.0)	11.811*
plain	18(47.4)	49(63.6)	207(72.6)	274(68.5)	
Hair Coat Type					
Long smooth	0	9(11.7)	36(12.6)	45(11.25)	
Short coarse	5(13.2)	8(10.4)	42(14.7)	55(13.75)	13.305*
Longcoarse	33(86.8)	55(71.4)	202(70.9)	290(72.5)	
Short smooth	0	5(6.5)	5(1.2)	10(2.5)	
Tail type					
Short fat	1(2.6)	0	2(0.7)	3(0.75)	
Long fat	11(28.9)	7(9.1)	7(2.5)	25(6.26	58.363***
Short thin	6(15.8)	3(3.9)	10(3.5)	19(4.75)	
Long thin	20(52.6)	67(87)	266(93.3)	353(88.25)	
Tail form					
Docked	0	1(1.3)	1(0.35)	2(0.5)	
Blunt	0	1(1.3)	1(0.35)	2(0.5)	9.621ns
Curved tip	0	3(3.90)	3(1.05)	6(1.5)	
Straight tip	38(100)	72(93.51)	280(98.25)	390(97.5)	
Head profile					
Biconvex	21(55.3)	31(40.26)	86(30.2)	138(34.5)	
Biconcave	16(42.1)	36(46.75)	154(54)	206(51.5)	14.039**
Straight	1(2.6)	10(12.99)	45(15.8)	56(14.0)	
Ear form					
Erect	0	0	0	0	
Horizontal	38(100)	77(100)	285(100)	100(100)	
Wattle					
Present	6(15.8)	8(10.4)	55(19.3)	69(17.24)	3.433 ns
Absent	32(84.2)	69(89.6)	230(80.7)	331(82.75	
Horn					
Present	13(34.2)	37(48.1)	87(30.5)	137(34.25)	8.268*
Absent	25(65.8)	40(51.9)	198(69.5)	263(65.75)	
Horn shape					
Straight	10(76.9)	14(37.84)	44(50.6)	68(49.64)	26.720***
Curving downward	1(7.7)	17(45.95)	18(20.7)	36(26.280	
Curving upward	2(14.4)	6(16.22)	25(28.7)	33(8.75)	
Ruff					
Present	6(15.8)	12(15.6)	17(6)	35(8.75)	9.632**
Absent	32(84.2)	65(84.4)	268(94)	365(91.25)	

NS= not significant. *= (P<0.05). **= (P<0.01), ***= (P<0.001)

4.1.5 Effect of Location on the Distribution of Qualitative Traits in Rams

The distribution of qualitative traits in rams based on location is presented in Table 5.The effect of location on coat colour pattern was not significant. White dominant coat color pattern was commonly observed in all the four locations with RGG-KRU having the highest proportion (59.26%), followed by BNK-KBY (46.88%), BBJ-TWD (40.63%) and MDB-KBT (32.63%). Similarly, white coat color pattern was observed in all the locations with MDB-KBT having the highest proportion (37.84%), followed by BNK-KBY (31.25%), RGG-KIRU (29.63%) and BBJ-TWD (28.13%). Brown dominant coat color pattern was observed in three locations with BNK-KBY having the highest proportion (18.75%), followed by BBJ-TWD (15.63%) and MDB-KBT (10.81%). Black dominant coat color pattern was only observed in MDB-KBT (8.11%) and BBJ-TWD (6.25%), while brown coat color pattern was observed in all the locations with the highest proportion obtained in RGG-KRU (11.11%), followed by BBJ-TWD (6.25%) and BNK-KBY (3.13%). Black coat color pattern was observed in BBJ-TWD (3.13%) and MDB-KBT (2.70%).

There was a strong ($P<0.01$) association between location and head profile. Biconcave head profile was observed in all the locations with BNK-KBY having the highest proportion (68.75%), followed by BBJ-TWD (56.25%), MDB-KBT (43.24%) while RGG-KRU recorded the lowest proportion (33.33%). Biconvex head profile was observed in all locations with RGG-KRU having the highest proportion (51.85%), followed by MDB-KBT (43.24%), BBJ-KBT (12.5%). Straight head profile was observed in all the locations with BNK-KBY having the highest proportion (18.75%), followed by RGG-KRU (14.81%), MDB-KBT (13.51%) and BBJ-TWD having the lowest proportion. Horizontal ear form was observed in all the locations with an equal proportions (100%), while erect ear form was not observed in any location.

Table 5: Distribution of Qualitative Trait in Rams (N=128) Based on Location

Traits	**Location**				
	BNK-KBY (n=32)	**RGG-KRU** (n=27)	**MDB-KBT** (n=37)	**BBJ-TWD** (n=32)	CHI-SQUARE VALUE
Coat color pattern					
Black	0	0	1(2.70)	1(3.13)	
Brown	1(3.13)	3(11.11)	3(8.11)	2(6.25)	
Black Dominant	0	0	3(8.11)	2(6.25)	15.843^{ns}
Brown Dominant	10(31.25)	0	4(10.81)	5(15.63)	
White Dominant	15(46.88)	16(59.26)	12(32.63)	13(40.63)	
White	6(18.75)	8(29.63)	14(37.84)	9(28.13)	
Coat Color Type					
Spotted	7(21.86)	3(11.11)	10(27.03)	5(15.63)	
Patches	5(15.63)	3(11.11)	5(13.51)	5(15.63)	3.565^{ns}
Plain	20(62.25)	21(77.78)	22(59.46)	22(68.75)	
Hair Coat Type					
Long Coarse	5(15.63)	2(7.41)	5(13.51)	2(6.25)	
Short Coarse	4(12.5)	2(7.41)	5(13.51)	3(9.36)	8.581^{ns}
Long Smooth	0	0	3(8.11)	3(9.36)	
Short Smooth	23(71.88)	23(85.19)	24(64.86)	24(70.00)	
Tail Type					
Short Fat	0	0	0	0	
Long Fat	3(9.36)	1(3.71)	4(10.81)	2(6.25)	4.505^{ns}
Short Thin	1(3.13)	0	2(5.41)	0	
Long Thin	28(89.5)	26(96.30)	31(83.78)	30(93.75)	
Tail Form					
Docked	0	0	0	0	
Blunt	0	0	0	0	2.133^{ns}
Curved Tip	0	1(3.71)	1(2.70)	0	
Straight Tip	32(100)	26(96.31)	36(97.30)	32(100)	
Head Profile					
Biconvex	4(12.5)	14(51.85)	16(43.24)	12(37.5)	
Biconcave	22(68.75)	9(33.333)	16(43.24)	18(56.25)	13.582*
Straight	6(18.75)	4(14.81)	5(13.51)	2(.25)	
Ear Form					
Erect	0	0	0	0	
Horizontal	32(100)	27(100)	37(100)	32(100)	
Wattle					
Present	5(15.63)	3(11.11)	6(16.22)	6(18.75)	0.664^{ns}
Absent	27(84.38)	24(88.89)	31(83.78	26(81.25)	
Horn					
Present	30(93.75)	25(92.59)	36(97.30)	31(96.88)	1.123^{ns}
Absent	2(6.25)	2(7.41)	1(2.70)	1(3.13)	
Horn shape					
Straight	11(36.7)	7(28.0)	23(63.9)	15(48.4)	16.513^{ns}
Curving downward	13(43.3)	8(32.0)	8(22.2)	7(22.6)	
Curving upward	6(20.0)	10(40.0)	5(13.9)	9(29.0)	
Ruff					
Present	8(25)	3(11.11)	11(29.73)	10(31.25)	3.886^{ns}
Absent	24(75)	24(88.89)	26(70.27)	22(68.75)	

Bnk-Kby = Bunkure-Kibiya, Rgg-Kru = Rogo-Kiru, Mdb-Kbt = Madobi-Kumbotso, Bbj-Twd = Bebeji-Tudunwada, NS= not significant. *= (P<0.05).

4.1.6 Distribution of Qualitative Traits in Rams Based on Breeds

The distribution of qualitative traits in rams based on breed is presented in Table 6. Breed had significant (P<0.01) effect on coat colour pattern. White dominant coat color pattern was commonly observed in all the breeds with Yankasa having the highest proportion (53.16%), followed by Uda (33.33%), while Balami had the least proportion (29.73%). White coat pattern was observed in two breeds with Balami having the higher proportion (32.43%) than Yankasa (31.65%). Brown dominant coat color pattern was observed in all the breeds with Uda having the highest proportion (33.33%) followed by Balami (27.73%) and Yankasa (1.27%). Black dominant coat color pattern was observed among all the breeds with Uda having highest proportional (33.33%), followed by Balami (5.41%) and Yankasa having the least proportion (3.80%). Brown coat color pattern and black coat color pattern were observed only among Balami and Yankasa breeds the latter having the higher proportions for both colors.

There was significant (P<0.01) association between breed and coat colour type. Plain coat color type was observed in all the breeds with Yankasa having the highest proportion (75.95%), followed by Balami (62.16%) whereas Uda had the least proportion (16.63%). Patches coat color type was observed in all the breeds with Uda having the highest proportion (33.33%), followed by Balami (13.51%) while Yankasa had the least proportion (11.39%). Spotted coat color type was also observed in all the breeds with Uda having the highest proportion (50%) followed by Balami (24.32%) and Yankasa having the least proportion (12.66%).

There was a significant (P<0.01) association between breed and tail type. Long thin tail type was observed in all the breeds with Yankasa having the highest proportion (96.20%), followed by Balami (86.49%) and Uda having the lowest proportion (86.49%). Long fat tail type was observed in all the breeds with Uda having the highest proportion (25%), followed by

Balami (10.81%) and Yankasa having the lowest proportion (2.53%). Short thin tail type was observed in all the breeds with Uda having the highest proportion (8.33%), followed by Balami (2.70%) and Yankasa having the lowest proportion (1.27%).

There was significant (P<0.01) relationship between breed and head Profile. Biconcave head profile was observed in all the breeds with Balami having the highest proportion (56.76%), followed by Yankasa (48.10%) and Uda (41.67%). Biconvex head profile was observed in all the breeds with Uda having the highest proportion (58.33%), followed by Balami (43.24%) and Yankasa (30.38%). Straight head profile was observed only in Yankasa breed with the proportion of 21.52%.Horizontal ear form was observed in all the breeds with equal proportions (100% each)while erect ear form was not observed among breeds.

Breed had significant association with horn shape. Straight horn shape was observed in all the breeds with Uda having the highest proportion (75.0%), followed by Yankasa (46.1%) and Balami (37.1%). Curving downward horn was observed in all the breeds with Balami having the highest proportion (48.6%), followed by Yankasa (22.4%) and Uda had the least proportion (8.33%). Curving upward was also observed in all the breeds with Yankasa having the highest proportion (31.6%), followed by Uda (16.67%) and Balami having the lowest proportion (14.3%).

Table 6: Distribution of Qualitative Traits in Rams (N=128) Based on Breeds

TRAITS	**BREEDS**			
	UDA(n=12)	**BALAMI(n=37)**	**YANKASA(n=79)**	**CHI-SQUARE**
Coat color pattern				
Black	0	1(2.70)	1(1.27)	
Brown	2(16.67)	1(2.70)	7(8.86)	
Black Dominant	0	2(5.41)	3(3.80)	154.319**
Brown Dominant	6(50.00)	10(27.03)	1(1.27)	
White Dominant	4(33.33)	11(29.73)	42(53.16)	
White	0	12(32.43)	25(31.65)	
Coat Color Type				
spotted	6(50)	9(24.32)	10(12.66)	
Patches	4(33.33)	5(13.51)	9(11.39)	146.998**
plain	2(16.63)	23(62.16)	60(75.95)	
Hair Coat Type				
Long Coarse	0	4(10.81)	10(12.66)	
Long Smooth	3(25)	4(10.81)	6(7.59)	134.369 ^{ns}
Short smooth	9(75)	27(72.97)	59(74.68)	
Short coarse	0	2(5.41)	4(5.06)	
Tail Type				
Long fat	3(25)	4(10.81)	2(2.53)	
Short thin	1(8.33)	1(2.70)	1(1.27)	141.195*
Long thin	8(66.67)	32(86.49)	76(96.20)	
Short fat	0	0	0	
Tail Form				
Blunt	0	1(2.70)	0	133.580 ^{ns}
Straight tip	12(100)	36(97.30)	79(100)	
Head Profile				
Biconvex	7(58.33)	16(43.24)	24(30.38)	
Biconcave	5(41.67)	21(56.76)	38(48.10)	143.631**
Straight	0	0	17(21.52)	
Ear Form				
Erect	0	0	0	
Horizontal	12(100)	37(100)	79(100)	
Wattle				
Present	4(33.33)	5(13.51)	11(13.92)	132.192 ^{ns}
Absent	8(66.67)	32(86.49)	68(86.08)	
Horn				
Present	12(100)	35(94.69)	76(96.20)	130.601 ^{ns}
Absent	0	2(5.41)	3(3.80)	
Horn Shape				
Straight	9(75)	13(37.1)	35(46.1)	145.582*
Curvingdownward	1(8.33)	17(48.6)	17(22.4)	
Curving upward	2(16.67)	5(14.3)	24(31.6)	
Ruff				
Present	6(50)	11(29.73)	16(20.25)	134.745 ^{ns}
Absent	6(50)	26(70.27)	63(79.95)	

NS= not significant. *= (P<0.05). **= (P<0.01), 4.1.7 Distribution of Qualitative Traits in Ewes Based on Locations

The distribution of qualitative traits in ewes based on locations is presented in Table 6. There was no significant relationship between location and coat colour type. Plain coat color type was observed in all the locations with BBJ-TWD having the highest proportion (75%), followed by MDB-KBT (71%.88), RGG-KRU (68.02%), and BNK-KBY (63.2%). Patchy coat color type was also recorded across all locations with BNK-KBY having the highest proportions (23.5%), followed by RGG-KRU (20.83%), BBJ-TWD (19.12%) and MDB-KBT recorded the lowest proportion (15.63%). Spotted coat color type was also observed throughout all locations with highest proportion of (13.2%) from BNK-KBY, followed by MDB-KBT (12.5%), RGG-KRU (11.11%) and the lowest proportion came from BBJ-TWD (5.88%).

There was a significant relationship between location and tail type. Long thin tail type was observed in all the locations with the highest proportion from RGG-KRU (91%), followed by BBJ-TWD (88.24%), MDB-KBT (85.94%) and BNK-KBY(83.82%). Long fat tail type was observed across all locations with BBJ-TWD having the highest proportion (11.76%), followed by MDB-KBT (4.9%), BNK-KBY (4.41%) and RGG-KRU (2.78%). Short thin tail type was recorded in three (3) locations with BNK-KBY having the highest proportion (10.29%), MDB-KBT (9.38%) and RGG-KRU with the lowest proportion (4.17%). Short fat tail type was only observed in RGG-KRU (2.78%) and BNK-KBY (1.47%).

There was a significant association between location and wattle. Presence of wattles was observed across all locations with the highest proportion obtained from BNK-KBY (22.54%), followed by BBJ-TWD (19.12%), RGG-KRU (18.06%) and the least proportion was obtained from MDB-KBT (10.94%).

Table 7: Distribution of Qualitative Trait in Ewes (N=273) Based on Location

Traits	Location				
	BNK-KBY (n=68)	RGG-KRU (n=72)	MDB-KBT (n=64)	BBJ-TWD (n=68)	CHI-SQUARE VALUE
Coat color pattern					
Black	1(1.47)	0	0	0	
Brown	0	0	1(1.56)	1(1.47)	
Black Dominant	1(1.47)	0	4(6.25)	1(1.47)	29.969^{ns}
Brown Dominant	7(10.29)	4(5.6)	2(3.13)	8(11.78)	
White Dominant	42(61.76)	37(51.38)	24(37.5)	28(41.18)	
White	17(25.00)	31(43.06)	33(51.56)	30(44.12)	
Coat Color Type					
Spotted	9(13.2)	8(11.11)	8(12.5)	4(5.888)	
Patches	16(23.5)	15(20.83)	10(15.63)	13(19.12)	3.9942^{ns}
Plain	43(63.2)	49(68.06)	46(71.88)	51(75.00)	
Hair Coat Type					
Long Coarse	9(13.24)	4(5.6)	6(9.38)	9(13.24)	
Short Coarse	16(43.53)	9(12.5)	3(4.69)	2(2.94)	12.979^{ns}
Long Smooth	0	9(12.5)	9(14.06)	8(11.76)	
Short Smooth	43(63.24)	59(81.92)	46(71.88)	49(72.06)	
Tail Type					
Short Fat	1(1.47)	2(2.78)	0	0	
Long Fat	3(4.41)	2(2.78)	3(4.69)	8(11.78)	17.080*
Short Thin	7(10.29)	3(4.17)	6(9.38)	0	
Long Thin	57(83.82)	65(90.28)	55(85.94)	60(88.24)	
Tail Form					
Docked	1(1.47)	0	0	0	
Blunt	0	0	0	0	6.681^{ns}
Curved Tip	2(2.94)	1(1.39)	0	0	
Straight Tip	65(95.59)	71(98.61)	63(100)	68(100)	
Head Profile					
Biconvex	13(19.12)	26(36.11)	24(37.5)	30(44.12)	
Biconcave	45(66.18)	34(47.22)	32(50.00)	31(45.51)	11.438*
Straight	10(14.71)	12(16.67)	8(12.5)	7(10.29)	
Ear Form					
Erect	0	0	0	0	
Horizontal	68(100)	72(100)	64(100)	68(100)	
Wattle					
Present	16(22.54)	13(18.06)	7(10.94)	13(19.12)	3.627**
Absent	52(76.47)	59(81.94)	57(89.06)	55(80.88)	
Horn					
Present	6(8.82)	2(2.78)	1(1.57)	6(8.82)	8.026^{ns}
Absent	62(91.12)	70(97.22)	63(98.43)	62(91.18)	
Horn shape					
Straight	6(100)	2(100)	0	3(50)	15.183*
Curving downward	0	0	1(100)	1(16.7)	
Curving upward	0	0	0	2(33.3)	
Ruff					
Present	1(1.47)	0	0	1(1.47)	2.0015^{ns}
Absent	67(98.53)	62(100)	64(100)	67(98.53)	

Bnk-Kby = Bunkure-Kibiya, Rgg-Kru = Rogo-Kiru, Mdb-Kbt = Madobi-Kumbotso, Bbj-Twd = Bebeji-Tudunwada, NS= not significant. *= (P<0.05). **= (P<0.01)

4.1.8 Distribution of Qualitative Traits in Ewes Based on Breeds

The distribution of qualitative traits in ewes based on breed is presented in Table 8. Breed had significant (P<0.01) effect on coat colour pattern. White dominant coat color pattern was observed in all the breeds with Yankasa having the highest proportion (51.94%), followed by Balami (50%) and Uda with the least proportion (42.31%). White coat color pattern was equally observed in all breeds with Yankasa having the highest proportion (43.20%), followed by Balami (27.5%) and Uda the least (15.34%). Brown dominant coat color pattern was also observed among all the breeds with Uda having the highest proportion (42.13%), followed by Balami (12.5%) and Yankasa the least (2.43%)while black dominant coat color pattern was observed in two breeds; Balami(5.0%) and Yankasa(1.94%).Similarly, brown coat color pattern was observed in two breeds; Balami and Yankasa with Balami having the higher proportion (2.5%) than Yankasa (0.49%)while black coat color pattern was observed only among Balami breed (2.5%) .

There was a significant relationship between breed and hair coat type. Long and smooth hair coat type was observed in all breeds with Uda having the highest proportion (92.41%), followed by Balami (70%) and Yankasa with the least proportion (69.42%). Short and smooth hair coat type was observed in two breeds (Balami and Yankasa) with Balami having the higher proportion (7.5%) compared to Yankasa w (0.49%). Short and coarse hair coat type was observed in all the breeds with Yankasa having the highest proportion (17.48%), followed by Balami (10%) and Uda with the least proportion (7.69%). Long and coarse hair coat type was observed in two breeds; Balami and Yankasa with the latter having the higher proportion (12.62%) than the former (12.5%).

Table 8: Distribution of Qualitative Traits In Ewes (N=272) Based on the Breeds

There was a significant association between breed and tail type. Long thin type was observed in all the breeds with Yankasa having the highest proportion (92.23%), followed by Balami (87.5%) and Uda with the least proportion (46.15%). Similarly, long fat tail type was observed in all the breeds with Uda having the highest proportion (30.77%), followed by Balami (7.5%) and Yankasa having the lowest proportion (2.43%). Short thin tail type was observed in all the breeds with Uda having the highest proportion (19.23%), followed by Balami (5%) and Yankasa with the least proportion (4.37%). Short fat tail type was observed in two breeds; Uda and Yankasa with Uda having the highest proportion (3.85%) and Yankasa having the lowest proportion (0.97%).

Breed had significant association with head profile. Biconcave head profile was observed in all the breeds with Yankasa having the highest proportion (56.31%), followed by Uda (42.32%) and Balami having the lowest proportion (37.5%). Biconvex head profile was observed in all the breeds with Uda having the highest proportion (53.85%), followed by Balami (42.5%) and Yankasa with the least proportion (30.10%). Straight head profile was also observed all the breeds with Balami (20%), followed by Yankasa (13.59%) and Uda with the least proportion (3.85%).Horizontal ear form was observed in all the breeds in equal proportions (100% each),while erect ear form was not observed in any breed.

There was a significant association between breed and wattles. Presence of wattles was observed in all the breeds with Yankasa having the highest proportion (21.36%), followed by Uda (7.69%) and Balami having the least proportion (7.5%).

Traits	Breeds			
	UDA(n=26)	BALAMI (n=40)	YANKASA(n=206)	CHI-SQUARE
Coat color pattern				
Black	0	1(2.5)	0	
Brown	4(15.34)	1(2.5)	1(0.49)	
Black Dominant	0	2(5)	4(1.94)	67.352***
Brown Dominant	11(42.31)	5(12.5)	5(2.43)	
White Dominant	11(42.31)	20(50)	107(51.94)	
White	0	11(27.5)	89(43.20)	
Coat Color Type				
spotted	16(61.54)	1(2.5)	25(12.14)	
Patches	7(26.92)	13(32.5)	34(16.50)	8.434 ^{ns}
plain	3(11.54)	26(65)	147(71.36)	
Hair Coat Type				
Long Coarse	0	5(12.5)	26(12.62)	
Short coarse	2(7.69)	4(10)	36(17.48)	18.943**
Short & smooth	24(92.41)	28(70)	143(69.42)	
Long & smooth	0	3(7.5)	1(0.49)	
TAIL TYPE				
Short fat	1(3.85)	0	2(0.79)	
Long fat	8(30.77)	3(7.5)	5(2.43)	48.399**
Short thin	5(19.23)	2(5)	9(4.37)	
Long thin	12(46.15)	35(87.5)	190(92.23)	
Tail form				
Docked	0	1(2.5)	0	
Curved tip	0	0	3(1.46)	6.771 ^{ns}
Straight tip	26(100)	39(97.5)	203(98.54)	
Head profile				
Biconvex	14(53.85)	17(42.5)	62(30.10)	
Biconcave	11(42.32)	15(37.5)	116(56.31)	10.588*
Straight	1(3.85)	8(20)	28(13.59)	
Ear Form				
Erect	0	0	0	
Horizontal	26(100)	40(100)	206(100)	
Wattle				
Present	2(7.69)	3(7.5)	44(21.36)	6.430
Absent	24(92.31)	37(92.5)	162(78.64)	
Horn				
Present	1(3.85)	2(5)	11(5.34)	0.108 ^{ns}
Absent	25(96.15)	38(95)	195(94.66)	
Horn shape				
Straight	1(100)	1(50)	9(75.0)	3.004 ^{ns}
Curving downward	0	1(50)	1(8.33)	
Curving upward	0	0	2(16.67)	
Ruff				
Present	0	1(2.5)	1(0.49)	2.075 ^{ns}
Absent	26(100)	39(97.5)	205(99.51)	

NS= not significant. *= (P<0.05). **= (P<0.01), ***= (P<0.001)

4.1.9 <u>Analysis of Variance for Quantitative Traits in Sheep Breeds.</u>

The results from Table 9 show that, there were significant (P<0.01) effects of location on body length, horn length and tail circumference; breed on pelvic width and shoulder width; sex on horn length; age on heart girth, withers height, shoulder width, body length, horn length and body weight; and location by sex on horn length; location by sex by age on withers height. However, location by breed, location by age, breed by sex, breed by age, sex by age, location by breed by sex, location by breed by age, location by sex by age and location by breed by sex by age did not show any significant influence on the traits.

4.1.10 <u>Analysis of Variance for Quantitative Traits in Rams (N=128)</u>

The results from Table 10 revealed that there were significant (P<0.01) effects of location on head length and horn lengths, breed on body weight, age on heart girth withers height, shoulder width, ear length, testis length, body weight and location by age on testis length. But there were no significant influence of location x breed, breed by age and location by breed by age on any morphometric trait in rams.

4.1.11 <u>Analysis of Variance for quantitative Traits in Ewes</u>

The results from table 11 show that there were significant (P<0.01) effects of location on shoulder width, pelvic width, body length and tail circumference; breed on pelvic width, head length and udder circumference; age on heart girth, withers height, shoulder width, body length, horn length tail length, tail circumference and body weight; location by age on tail length; breed by age on horn length and tail circumference .However, location by breed and location by breed by age showed no significant difference.

Table 9: Analysis of Variance for quantitative traits in sheep breeds (mean squares and level of significance (N=400)

SV	DF	HTG	WTH	SDW	PVW	BDL	ERL	HDL	HNL	TLL	TLC	BDW
Location	3	86.47	31.56	12.13	5.05	107.39*	7.4	15.15	90.66***	23.15	8.64**	30.38
Breed	2	3.14	7.78	21.38*	43.89**	32.47	9.35	3.23	19.78	30.17	0.47	71.28
Sex	1	32.87	32.33	11.45	0.1	4.74	2.82	27.41	12501.04***	4.06	1.47	59.66
Age	2	758.97***	534.41***	78.34***	6.67	191.31**	32.33	5.54	60.68**	21.62	0.76	573.40***
L x B	6	21.51	10.19	5.45	8.71	27.55	9.05	8.03	16.08	16.15	1.15	30.65
L X S	3	30.6	11.95	1.46	11.05	61.36	6.16	16.84	108.73***	5.89	2.57	24.28
L x A	6	65.42	24.04	3.56	1.71	14.34	8.49	11.8	18.95	21.9	1.25	48.34
B x S	2	47.63	3.36	9.33	2.07	13.58	3.19	33.94	50.64	13.51	0.07	64.23
B x A	4	33.97	32.5	1.91	13.03	62.9	4.14	2.25	23.72	6.68	4.14	45.29
S x A	2	70.32	1.17	9.47	2.18	24.24	11.54	3.05	9.21	20.96	0.2	25.43
S x B x A	6	70.51	20.46	4.67	5.65	45.82	1.64	26.47	17.3	18.35	0.54	30.73
L x B x A	11	19.74	24.58	2.24	4.61	34.33	3.73	5.28	7.31	9.01	2.64	17.98
L x S x A	6	31.97	24.72	4.99	3.67	26.59	9.42	15.17	22.74	9.68	0.68	42.16
B x S X A	2	9.17	98.16*	1.93	1.89	89.28	4.8	12.38	33.16	13.59	0.39	37.1
L x B x S x A	4	63.63	34.42	3.47	0.59	31.46	30.07	3.55	17.48	21.93	0.92	17.13
Error	338	38.52	28.99	6.82	8.12	32.87	58.94	15.25	12.34	18.22	2.19	26.62

SV= Source of Variation, L.= Location, B= Breed, S= Sex, A= age. HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= (P<0.05), **, ***(P<0.01).

Table 10: Analysis of Variance for quantitative Traits in Rams (mean squares and level of significance (N=128))

	DF	HTG	WTH	SDW	PVW	BDL	ERL	HDL	HNL	TLL	TLC	TTL	SCT	DBT	BDW
Location	3	45.58	16.4	3.42	4.31	14.52	0.84	35.26*	182.16**	22.68	1.1	20.04	6.4	0.15	15.27
Breed	2	11.13	12.84	24.58	22.56	14.81	1.83	31.08	34.46	13.28	3.1	9.26	2.37	0.09	120.9*
Age	2	592.92***	284.75***	44.32*	16.85	70.69	14.17*	6.82	18.24	8.54	0.69	45.21*	23.32	0.62	370.35***
L x B	6	52.84	18.27	4.25	6.37	33.4	3.35	19.97	33.92	20.19	3.14	10.86	1.44	0.19	21.5
L x A	6	58.61	17.84	8.71	3.74	9.07	2.03	20.34	44.65	21.27	1.21	32.23*	4.74	0.42	58.29
B x A	3	9.69	24.78	4.45	4.51	52.47	1.31	6.82	43	12.11	0.47	7.58	8.02	0.14	59.77
L x B x A	5	47.85	44.42	2.16	1.58	25.76	5.15	4.86	19.59	10.67	0.65	7.58	11.34	0.53	9.06
Error	100	34.76	32.1	9.97	8.07	27.28	3.49	12.93	41.54	18.8	3.47	14.56	14.4	0.24	28.37

L.= Location, B= Breed, S= Sex, A= age. HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= (P<0.05), **, ***(P<0.01).

Table 11: Analysis of Variance for Quantitative Traits in Ewes (mean squares and level of significance (N=272)

SV	DF	HTG	WTH	SDW	PVW	BDL	ERL	HDL	HNL	TLL	TLC	UDL	UDC
Location	3	59.28	19.48	12.26*	20.88*	171.76**	0.69	0.74	1.63	34.03	12.61**	9.9	13.24
BREED	2	18.91	6.39	2.14	27.58*	18.1	2.39	35.67*	6.36	60.28	6.1	3.05	91.75*
AGE	2	372.05***	342.81***	43.17***	1.06	241.82**	10.92	5.5	26.75*	87.43*	7.72*	32.32	151.37**
L x B	6	25.08	14.17	3.28	11.67	30.56	7.36	22.98	1.27	29.74	1.56	19.93	17.76
L x A	6	40.56	20.01	1.34	2.08	34.83	2.32	11.03	1.18	60.72*	1.65	9.64	6.48
B x A	4	56.15	62.63	0.37	14.85	57.84	4.08	5.19	22.41**	5.9	12.59***	22.35	45.36
L x B x A	10	22.71	16.14	1.95	5.28	32.75	5.28	5.37	4	29.32	2.38	7.07	26.57
Error	238	40.09	27.64	5.2	8.14	35.21	4.29	14.67	5.68	43.88	2.33	20.04	26.42

SV= Source of Variation, L.= Location, B= Breed, S= Sex, A= age. HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= (P<0.05), **, ***(P<0.00

4.1.12: <u>Average Values of Quantitative Traits of Sheep</u>

The average values of quantitative morphometric traits of sheep are presented in Table 12.The overall mean for body weight for all the breeds was 31.88kg, with the highest value (35.16kg) in Balami followed by Uda (32.45kg) and Yankasa recorded the least body weight (27.78kg). For heart girth, the mean was 76.5cm with the highest (76.86cm) in Balami, followed by Uda (76.39cm) while the lowest (66.57cm) was recorded in Yankasa. Withers height had an overall mean of 65.64cm with Balami having the highest value (68.52cm) followed by Uda (66.32cm), while Yankasa recorded the least value (62.09cm). The overall mean for shoulder width was 16.7cm, with Balami having the highest mean of 17.66cm followed by Uda (16.42cm) and Yankasa had the least mean (15.98cm).For pelvic width, the overall mean was 11.49 cm with Uda having the highest value (12.32cm), followed by Balami (10.57cm) and the least was in Yankasa (8.9cm). Body length recorded an overall mean of 66.11cm with Balami recording 67.99cm as mean, Uda had 66.08cmwhile Yankasa recorded 64.23cm.In terms of ear length, the overall mean was 15.37cm, with Balami, Uda and Yankasa having respective means of 16.71cm, 15.76cm and 13.45cm.The overall mean for head length was 31.79cm and the values for Uda, Balami and Yankasa were 32.53cm, 31.82cm and 25.08cm, respectively. Horn length had an overall mean of 9.42cm, with the Balami having the highest value (12.53cm) followed by Uda (8.47cm) and the Yankasa (7.26cm). The overall mean for tail length was 34.12cm, and the highest value was observed in Balami (36.82cm) followed by Uda (34.00cm) and then Yankasa (31.54cm). Tail circumference had the overall mean of 10.01cm and the values for Uda, Balami and Yankasa were 10.26cm, 10.01cm and 9.94cm, respectively.

Table 12: Average Values of Quantitative Morphometric Traits by Breeds of Sheep (Means ±SE, cm; N=400)

Morphometric traits	Yankasa	Balami	Uda	Overall mean
HTG	66.57±0.42[b]	76.86±0.75[a]	76.39±1.10[a]	73.34
WTH	62.09±0.36[c]	68.52±0.65[a]	66.32±0.8[b]	65.64
SDW	15.98±.017[b]	17.66±0.29[a]	16.42±0.43[a]	16.7
PVW	8.9±0.18[c]	10.57±0.29[b]	12.32±0.42[a]	10.6
BDL	64.23±0.38[c]	67.99±0.66[a]	66.08±0.88[b]	66.11
ERL	13.45±0.5[b]	16.71±0.19[a]	15.76±0.42[a]	15.37
HDL	20.08±0.24[b]	31.53±0.47[a]	31.82±0.5[a]	27.81
HNL	7.26±0.66[b]	11.53±0.1.46[a]	10.47±1.69[a]	9.42
TLL	31.54±0.28[c]	36.82±0.37[a]	34.00±0.47[b]	34.12
TLC	9.01±0.09[c]	10.94±0.14[a]	10.26±0.42[b]	10.01
BDW (kg)	27.78±0.36[c]	35.16±0.70[a]	32.45±0.65[b]	31.88

HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, 4.1.13: Average Values of Quantitative Traits of Rams and Ewes

Table 13 presents the average values of quantitative traits of rams and ewes. The result revealed that, the mean body weight for males and females were 35.27kg 38.09kg, respectively, while the respective values of heart girth for the two sexes were 75.06cm71.94cm.For withers height, males had a higher mean (68.57cm) than females (62.36cm), while the corresponding means for shoulder width were 17.6cm and 15.4cm. For pelvic width, females recorded a higher mean (11.63cm), than males (9.34cm), but shorter body length (65.09cm) than males (67.02cm).In terms of ear length, the means for males and females were 15.60 and 15.14cm, respectively, while the respective values for head length were 28.65cm and 26.93cm.Forhorn length, males had a mean of 24.36cm while females a relative very low value of 0.88cm, while the corresponding values for tail length were 34.24cm and 34.00cm. Similarly, males had thicker tails than females with respective means of 10.4cm and 9.91cm.

Table 13: Average Values of Quantitative Morphometric Traits by Sex of Sheep (Means ±SE, cm; N=400)

Morphometric traits	Male	Female
HTG	75.06±0.08^{a}	71.94±0.60^{b}
WTH	68.57±0.68^{a}	62.36±0.60^{b}
SDW	17.6±0.31^{a}	15.40±0.8^{b}
PVW	9.34±0.8^{b}	11.63±0.4^{a}
BDL	67.02±0.51^{a}	65.09±0.4^{b}
ERL	15.60±0.31^{a}	15.14±0.51^{a}
HDL	28.65±0.32^{a}	26.93±0.25^{b}
HNL	11.72±0.50^{a}	0.88±0.15^{b}
TLL	34.24±0.34^{a}	34.00±0.28^{a}
TLC	10.14±0.12^{a}	9.91±0.10^{a}
BDW (kg)	35.27±0.58^{a}	28.09±0.34^{b}

HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight.

4.1.14 Correlation Matrix for Body Measurements of Sheep

Table 14 presents the correlation matrix of body weight and linear body measurements of sheep. The result showed highly significant associations between body weight and most of the linear body measurements. The values ranged from 0.15 to 0.54. The result also revealed significant relationships (P<0.05) between HTG: HNL and TLC, WTH: HNL and TLC, SDW: PVW, HDL, HNL and TLC, PVW: HDL, BDL: TLC, HDL: HNL, TLL: BDW and TLC: BDW. On the other hand, non-significant associations were observed between ERL and all the variables, HNL: TLC and BDW, TLL and TLC.

Table 14: Correlation Matrix for Body Measurements of Sheep (in CM; N=400)

	HTG	WTH	SDW	PVW	BDL	ERL	SDL	HNL	TLL	TLC	BDW(kg)
HTG	1										
WTH	0.54**	1									
SDW	0.28**	0.46**	1								
PVW	0.15**	0.20**	0.17*	1							
BDL	0.37**	0.35**	0.29**	0.27**	1						
ERL	0.08ns	0.03ns	0.04ns	0.04ns	0.04ns	1					
HDL	0.31**	0.21**	0.13*	0.12*	0.25**	0.01ns	1				
HNL	0.11*	0.14*	0.10*	-0.02ns	0.05ns	-0.01ns	0.11*	1			
TLL	0.34**	0.34**	0.24**	0.08ns	0.22**	0.04ns	0.32**	0.16**	1		
TLC	0.10*	0.12*	0.16*	0.23**	0.13*	-0.02ns	0.15**	0.05ns	0.08ns	1	
BDW	0.42**	0.36**	0.31**	0.17**	0.25**	0.06ns	0.16**	0.08ns	0.10*	0.14*	1

HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= ($P<0.05$), **, 4.1.15: Correlation Matrix for Body Measurements of Rams

Table 15 presents the correlation matrix of body weight and linear body measurements of rams. The result showed highly significant associations between body weight and most of the linear body measurements, with values of correlation coefficients ranging from 0.25 to 0.58.The results also showed significant relationships ($P<0.05$) between HTG: HNL, TLL, STC and DBT, WTH: HNL and TLL, SDW: PVW, ERL and DBT, PVW: STC, BDL: STC, ERL: STC and DBT, HNL: TLL and BDW, TLL: BDW, TLC: TTL, DBT and BDW, STC: DBT and DBT: BSW. On the other hand, non-significant associations were observed between TLC and all the variables except ERL, HTG: TLC, WTH: TLC, SDW: HDL, HNL, TLC and STC, PVW: HNL, TLL, TLC and TTL, DBL: ERL, TLC, TTL and DBT, ERL: HDL, HNL, TLL and TTL, HDL: HNL, TLC, TTL and STC, HNL: TLC, TTL, STC and DBT, TLL: TLC, TTL STC, TLC: STC, TLL: STC and DBT and STC: BDW.

Table 15: Correlation Matrix for Body Measurements of Rams

	HTG	WTH	SDW	PVW	BDL	ERL	HDL	HNL	TLL	TLC	TTL	STC	DBT	BDW
HTG	1													
WTH	0.52**	1												
SDW	0.33**	0.58**	1											
PVW	0.38**	0.38**	0.24*	1										
BDL	0.61**	0.49**	0.29**	0.35**	1									
ERL	0.29**	0.31**	0.21*	0.34**	0.08NS	1								
HDL	0.33**	0.28**	-0.14ns	0.28**	0.37**	-0.01ns	1							
HNL	0.14*	0.11*	0.12NS	0.09NS	0.29**	-0.01ns	0.11NS	1						
TLL	0.20*	0.35**	0.36**	0.04NS	0.27**	0.09NS	0.30**	0.19*	1					
TLC	0.09NS	0.10NS	0.16NS	0.16NS	-0.02ns	0.29**	-0.05ns	-0.01ns	-0.02ns	1				
TTL	0.26**	0.16*	0.27**	0.07NS	0.08NS	0.13NS	0.12.NS	-0.14ns	0.03NS	0.15*	1			
STC	0.22*	0.34**	0.06NS	0.20*	0.21*	0.17*	0.12NS	0.08NS	0.10NS	0.02NS	0.07NS	1		
DBT	0.13*	0.29**	0.23*	0.26**	0.11NS	0.20*	0.27**	0.13NS	0.25**	0.21*	0.02NS	0.20*	1	
BDW	0.56**	0.39**	0.41**	0.25**	0.34**	0.28**	0.26**	0.18*	0.18*	0.15*	0.34**	0.06NS	0.16*	1

HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= (P<0.05), **, 4.1.16 Correlation matrix for body measurements of ewes

Table 16 depicts the correlation matrix of body weight and linear body measurements among ewes. The results showed highly significant associations between body weight and most of the linear body measurements, the values of which ranged from 0.17 to 0.89.The results revealed significant relationships ($P<0.05$) between HTG: TLC, WTH: PVW, HDL and TLC, SDW: PVW, HDL and TLC, PVW: TLL and BDW, BDL: ERL and UDL, ERL: TLL, HDL: HNL and BDW, TLL: TLC and BDW and TLC: BDW. On the other hand, non-significant associations were observed between HTG: PVW, HNL and UDL, WTH: HNL, UDL and UDC, SDW: HNL, HNL and UDC, PVW: HDL and HNL, BDL: HNL, ERL: HDL and HNL, HDL: all variables, TLL: UDL and UDC, and TLC: UDC.

Table 16: Correlation Matrix for Body Measurements of Ewes

	HTG	WTH	SDW	PVW	BDL	ERL	SDL	HNL	TLL	TLC	UDL	UDC	BDW
HTG	1												
WTH	0.55**	1											
SDW	0.25**	0.36**	1										
PVW	0.05NS	0.11*	0.14*	1									
BDL	0.27**	0.29**	0.89**	0.23**	1								
ERL	0.22**	0.24**	0.23**	0.27**	0.15*	1							
HDL	0.28**	0.15*	0.04NS	0.05NS	0.17**	0.02NS	1						
HNL	0.00NS	-0.10ns	-0.03ns	-0.07ns	-0.09ns	0.01NS	0.10*	1					
TLL	0.41**	0.32**	0.14*	0.13*	0.18**	0.15*	0.33**	0.07NS	1				
TLC	0.10*	0.12*	0.18**	0.27**	0.20**	0.17**	0.18**	-0.04ns	0.11*	1			
UDL	0.09NS	0.07NS	0.17**	0.26**	0.15*	0.34**	0.01NS	0.11NS	-0.12ns	0.19**	1		
UDC	0.23**	0.15NS	0.09NS	0.19**	0.22**	0.18**	0.05NS	-0.08ns	0.04NS	0.11NS	0.48**	1	
BDW	0.33**	0.34**	0.21**	0.14*	0.20**	0.24**	0.12*	-0.08ns	0.11*	0.12*	0.23**	0.28**	1

HTG= Heart girth, WTH=Withers height, SDW= Shoulder width, PVW= Pelvic width, BDL= Body length, ERL= Ear length, HDL= Head length, TLL= Tail length, TLC= Tail circumference, STC= Scrotum circumference, DBT= Distance between teat, UDL= Udder length, BDW= Body weight, *= (P<0.05), **,

4.2 DISCUSSION

4.2.1 Coat Color

Coat color pattern and type revealed that white dominant coat color pattern and plain coat color type were predominant across all breeds and locations with Yankasa having the highest proportion (52.6%) and (72.6%) for coat color pattern and coat color type, respectively. This is similar to the report by Wamagi *et al.* (2013) which indicated that Yankasa (spotted black) breed was dominant in southern part of Kaduna state, Nigeria, and spread across all locations. This is supported by the Philips (1977) and Osinowo *et al*. (1985), who observed that the Yankasa sheep was the most numerous and most widely distributed of the Nigerian sheep breeds and is found throughout the Guinea and Sudan Savannah Zones. In studies conducted in Hararghe by Alemayehu (1993) and in Eritrea and part of Ethopia by Derege Tsegaye *et al*., (2013) on sheep, plain coat color pattern was found to be dominant. It was reported by Fontanesi *et al*, (2011) that two main loci affect coat color in sheep: Agouti and extension coding for the Agouti signaling protein (ASIP) and Melanocortin 1 receptor (MC1R) genes respectively. The present study revealed increasing trend of white color pattern in sheep which might be attributed to the selection and preference of sheep owners towards white sheep due to market demands for white colors.

4.2.2 Hair Coat Type

The fact that short and smooth hair coat type was predominant among all the breeds and locations was similarly observed by Abera *et al.* (2013) who reported that most of the sheep characterized in southern regional state of Ethiopia had short and smooth hair. According to the findings of Gizaw *et al*., (2008), the Adilo sheep were reported to be short-haired, whereas the Arsi-Bala, Bonga and Afar sheep were characterized by hairy fibre hair.

4.2.3 Tail

Tails are natural part of sheep, lambs are born with tails. The length of a lamb's tail is usually half-way between the length of its mother's tail and its father's tail. In fact tail is a highly heritable traits. Up to 84 percent of the differences in sheep tail length is due to genetics. The purpose of the sheep's tail is to protect the sheep's anus, vulva, and udder from weather extremes. Sheep lift their tails when they defecate and use their tails to some extent to scatter their faeces. (Anonymous, 2015). This study revealed that long thin tail type and straight tip tail form were predominant in all the breeds and locations .Variations in tail characteristics among sheep breeds were reported by different authors. For example, Aberra *et al.* (2013) reported that GAL sheep were characterized by a long thin tail type but had straight curved tips. On the other hand, Gizaw (2008) observed that Adilo and Arsi-Bale sheep which were characterized by long fat tail with a straight tip. In other studies conducted by Tibbo *et al.* (2004) and Getache *et al.* (2010), the Menz sheep had a characteristic short fat tail which was curved upward at the tip.

4.2.4 Head Profile

Biconcave head profile was predominant across all the breeds and locations, however, Wilson, (1991) reported long and heavy head with flat forehead and slightly convex head profile in Bali-Bali sheep, this may be breed attribute.

4.2.5 Ear Form

All the sheep in the study area had a horizontal ear form. This findings resemble the research outcome of Salako (2013) which also reported horizontal and long ear in yankasa sheep and some other breeds in Sri-lanka .

4.2.6 Horn

A sheep's horns are hollow, consisting of keratinous she alth overlaying a bony core that is attached to the skull. Horns will grow through a sheep's lifetime, with the most rapid growth occurring during the first two-three years of life. Horn presence is controlled by three genes, one gene (p) is dominant for the polled condition. One gene (p) is sex-linked for non-polled. The third gene (p) produces horn in both ewes and rams. There is a 25 percent chance of getting horned offspring from two polled parents, if each parent is heterozygous for horns (Pp). There is variability in horn possession where more than half of the sheep are polled and few possess horn. Straight horn shape were predominant in the study area. Results from this study indicated that presence of horn was predominant in Yankasa breed with high in rams and very low in ewes. Gizaw (2008) and Edea *et al*. (2010) on the other hand, observed rams and ewes of Bonga sheep to be polled.

4.2.7 Ruff and Wattle

It was observed from this research that ruff was present and predominant in ram of Yankasa breed and absent in ewes. This is contrary to the work of Edea *et al*. (2010) for Bonga and Horro sheep where absence of ruff was observed in both sexes.

Wattle**:**

This finding revealed that the presence of wattle was predominant in Yankasa breed in both sexes. However, Tibbo and Ginbar (2004) reported low presence of wattle in rams but high rate in ewes.

4.2.8 Quantitative traits

The result from this study revealed significant differences between locations in BDL, HNL and TLC .This might be caused by the age of animals, breeds and production environment in which the animals were kept. Several researches reported a significant effect of location on body weight and some linear body measurements adding that; the environment in which an animal lives significantly influence its linear body measurements, as the phenotype is the function of gene and environment (Ibe, 1989). Adejoro and Salako (2013) observed that there were highly significant differences in wither height, body length, foreleg length, thorax depth, hock length, rump length, face length, face width, rear leg length, cannon bone length measurements of Yankasa sheep across different locations. Tibbo (2006) reported that live weight of male sheep from GUS and WOL meets the recommended live export body weight of 30kg at yearling age. A scrotal circumference is an indirect measure of ram fertility and used to assess breeding soundness of ram with a high heritability (Soderquist and Hulten, 2006).

The current study also reported a significant effect of age on most of the measured variables, as demonstrated by several researchers. For example, Olutugun *et al.* (2003) and Kanai *et al.* (2013) observed significant variations in body measurements between sexes among cattle breeds. A Similar observation was made by Otoikhian *et al.* (2008) in goats. Osinowo *et* *al.*(1989) and Otoikhian *et al.*(2006) also observed that different age groups had differences in body measurements for traits like BL, EL, TL, WH, HG, HL etc.

4.2.9 Average values of quantitative morphometric traits by breeds and sex of sheep

The differences between the three breeds of sheep obtained in this study with Balami recording the highest value for most of the quantitative traits followed by Uda and Yankasa could be due to genetic reasons. This is in agreement with the findings of several researchers. For instance, Yunusa *et al* (2013) reported that, Balamis were superior in most quantitative variables followed by Uda and then Yankasa. (Yakubu and Ibrahim, 2011).The latter explained that the differences between the three sheep breeds may have genetic underpinning, which is often facilitated when measurements are restricted to phenotypically pure animals (Yakubu *et al*. 2010).

The differentials obtained in the morphological traits of the sexes in this research could be attributed to sexual dimorphism as reported by Yakubu and Akinyemi (2010). Festa-Bianchet *et al*. (1996) also reported that most dimorphism developed post-weaning because of faster mass gain by males during the age of 1–2 years. They also suggested that males might have a longer season of mass gain each year throughout their lives, while females divert annual resources into reproduction, rather than body mass. The result for pelvic width which favoured ewes can be attributed to lambing that relaxes of pelvic bones during parturition.

4.2.10 Correlation matrix of body weight and body measurements

The positive correlations between body weight and linear body measurements obtained in this study agreed with the findings of several researches. Similar observations were made by Otoikhian *et al.* (2008) and Jamssems and Vandepitte (2004). Afolayan *et al.* (2006) reported that, with Pearson (raw) correlation modules, live weight was very highly correlated with body dimensional traits (0.76–0.94). Of the body dimensional characters, girth was the most related trait to weight and the correlation between these two traits was 0.94. Variables such as height, length, girth, which are directly related to the size and weight of animal, displayed moderate to very high positive correlations with one another.The relationship between most of the linear body measurements were found to be positive except for ear length, horn length, tail length, tail circumference, udder length and scrotum circumference, as was similarly observed by Pesmen and Yardimci (2008).The positive and moderate to high relationships between the traits could be attributed to pleiotropy, a situation where a gene influences the expression of more than one character (Falconer and Mackey, 1996). This is also indicative of the fact that linear body traits could be used in assessing body weight as well as selection criteria for genetic improvement of sheep.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The study was conducted in some selected Local Government Areas (LGS's) of Kano State to assess the quantitative and qualitative morphometric traits from four hundred sheep comprising of two hundred and seventy two Ewes and one hundred and twenty eight Rams. Body weight and sixteen morphometric traits were measured using weighing band calibrated in centimeters (cm). Categorical traits were recorded after visual inspection. The results showed that Yankasa were the most predominant (71.25%) breeds reared in the study area. White dominant coat color pattern, plain coat color type, short and smooth hair coat type, long thin tail type, straight tip tail form, biconcave head profile, horizontal ear form, straight horn shape were the most prominent categorical traits in the study Area. The results showed that, there was significant effect of location in BDL, HNL and TLC. In addition, variations in morphometric traits exist between the sheep breeds in the study area with Balami recording the highest values for most characters. Positive correlations were observed between body weight and most linear body measurements, irrespective of sex of sheep.

5.2 CONCLUSION

In conclusion, the study has revealed that Yankasa was the predominant breed of sheep reared in the study area. White dominant coat color pattern, plain coat color type, short and smooth coat hair type, long thin tail type, straight tail tip form, biconcave head profile, horizontal ear form, straight horn shape, absence of wattle and horn were the most observed categorical traits in the study Area. The study showed that, there was significant effect of location on BDL, HNL and TLC, Variations in morphometric traits existed between the sheep breeds in the study area with Balami recording the highest values for most characters. High correlations were observed between body weight and most linear body measurements, irrespective of sex of sheep. Thus, coat color, hair coat type, tail form, heart girth, head profile, shoulder width, body length, body weight and ear length should be considered in breed identification. In addition, linear body traits could be used as selection criteria for increased body weight.

5.3 RECOMMENDATIONS

It is recommended that

1. Coat color, hair coat type, tail form, heart girth, head profile, shoulder width, body length, body weight and ear length should be considered in breed characterization.
2. Linear body traits (heart girth, withers height, shoulder width, pelvic width, body length, ear length, head length, tail length, tail circumference, testis length, scrotum circumference, udder length, udder circumference, and distance between two testicles) could be used as selection criteria for increased body weight.
3. Molecular tools should be used for further studies on morphological and genetic characterization of indigenous sheep breed in Kano State, Nigeria to aid conservation of the breeds.

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