ASSESSMENT OF TRADITIONAL BREEDING PRACTICES AMONG SHEEP OWNERS IN SELECTED LOCAL GOVERNMENT AREAS OF KANO STATE

AMINU SALISU USMAN
SPS/12/MAS/00002

OCTOBER, 2016

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AMINU SALISU USMAN
(SPS/12/MAS/00002)
B.AGRICULTURE

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE, FACULTY OF AGRICULTURE, BAYERO UNIVERSITY, KANO IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ANIMAL SCIENCE

OCTOBER, 2016

DECLARATION

I hereby declare that this work is the product of my research effort undertaken under the supervision of Professor Ibrahim Tahir and has not been presented anywhere for the award of a degree or certificate. All sources have been duly acknowledged.

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AMINU SALISU USMAN
(SPS/12/MAS/00002)

CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent write-up (Aminu Salisu Usman SPS/12/MAS/00002) were carried out under my supervision.

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Professor I.Tahir
(Supervisor)

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Dr. M. Baba
(HOD, Animal Science)

APPROVAL

This dissertation has been examined and approved for the award of Masters in (Animal Science).

Prof. G.N. Akpa (External Examiner)	Date
Dr. A. M. Abdussamad (Internal Examiner)	Date
Professor I.Tahir (Supervisor)	Date
Dr. M. Baba (HOD, Animal Science)	Date
Mrs. Amina Mustapha (SPS Board Representative)	Date

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Alhamdulillah all praises belongs to Allah, the most merciful, most gracious, most beneficial and ever knowing. I thank Allah for his guidance, protection, and forgiveness. I also extend my greetings to our Prophet (S.A.W) may the peace of Allah be upon him. I wish to give credit to my supervisor professor Tahir Ibrahim for making this work possible. Special thanks to my internal examiner Dr. Abdussamad Muhammad Abdussamad for his guidance during this work.

I take this opportunity to thank Bashir Maaruf, lecturer at Department of Animal Science Faculty of Agriculture, Federal University, Kashere, Zulaiha Auwal Dankoli and Halima Abdullahi Muhammad, lecturers in Department of Animal Science Faculty of Agriculture, Bayero University Kano for working patiently and tirelessly during this work. I also acknowledge with thanks the cooperation of the lecturers of Department of Animal Science Bayero University Kano, for working with students during the period of study in the Department. My sincere grateful goes to my parents for their maximum contribution to my education. I also use this opportunity to express my appreciation to my Uncles; Ibrahim Adamu Shanono (baba) and Shehu Adamu Shanono for their maximum contributions during the period of study, may Allah reward them.

Lastly, I am grateful to my younger brother, Mustapha Salisu Usman, my elder brother Abbas Jibril, my friend, Mustapha Sadi Gabari and the entire members of my family and my course mates for their support and prayer in order to achieve success in this work.

DEDICATION

In consideration and appreciation of their contributions towards my success in life, I have dedicated this work to my beloved parents, my father late Salisu Usman, and my mother late Khadija Adamu Shanono; may Allah reward them with Jannatul Firdaus , Ameen.

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ABSTRACT

The study was conducted in five selected Local Government Areas of Kano State, namely Shanono, Dawakin kudu, Dambatta, Wudil and Bebeji, to assess the traditional breeding practices and selection criteria for indigenous sheep breeds and identify aspects of sheep breeding to be improved based on farmers' trait preferences. Purposive sampling technique was employed to select 350 farmers (71.43% of which were males) from the locations. A structured questionnaire and focused group discussions were used to generate the required data. Sheep were kept for a variety of reasons including income generation, economic security (savings) and social/religious functions. The relative importance given by respondents to the different functions varied across locations. However, irrespective of location, sheep were primarily kept as source of income. Female animals represented approximately 64% of the total flock of sheep in the study areas and male animals accounted for 36% (ratio of 3:2 of female to male). Breeding ewes dominated Breeding rams in each flock in all the locations with overall ratio of 9: 1 respectively. The flock size of respondents was significantly ($p < 0.001$) differ across location. Famers that had sheep flock size ranging from 1 to 5 sheep were the highest across the location with total number of respondents of 154 which was up to 44% followed by Respondents with flock size ranging from 6-10 heads (which was 29.1% of the total population of respondents), those with 11 to 15 heads and numbered up to 50 which makes 14.1% of the total number of respondents, famers with more than 15 (>15) sheep in their flock and had 44 as the total number of respondents accounted for 12.6% of the total number of respondents. Irrespective of location, most (85.1%) of the sheep were of the Yankasa breed type while Balami breed was the least prominent (1.4%). Keeping crossbred animals and/or maintaining more than one genotype in the same flock was practiced by few sheep keepers. The reason for breed preference by most (85.14%) of the farmers was adaptability and feed shortage tolerance. Although considerable proportions (68.28%) of the respondents were aware of inbreeding, mating was predominantly uncontrolled (61.14%). Body size, head morphology , body shape and appearance were the most frequently reported traits in selecting breeding rams across the locations; whereas body size was mentioned as the trait given due emphasis in choosing future breeding ewes. Majority (54.3%) of the respondents had no contact with extension agents. Uncontrolled mating and absence of breeding rams in many of the flocks are challenges which have to be tackled in order to improve the productivity of sheep in the study areas. A community based traditional breeding program with farmers' involvement considering the existing breeding practices, selection criteria and trait preferences is therefore recommended.

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CHAPTER ONE

INTRODUCTION

1.1BACKGROUND OF THE STUDY

Nigeria possesses vast resources in livestock comprising cattle, sheep, goats, poultry horses, donkeys, camels, rabbits and fish. The immense position of livestock farming in this country cannot be over emphasized. Among all the livestock that make up the farm animals in Nigeria, ruminants, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system. 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. The larger proportion of these animals population are however largely concentrated in the northern region of the country than the southern region (Adebowale, 2012). Specifically about 90 percent of the country's cattle population and 70 percent of the sheep and goat populations are concentrated in Northern region of the country. Concentration of Nigeria's livestock-base in the northern region is most likely to have been influenced by the ecological condition of the region which is characterized by low rainfall duration, lighter sandy soils and longer dry season. This submission is predicated by the fact that drier tropics or semi-arid regions are more favorable to the ruminants (Yemi, 2010).

The livestock sub-sector is contributing significantly to the Nigerian economy considering the population figure of 2010 stated above. In monetary terms, the value of Nigerian livestock resources, based on prevailing market prices in mid 1991, was conservatively estimated to be in the order of US $6 billion (Bourn, Wint, Blench, and Woolley, 1992). Small ruminants (sheep and goats) have a unique niche in smallholder agriculture from the fact that they require

small investments; have shorter production cycles, faster growth rates and greater environmental adaptability as compared to large ruminants. They are important protein sources in the diets of the poor and help to provide extra income and support survival for many farmers in the tropics and sub-tropics (Tibbo, Philipsson and Ayalew, 2006).

Small ruminants are widespread in the tropics and contribute to the subsistence, economic and social livelihood of a large human population. They are a source of tangible benefits (i.e., cash income from animal sales, meat for home consumption, manure, fiber and skins) and intangible benefits (e.g., savings, insurance, culture and ceremonial purposes). The main beneficiaries are the women, children and the aged, who are often the most vulnerable members of the society in terms of under – nutrition and poverty (Kosgey, 2004). Besides, small ruminants complement other livestock in the utilization of available feed resources and provide one of the practical means of using vast areas of natural grassland in regions where crop production is impractical, such as arid and semi-arid areas, and hilly and rocky grounds. Despite the large number and importance of these animal species in the tropics, good definitions of comprehensive breeding objectives are rare. In addition, sustainable breeding programmes using indigenous breeds are scarce. The developing countries in the tropics currently experience high increases in human population, dramatic urbanization, increasing monetarization of their economies and income change. Consequently, there is need to address issues related to under-nutrition, food security, rural poverty and rates and patterns of agricultural growth that contribute to overall economic development, and protection of the environment. Sustainable breeding programmes can make a significant contribution (Kosgey, 2004).

The tropical sheep breeds as we see today have evolved as the result of several generations of human and natural selection, predominantly for traits related to

adaptation/survival under several natural challenges (Fsahatsion, Aberra and Banerjee, 2013; Markos, Ayalew, Awgichew, Ermias and Rege, 2004). In spite of the several constraints, they have been able to contribute significantly to the income of the small holder farmers/ pastoralists and also help in poverty alleviation schemes (Kosgey and Okeyo, 2007) as mentioned earlier. Therefore, genetic improvement of the indigenous livestock through appropriate techniques or selection and breeding programme is the need of the day especially under such constraints (Yakubu, 2010).

1.2 PROBLEM STATEMENT

The productivity of sheep as in case of most of the ruminants is markedly low due to several genetic and environmental factors besides the institutional, environmental and infrastructure constraints (Markos, Ayalew, Awgichew, Ermias, and Rege, 2004; Kosgey,and Okeyo, 2007).

Unfortunately, attempts to improve small ruminants in the tropics including Nigeria so far faced several constraints mainly due to weak planning, poor involvement of livestock owners and implementing livestock improvement programs without taking into consideration all the needs of farmers (Sölkner, Nakimbigwe, and Valle-Zarate, 1998; Tibbo, Philipsson and Ayalew, 2006).

1.3 JUSTIFICATION OF THE STUDY

Considering the above problem stated, there is therefore, the need for new thinking and developing breeding programs with the consultation and involvement of all stakeholders from the planning to implementation phase. Sölkner, Nakimbigwe and Valle-Zarate (1998) proposed a new approach, which is a community based breeding program. Detailed and up-to-date information on production system, indigenous knowledge of managing the breed, identification

of important traits for selection with full participation of farmers are prerequisites (Sölkner, Nakimbigwe and Valle-Zarate, 1998; Kosgey, Baker, Udo, and van Arendonk, 2006). Assessment of the sheep breeds, breeding system and flock structure in the smallholder production system is important to bring improvement in sheep productivity (Yenesew, Solomon and Azage, 2013).

1.4 OBJECTIVES OF THE STUDY

The broad objective of this work is to assess indigenous breeding strategies of farmers in the study area towards improving productivity of Nigerian indigenous sheep. The specific objectives are:

I. To determine the socio-economic characteristics of sheep owners in the study areas
II. To identify the breeds of sheep being reared
III. To assess the flock size and structure
IV. To assess the breeding objectives and traits of preference of farmers
V. To assess the breeding practices and selection criteria of farmers
VI. To identify aspects of traditional sheep breeding to be improved based on farmers traits preference

CHAPTER TWO

LITERATURE REVIEW

2.1 THE BASIS FOR DESIGNING COMMUNITY-BASED BREEDING PROGRAMME

The bases for designing community-based breeding programs are the farmers' and pastoralists' indigenous breeding strategies and the resultant mode of livestock production. Farmers' and pastoralists' strategies arise from their indigenous knowledge of animal breeding and management. Farmers' and pastoralists' strategies are expressed in their indigenous breeding and management practices, breeding/production objectives, and marketing strategies (Gizaw *et al*., 2013). The indigenous strategies of the farmers and pastoralists take into account the production environment, long-standing tradition of livestock production practices, management skills, socio-economic and cultural factors, and the availability of inputs and services. The mode of livestock production practiced by a farming community has a direct bearing on the design of livestock development strategies. Thus, the production system in a target area needs to be characterized and understood in order to design a suitable breeding program (Gizaw *et al*., 2013). Community-based sheep breeding requires a full description of the existing environment, the current level of productivity, breeding objectives, and the selection criteria of sheepherders, available indigenous knowledge and breeding practices, and the full participation from the beginning of the farmers and pastoralists (Sölkner, Nakimbigwe and Valle-Zarate, 1998; Kosgey, Baker, Udo and van Arendonk, 2006). The approach to designing breeding programs should attempt to fit new breeding strategies into the indigenous breeding strategies of the target farmers and pastoralists, rather than forcing exotic methods and products as is the case with the conventional top–down design of breeding programs.

2.2 SMALL RUMINANTS POPULATION IN NIGERIA

Small ruminants are almost as ubiquitous as poultry, though not so numerous. Nationally there are estimated to be a total of 56.6million heads, with goats out numbering sheep by three to two, although some seasonal movement of pastoral sheep does take place (Bourn, Wint, Blench and Woolley, 1992). The great majority of small ruminants are sedentary village livestock and their pattern of distribution mirrors that of human settlement (Adebowale, 2012).

Small ruminant flock holding sizes are larger in the drier north than in the south (Adebowale, 2012). In south Eastern Nigeria (Adebowale, 2012) reported that goats were more widely owned than sheep. Sheep were owned by 28% of the households contrary to 92% goats' ownership. In south western Nigeria, average flock size is in the range of 2-5 animals per owner with goats being also more common than sheep (Matthewmann, 1977); he also reported in two villages in the south western Nigeria approximately 60% of the households owned goats and 22% owned sheep.

The population of the major domestic animal species found in the semi-arid zone of west African region is said to have increased in the last 30 years (Jean, 2008). According to Gerdiner and Devendra (1995), the population of cattle, sheep and goats increased by 0.5, 2.2 and 1.7% per year, respectively between 1961-63 and 1991-93. Small ruminants, comprising sheep and goats dominated the livestock population. Cattle, sheep and goat distribution in Nigeria is limited by tsetse fly incidence and by the availability of forage. The semiarid ecological zone is virtually tsetse fly free, but has the lowest forage resources, carry over 70% of the total population of livestock in Nigeria are concentrated in the Guinea and Sudan zones (Adu and Ngere, 1979).

2.3 THE PLACE OF SMALL RUMINANTS IN NIGERIAN AGRICULTURE

Small ruminant animals continue to make substantial contribution to the economy of Nigeria as supplies of food, raw materials and foreign earning. Oni (2002) reported that sheep and goats account for about 36% of total national meat supply and they have tremendous potential for growth. Goats also feature prominently in the economic and social lives of Nigerians. They serve as a quick source of income and play a role in dowry, ceremonies and ritual sacrifices. Goats have successfully served mankind with meat, milk, hair, leather and other products including manure, even though they are frequently objects of neglect and prejudice (Lamorde, 1993). Sheep and goats with their small body, high reproductive capacity and rapid growth rates in some instances are ideally suited to production by resource poor small holders. They can be integrated into overall production system, absorbing surplus labour and consuming small amounts of otherwise unused feed. The low capital requirement for starting or expanding small ruminant production means that risks are low and that the enterprise is well suited to low input system (Lamorde, 1993).

Small ruminant livestock under small holder systems were considered as scavengers, surviving on crop residues, household wastes and natural vegetation regardless of their quality. However, the economic importance of livestock especially small ruminants (sheep and goats) in mixed farming systems is now receiving attention. In small holder production systems, sheep and goats are important because they require less initial capital and maintenance costs, are able to use marginal land and crop residues; produce meat and milk in readily usable quantities; easily cared for by most family members; are prolific and require only short periods to increase flock sizes after natural disasters such as diseases or drought as a result of increased demand and market

prices. The rate of return on investment under good management is high (3 5%) for goats and 55% for sheep (Lamorde, 1993).

Sheep contribute enormously towards promotion of livelihoods security and as an insurance cover to crop with crop failures particularly for rural landless, small and marginal female farmers (Adeloye, 1998). Sheep farming is also increasingly being taken up by peril-urban poor population due to market access and as a source of nutritional security for the household (Oni, 2002). Sheep are favored because of low investments, easy to raise and manage, low feed requirement compared to cattle, ability to thrive different flora, high disease resistance, and superior market potential (Oni, 2002).

2.4 BREEDS OF SHEEP IN NIGERIA

Sheep are kept everywhere in Nigeria, with a broad distinction between their importance and ubiquity in the north, and the more dispersed populations of the humid zone. Sheep and goats are seen as having secondary importance in relation to crops. Sheep are the second most numerous pastoral species, and small flocks accompany many cattle herds in the north and in the Middle Belt (Bourn, Wint, Blench and Woolley, 1994). There are generally considered to be four breeds or races of sheep native to Nigeria, the Balami, Uda, Yankasa and West African Dwarf (WAD) (Adu and Ngere, 1979).

2.4.1 Balami

Balami is the largest bodied native sheep in Nigeria. As a pastoral animal, it is confined to the semi arid north but it is favored as a stall fed breed by muslims throughout the Nigerian middle belt. It is white and hairy with pendulous ears, long-leg and a long thin tail (Adu and Ngere, 1979). Rams are horned but ewes are normally polled. Another feature that makes the Balami distinctly recognisable is its Roman, bulbous nose that distinguishes it from the Yankasa

(Adu and Ngere, 1979). It has good potential as a meat producer and milk yield per lactation lies between 28 and 33 kg in 70 days.

2.4.2 Uda

Also Known By: Oudah bicolore (French), Bali-Bali, Bororo, Fellata, Foulbe, Houda, Louda, North Nigerian Fulani, Ouda, Pied.

The Uda is one of the hair sheep breeds of the Sahel type. Haumesser and Gerbaldi (1980) studied traditionally-managed Uda flocks in Niger Republic; Wilson and Durkin (1983a, b) and Wilson and Light (1986) report on related sheep production systems in central Mali. It is a meat breed. It is a long-legged breed of sheep with distinctive coat colour of brown or black anterior and white posterior. They are large with straight and long face. The rams of the Uda are horned (Adu and Ngere, 1979) and the ewes are usually polled. Milk yield per lactation lies between 32 and 36 kg for an average lactation length of 91 days.

2.4.3 Yankasa

Also Known By: Hausa, White Fulani, Y'ankasa

The Yankasa is a meat breed found in north and north central Nigeria. In size it is intermediate between Uda and the west African Dwarf sheep. The milk yield (kg) per lactation is between 30 and 56 kg and has a lactation length of 91 days. The peak milk yield per day is 960 grammes (Adu and Ngere, 1979). The coat colour of Yankasa is typically white with black patches around the eyes, ear, muzzle and sometimes the feet. The tail is long and thin, the ears moderately long and somewhat droopy. Rams have curved horns and a hairy white mane and ewes are polled (Aganga, Umunna, Oyedipe and Okoh, 1988).

2.4.4 West African Dwarf

Also Known By: Cameroons Dwarf, Djallonké, Forest-type, Fouta Djallon, Futa Jallon,

Guinean, Kirdi, Kirdimi, Lakka, Nigerian Dwarf, Pagan, Savannah-type, Southern, West African Maned

The West African Dwarf is small bodied, compact breed which may be all white, black, brown or spotted black or brown on a white coat. Its variation in colour and patchy distribution make it difficult to distinguish it clearly from the Yankasa. Adult males weight approximately 37 kg. They have a well-developed throat ruff and are horned. Ewes have mature weights of 25 kg. The females are usually polled. Adu and Ngere (1979) reported that different types exist, mentioning the 'Pagan' variety on the Jos Plateau, and the 'Umuahia' variety near the Confluence, but there is no published account of such varieties. Devendra and McLeroy (1982) argue that the WAD breed cannot be sub categorized on the basis of appearance, and no performance data is available. They can be bred at the age of 7 to 8 months. They tend to have a short lambing interval. The prolificacy of adult ewes is low to moderate ranging from 1.15 to 1.50 lambs per lambing. At less than 100 g per day under good feed conditions, their growth rate is low and lamb mortality is high.

2.5 DISTRIBUTION OF SHEEP IN NIGERIA

Sheep are kept everywhere in Nigeria, with a broad distinction between their importance and ubiquity in the north, and the more dispersed populations of the humid zone. Sheep and goats are seen as having secondary importance in relation to crops. Sheep are the second most numerous pastoral species, and small flocks accompany many cattle herds in the north and in the Middle Belt (Bourn, Wint, Blench and Woolley, 1994). Sheep and Goats were spread all over Nigeria in the pre-colonial era, and West African Dwarf (WAD) types dominated the forest and derived savannah (Blench, 1993).

Sheep are kept both in villages and by pastoralists in the north, and along the northern borders of Nigeria, there are occupationally specialized pastoralists who depend on very large herds of sheep for subsistence (Adu and Ngere, 1979). Sheep are more prestigious than goats in Islamic ceremonies and substantial changes in price within the ritual year encourage sheep-production.

The West African Dwarf is the predominant breed of the humid tropics from southern West Africa through central Africa. The West African dwarf sheep is widely distributed in the southern Nigeria (Adu and Ngere, 1979), these seem to have had the same advantages as taurines, the ability to digest a broad diet and resistant to high-humidity pathogens. In the south, the traditional purpose of sheep was as sacrifices at social and religious ceremonies, and they do not form a regular source of protein in human diet, Long-legged savannah breeds are being crossed with WAD goats and sheep or are (Adu and Ngere, 1979) thriving in purebred form in regions far south of their previous limit.

The Yankasa breed is widely distributed in the northern part of Nigeria (Adu and Ngere, 1979). Balami is most predominant in the North eastern part of Nigeria. As a pastoral animal, it is confined to the semi arid north but it is favored as a stall fed breed by muslims throughout the Nigerian middle belt (Adu and Ngere, 1979). The Uda is found in northern Nigeria, southern Niger, central Chad, northern Cameroon and western Sudan, Uda breed occurs throughout the Sahelo-sudan vegetation zone of Nigeria. Uda Sheep are adapted to long-distance transhumance and are less popular for fattening. Recent years have seen a considerable expansion in the distribution of this breed, since it apparently resists foot rot and other high-humidity pathogens considerably better than the Sahel sheep. Pastoralists have been exploiting the derived savannah

in the south-west of Nigeria, bringing Uda down to the edge of the forest, thereby bringing the flocks close to the large urban markets of the south (Adu and Ngere, 1979).

2.6 MORPHOMETRIC CHARACTERISTICS OF BREEDS OF SHEEP IN NIGERIA

In the research conducted by Yunusa, Salako, and Oladejo (2013), Tail length was found to be the most discriminating character followed by ear length, rump width, hock length, rear leg length, heart girth, wither height and shoulder width 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 Northern sheep southwards.

Rump width was the only character that was apart between Uda and Balami, it also differentiated between Yankasa and WAD. Distinguishing Yankasa and WAD from Balami. The highest discriminating power of Tail length observed by Yunusa, Salako, and Oladejo, 2013; Yakubu, A., 2011 brought to light that the Northern and Southern sheep of Nigeria can best be distinguished with Tail length and This result is partly in variance with the findings of Salako and Ngere (2002) where Tail length was obtained as the most discriminating character between Yankasa and WAD sheep. Agievezor et al. (2012) also reported tail length, rump height, chest girth, ear length and chest depth as the most discriminating variables to separate WAD, Yankasa, Uda and Balami sheep. Uda has the tallest ear length and Tail Length, followed by Balami, Yankasa and WAD. While Balami has taller rump height, chest girth, followed by Uda, Yankasa and WAD (Yunusa, Salako, and Oladejo, 2013; Yakubu, A., 2011).

The weight of mature males of Balami ranges from 40 to 80 kg while that of female lies between 30 and 40 kg. The Uda is slightly smaller bodied than the Balami, although their size ranges overlap. The weight of mature females could be 30 to 40 kg while mature rams weigh 30 to 60 kg (Adu and Ngere, 1979). Yankasa rams stand 70 to 80 cm at the withers and weigh 55 to

60 kg at maturity. Mature females could weigh 25 to 40 kg while male weighs between 35 and 50 kg (Adu and Ngere, 1979). West African Dwarf Sheep are those whose average shoulder height does not exceed 50 cm (Oseni and Ajayi, 2014).

2.7 REPRODUCTION OF NIGERIAN BREEDS OF SHEEP

Sheep attain puberty at 5-6 months, sexual organ of rams are already functional at this time. However, rams should not be used before age of one and half years while ewe lamb could be bred at 9-12 months. It is good practice to replace breeding rams with newly selected ones after each breeding season. A minimum of 6 rams should be in a flock of 100 ewes. Feeding of breeding rams should be improved 6 weeks before the breeding season (Adu and Ngere, 1979).

The estrous cycle in the ewe is 16-17 days with estrous duration being 20-42 hours i.e. approximate 1-2 days average being 30 hours. Ovulation occurs in the ewe from about 24-30 hours after the onset of estrous after 16-17 days. There are no visible signs of heat in the sheep except the acceptance of the ram or teaser with an apron. This is the only external detection of heat in ewes. In flock mating, rams should be left in flock for 6-8 weeks to ensure (3 estrous cycles) that all ewes are bred. After that, they are withdrawn (Adu and Ngere, 1979). Rams should be joined with ewes 2 weeks after lambing. The ewes will still be nursing their lambs at this stage, but this does not prevent them from getting pregnant. Batch lambing could be ensured by synchronization using progestogen virginal sponges. Ewes lambing within 2-3 weeks interval would be synchronized. This consists of inserting the progestogen in-plants into their vaginal for 12 days. Introduction of rams to treated flock 2 days before sponge removal would enhance ovulation. Mating does not begin until sponge removal. Estrous normally spread over 4 days following sponge removal. Non-pregnant ewes would return to estrous 16-21 days following sponge removal (Adu and Ngere, 1979). Gestation period in ewes is about 5 months i.e. 152

days. Repeat breeder ewes, those weaning poor weight lambs and old ewes above 7 years should be culled.

Nutrition exerts some influence on the reproductive performance of the sheep. The practice of flushing ewes i.e. feeding these ewes more generously 2-3 weeks before breeding would improve lamb crop by 15-30% and make rebreeding easier. Flushing could be accomplished by feeding concentrate or providing lush pasture or range. Steaming is done to pregnant ewes 6-8 weeks to parturition or prior to lambing to increase parturition rate and lactogenesis or milk production (Adu and Ngere, 1979). Fat ewes are conditioned by exercise. Undernourishment during late pregnancy may cause pregnancy toxaemia (a metabolic disease), low birth weight and poor lamb survival. Undernourishment during lactation and rebreeding may result in depressed lactation, delay estrous, lower ovulation rate and poor fertility. Survival rates, weaning weights of lambs of undernourished ewes are poor. Good nutrition and management ensures about 80% lambing rates of bred ewes with 25% twinning rate (Adu and Ngere, 1979).

2.8 ADAPTIVE CHARACTERISTICS OF BREEDS OF SHEEP IN NIGERIA

Concentration of Nigeria's livestock-base in the northern region is most likely to have been influenced by the ecological condition of the region which is characterized by low rainfall duration, lighter sandy soils and longer dry season. This submission is predicated by the fact that drier tropics or semi-arid regions are more favorable to the ruminants, notwithstanding this situation, certain breeds of sheep and goats, particularly the West African Dwarf (WAD) species, are peculiarly adapted to the southern (humid) region of the country and are commonly reared by rural households in the region (Lawal-Adebowale, 2012).

Particular feed preferences are usually ascribed to individual breeds which make them appropriate for certain environments. These are a major factor in determining breed distribution,

but also in interpreting ‘interlocking’ distributions; two or more breeds can exploit the same ecozone by making different use of feed resources. As the vegetation gradually changes, due to both climatic and anthropic factors, producers must adapt either the breeds they use or bring in new ones (Blench, 1999).

Uda sheep are adapted to long-distance transhumance and are less popular for fattening. Recent years have seen a considerable expansion in the distribution of this breed, since it apparently resists foot rot and other high-humidity pathogens considerably better than the Sahel sheep. Pastoralists have been exploiting the derived savannah in the south-west of Nigeria, bringing Uda down to the edge of the forest, thereby bringing the flocks close to the large urban markets of the south (Blench, 1999).

The Yankasa are distributed in the Northern part of Nigeria and due to their high adaptation to the ecological constraints of this region, they dominated all breeds of sheep in the region (Adu and Ngere, 1979). Yankasa Sheep do not need daily watering in the wet season and watering once a day suffices in the dry season (Aganga, Umunna, Oyedipe and Okoh, 1988).

West African Dwarf Sheep Years of adaptation and natural selection under humid tropical conditions made this breed highly adapted to the humid forest zone (Oseni and Ajayi, 2014). These Sheep are present in all of humid Africa, from Southern Sudan to the west coast areas that are noticeably humid and warm, and characterized by dense vegetation ranging from swamp mangrove to rainforest and derived savannah. In these zones, ambient temperature and relative humidity are notably high all year round (Adu and Ngere, 1979).

West African Dwarf are highly prolific, can be bred all year round, with up to three parturitions in two years. The sheep are hardy, with the ability to thrive and survive under harsh environmental conditions of heat and humidity, ability to digest a broad range of diets and

resistance to high-humidity pathogens and haemonchosis, tolerant of gastro-intestinal nematodes and trypanosomiasis (Oseni and Ajayi, 2014) and the ability to thrive in tse-tse fly infested humid forests and guinea savannah zones.

2.9 STRATEGIES FOR IMPROVEMENT OF TROPICAL SMALL RUMINANTS

2.9.1 Improvement Pathways

Conventionally three main pathways have been considered for the genetic improvement of livestock: (1) selection between breeds (or stains), (2) crossbreeding, and (3) selection within breeds (stains) Baker and Gray (2003). For any of these strategies to be effective it is important to have a clear view of what traits are important in small ruminants for the particular environment being considered (Carles, 1983; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Consequently, it is logical to first choose the most appropriate breed or cross, and then to consider whether this breed, or the `parent` breeds in the case of crossbred animals, can be improved further by within-breed selection. Selection between breeds (or strains) can achieve dramatic and rapid genetic change when there are large genetic differences between breeds (population) in traits of importance (Simm, Conington, Bishop, Dwyer, and pattinson, 1996). However, it is costly when you need to replace males as well as females, and not always feasible to replace whole flocks of animals. In practice, ` grading up` or repeated crossing to the new breed leads to more gradual changes. It is often only involve the use of males and/or semen (where artificial insemination is feasible) of the new breed. In the tropics, breed substitution of exotics for the indigenous breeds and crossbreeding with breeds from temperate regions have been widely used, but have invariably been unsuccessful or unsustainable in long-term. This is due to incompatibility of the genotypes with the breeding objectives and management approaches of the prevailing low-input traditional production systems in these areas (Rowe,

Ogore, and Kahi, 2002; Ayalew, Rischkowsky, King, and Bruns, 2003). Within- breed selection of the adapted indigenous genotypes could be a viable option.

Within-breed selection is a strategy of genetic improvement usually carried out in individual populations. Selection within breeds or strains is intended to increase the average level of genetic merit of the population. Objectives within-breed selection usually involves measuring and selecting on productivity (e.g., litter size, growth of the young and mature size). However, effective small ruminant breeding methods in smallholder production systems in the tropics are constrained by small animal populations, single sire flocks, lack of systematic animal identification, inadequate animal performance and pedigree recording, low levels of literacy and organizational shortcomings (Turner, 1977; Kiwuwa, 1990; Jaitner, Sowe, Secka-Njie, Dempfle, 2001; Wollny, Banda, Mlewah, and Phoya, 2002). In addition to the factors constraining successful small ruminant breeding strategies in smallholder production systems, apart from small animal population and probably single sire flocks face a problem of mobility. The infrastructure necessary for collection of reliable pedigree and performance data does not exist to set up a breeding programme involving the populations maintained by the mobile pastoral communities (Franklin, 1986; Kiwuwa, 1990).

Traits that represent a comprehensive breeding goal are mostly complex with components of production and reproduction, e.g., number or weight of offspring per year (Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Recording of such traits and individual animal identification is in many cases difficult under traditional smallholder and pastoral conditions. The difficulty to measure and value the intangible benefits (e.g., savings, insurance, ceremonial and prestige) derived from the animals presents more complications (Roeleveld, 1996).Strategies for genetic improvement that overcome these problems need to be considered. In this regard,

nucleus schemes have been proposed as a good strategy for genetic improvement of small ruminants in developing countries (Turner, 1982; Hodges, 1990; Kiwuwa, 1990).

2.9.2 Breeding Programmes of Sheep

Two activities need to be distinguished in breeding programmes (Van Arendonk and Bijma, 2003).the first is the generation of genetic improvement by selecting animals based on their estimated breeding value for the relevant traits. Secondly, there is dissemination of the improved animals to the commercial population. In large scale small ruminant production, for instance in Australia or Newzealand, there could be millions of animals in the population. It is not worth or practical including them all in the active part of the breeding programme due to measurement costs, recording costs and lack of proper control (Kinghorn, 2000). Whereas flocks are not that large in developing countries in the tropics, resources are scarce and it is critical to optimize the little that is available. This is possible if the genetic improvement is generated in a small fraction of the population (referred to as the nucleus), while at the same time controlling the pedigree (i.e., inbreeding). All recording and genetic evaluation is done in the nucleus. Recording is not needed for the remainder of the population. The genetic progress is disseminated to the commercial population through use of males and/or semen (where artificial insemination is feasible) originating from the nucleus.

Basically, a nucleus breeding unit would require the pooling of superior animals with the highest genetic merit from many sources to form the foundation animals. Depending on the complexity and requirement of the breeding programme, a nucleus scheme can have different numbers of tiers and migration policies. Van der Werf (1999) summarized the roles of the different tiers of nucleus scheme in a livestock breeding structure. Generally, the central nucleus and the multiplier flocks generate sires for distribution to commercial farmers. a crucial point for

the successful implementation of distribution of breeding scheme in smallholder and pastoral production circumstances is adequate interaction between nucleus and farmers` flocks, in a technical as well as socio-economic sense. It is always important to bear in mind that nucleus breeding objectives impact on the whole scheme. The nucleus should therefore be set up with the breeding objectives of the farmers in mind. The nucleus could be open or closed. In a closed nucleus there is no upward migration of animals from the lower tiers to the nucleus, and all recording is confined to the nucleus. On the other hand, an open nucleus allows animals of higher merit to be migrated up for breeding in the nucleus. Open nucleus breeding schemes have been recommended for small ruminants in the tropics (Jasiorowski, 1990). An open nucleus breeding schemes, from a genetic point of view is more interesting because it affords selection in larger population, but this has consequences for infrastructure and costs because naturally it would involve some pedigree or performance recording in the lower tiers.

Small ruminant breeding programmes found in the tropics differ in design. Some are three-tiered with a nucleus, pre-nucleus (multiplier) and a base population (Kosgey, 2004) while others are two-tiered, involving only a central performance evaluation station (nucleus) and farmer flocks (base) (Yapi – Gnoare, Rege, Oya, Alemayehu, 1997). Some do not operate a nucleus at all (FAO, 1988). Certain programmes select only males (Yapi-Gnoara, 1999) while others select both sexes (Darfaoui, 1999). It is apparent that the design of the breeding programme will depend on the ecological region and on the production system the breeding programme is aimed at (Van der Waaij, 2001).

The design of the breeding scheme has an impact on the anticipated result. For instant, selection of both male and female animals in an open nucleus would generate more genetic progress than selection of males alone. If lower tiers buy average males (and no females) from

the tier above, they will be lag behind the tier above by 2 generations (about 7 years in sheep and goats) of selection response (Bichard, 1971). Opening the nucleus pushes it to progress more quickly, and this benefits the whole scheme as the base will move as fast as the nucleus when the nucleus runs smoothly (Kinghorn, 2000). Overall response in 2-tiers schemes is 10-15% faster than in closed schemes when optimal design, from the genetic point of view and not necessarily cost, is applied, i.e., about 10% of the population in the nucleus and about 50% of the nucleus mated females born in base (James, 1977). An open nucleus in form of geographically diffused flocks could be used. It involves creating elite `nucleus` mating in the flocks of birth of female partner, with migration of males and/or semen to these flocks (Kinghorn, 2000). This relies on good pedigree information, and may not be easy to effect in traditional animal production systems.

The dilemma in genetic improvement programmes in developing countries in the tropics is on how to: effectively organize breeding schemes involving farmers at the village level; and record such flocks and monitor progress (Osinowo and Abubakar, 1988). To involve farmers, it is advisable to back the breeding programme with an effective extension service for maximum effect. The selection programme should be preceded with several years of extension work to train the farmers and boost their experiences and skills in small ruminant production techniques (Yapi-Gnore, 1999). During that period farmers should be made aware of the benefits derived from the recording activity (Moioli, Astruc, and Sanna, 2002). Another possible problem with breeding programmes in developing countries is the frequently long and complicated bureaucracy involved in the distribution of improved animals from the nucleus to co-operating farmers. The procedure is often subjected to abuse by those in authority or those with powerful connections. A fair system of distributing animals, for instance on a `first-come-first-served`

basis, needs to be agreed upon and made a policy where facilities and resources allow, institutional nucleus farms could be expanded to generate more breeding stock to meet the demands of the commercial farmers. A point to note is that unless due consideration is made, selection of animals under institutional management is not likely to reflect the management conditions of commercial farms, resulting in genotype by environment interactions and wastage of selection opportunities due to ill-adapted animals to the local low input conditions. Assuming the breeding programme is successfully launched, immediate returns to the farmer would likely emanate from non-genetic factors as the program picks ups.

2.9.3 Non-Genetic Gains from Breeding Programmes

The motivation for rearing small ruminants and their functions are geared to natural and economic conditions and thus correspond to the requirements of the farmer (Peters, 1988), which in most cases are livelihood oriented. The breeding programme in principle must have expected outputs consistent with the producer`s objectives and would be driven by incentives (i.e., expected returns from the producers) to justify the producer`s investments – e.g., they and their families labor, hired labor and other costs, including the difficulties of controlled breeding required of the programme.

Much as within breed genetic improvement can enhance output and profitability at all levels of production, from smallholder to large livestock enterprises (Holst, 1999), results in the traditional low-input management systems of the tropics may seem too long-term to be felt (Gatenby, 1986; Ponzoni, 1992). It seems therefore that immediate to medium-term returns or perceived returns on investments in improvement programmes, will likely result from non-genetic gains, i.e., improved husbandry practices, and conflict resolution in terms of farmer`s expectations and involvement in the breeding programme (Van Vlaenderen, 1985; Wollny,

Banda, Mlewah, and Phoya, 2002; Ayalew, Rischkowsky, King, and Bruns, 2003). Consequently, any improvement of small ruminants through breeding would have to account for other intervening factors likely to interfere with any progress made (Mwendia, 1997). There would be little value in implementing a carefully designed breeding programme if managerial, nutritional and animal health aspects are not being attended to in the environment in question (Ponzoni, 1992). For example, manipulation of the management system could easily result in improved reproductive performance for indigenous type of small ruminants as long as their current productivity and functions are well understood. Generally, knowledge of the production objectives of the traditional small ruminant systems and how these may impact upon genetic improvement programmes would be necessary when deciding breeding programmes to adopt.

2.10 THE ROLE OF SMALL RUMINANTS IN TRADITIONAL FARMING SYSTEMS

2.10.1 Crop-Livestock Production Systems

Crop-livestock mixed farming systems comprise sedentary smallholder farmers carrying out mixed crop and livestock farming concurrently as the main activity. The mixed farming systems of the developing world contain about 64 percent of the small ruminants of the world (Steinfeld, de Haan, and Blackburn, 1996). These farming systems are a predominant feature and continue to develop with human population pressure increasing further (De Haan, Steinfeld, Blackburn, 1996). Sheep and goat numbers are growing fastest in the mixed farming system, and most rapidly in the humid/sub humid areas, underlining how human population pressure is reducing farm size and access to and use of resources (Steinfeld, de Haan, and Blackburn, 1996). In the tropics, the crop-livestock mixed farmers are found mainly in medium to high potential areas (Rege, 1992) and they own small size of land. The animal are confined to small areas for grazing or left to wander freely around villages scavenging for feed (Gatenby, 1986). In some

cases stall-feeding is livelihood oriented. Unlike commercial farmers, smallholders tend to keep animals for family needs, rather than purely as an economic enterprise. Animals have intangible roles to the farmer (e.g., savings, insurance, cultural, ceremonial and prestige) and farmers expect their animals to fulfill these traditional functions (Peters, Dei chert, Drewes, Fitcher, and Moll, 1981; Wilson, 1985; Agishi, 1988; Peters, 1988; Ayalew, Rischkowsky, King, and Bruns, 2003). Survival of animals in the face of multiple stresses (heat, parasites and disease, and poor nutrition) is one the most important traits, while increasing growth rate is of less value (Upton, 1985; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Therefore, adaptability traits such as survival rates and reproductive performances become important (Franklin, 1986; Osinowo and Abubakar, 1988; Ponzoni, 1992). It is important to note that matings within smallholder flocks are largely uncontrolled and organized mating would naturally demand more labour, which is a serious problem at the time of land preparation for sowing and harvesting of crops (Gatenby, 1986). In addition, farmers may be keeping a mixture of breeds and would be difficult to sort out animals for pure-breeding.

2.10.2 Pastoral Production Systems

Pastoral farming systems are found mainly in the medium to low potential areas where crop production is difficult due to low rainfall and high evapotranspiration. In these systems, livestock forms an integral part of the socio-cultural life of the people. Pastoral farmers rely on livestock as their main source of livelihood, and usually own relatively large numbers of animals under extensive or communal grazing and management. Most of the livelihood is directly from livestock use and sales or exchange (Adu and Lakpini, 1988). Pastoral communities often herd cattle, camels, donkeys, sheep and goats together. Only a few herd or raise sheep and/or goats exclusively (Adu and Lakpini, 1988; Peters, 1988).the mixed species approach is to ensure

complementarily in forage use and direct benefit to the household in terms of tangible and intangible requirements (Adu and Lakpini, 1988). The animals therefore need to fit in the production system. Nomadic life, overgrazing and low production are common features of pastoral systems, especially in the arid areas. In recent times pastoral communities, especially in the medium potential areas, have changed a lot and are now tending towards sendentarized agro-pastoral systems compared to previously when they purely kept livestock. Encroachment of crop farmers from other communities, and adoption of crop-based foods by the pastoral communities, is now evident in some areas of the tropics.

Risk avoidance is an important integral part of breeding objectives in marginal areas (Jahnke, 1982; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Due to the fluctuating harsh environment, both individual and flock survival are important. The farmers adopt a two-pronged approach. First, in addition to stock diversification, pastoral communities use mobility to counter problems of uncertainty in the timing and distribution of rainfall and hence availability of forages, water shortage and incidence of diseases (Adu and Lakpini, 1988). Secondly, farmers use adapted breeds that survive and thrive in the environment (Mason and Buvannendran, 1982). Therefore, survival (e.g., pre-weaning, post-weaning and adult animal) traits and reproductive traits (e.g., litter size and lambing frequency) are important under this system. Many of the pastoral communities have their own breeding methods (Carles, 1983; Gatenby, 1986) and they have different cultural and social values by which to judge, appraise and decide on animals used for breeding (Sölkner, Nakimbigwe, and Valle-Zarate, 1998). For instant, in a study of nomads in northern Somalia it was observed that the breeding ram or buck has to posses specific qualities (Mirreh, 1978 cited by Sölkner, Nakimbigwe, and Valle-Zarate, 1998): mostly female offspring,

be well built, strong, a good fighter able to assert himself in the flock and offspring should be healthy, able to withstand the dry period and have a good record of milk production.

2.11 GENETIC IMPROVEMENT PROGRAMMES

2.11.1 Successes of Programmes

This highlights the key points of success of within-breed genetic improvement strategies for indigenous small ruminants in the tropics. The criterion is if the improvement project achieved its objective. It is important to concede that this criterion of success could be contentious, considering there could be points of view of the farmer and the scientist and /or policy maker (Kosgey, Baker, Udo, and van Arendonk, 2006).

2.11.2 Nucleus-Based Breeding Schemes

In response to declined animal imports from within the region due to drought, a national sheep selection programme was initiated in Ivory Coast in 1983 with the aim of improving grouth and live weight of the local Djallonke sheep breed (Oya, 1990; Yapi – Gnoare, Oya, 1994; Yapi – Gnoare, Rege, Oya, Alemayehu, 1997; Yapi-Gnoare, 2000).Only males were selected under a 2-tier open nucleus-breeding scheme. Involvement of experienced farmers and availability of technical support ensured the success of the project. However, no justification was given for selection of the traits or the definition of the breeding objective – improvement of growth and live weight of the local breed, while reproduction and adaptation were neglected (Sölkner, Nakimbigwe, and Valle-Zarate, 1998).

A nucleus breeding scheme involving the indigenous locally adapted Deccani sheep was initiated in the semi-arid Deccan plateau in Maharashra, India in 1993, although breeding of animals started in 1996 (Nimbkar, Ghalsasi, Walkden-Brown, and Kahn, 2002). The aim is to get a sheep with a modest to manageable prolificacy and an optimum body size for meat

production in the local environment, as well as being worm-resistant. The first step was introgression of the fecundity (FecB) gene into the Deccani breed from the Garole breed. Following successful establishment of a direct DNA test for the FecB gene (Wilson et al., 2001), there is now selection of those individuals with the gene and backcrossing them to the Daccani to reduce the proportion of the Garole genes further. Garole is native to a hot humid region and is not well adapted to semi-arid Daccan plateau, has a small size, poor milk yield (Nimbkar, Ghalsasi, Walkden-Brown, and Kahn, (2002) and is susceptible to infections such as pneumonia. The programme is still at the nascent stage and it is difficult to clearly state its fate at the moment, because the resulting genotypes are yet to be assessed for their suitability to the local production system. However, given the approach –the direct involvement of researchers with the local shepherd community, use of indigenous genetic resources, and no provision of free incentives, the programme has potential for success (Iniguez, 1998).Setback in the programme include diseases resulting in lamb mortality and abortions, shortage of man power, and inadequate feed for the animals. Other within breed selection programmes in India involves important indigenous sheep breeds – Malpura, Sonadi, Muzzaffanagari, Mandras Red, Mandya and Nellore are purportedly successful (Arora, Sharma and Khan, 2002). Rams of these breeds are reportedly available for enhancing mutton production in farmer`s flock.

A very active Martinik hair sheep programme was initiated in French West Indies 1n the 1990`s (Naves, Leimbacher, Alexandra and Mandonnet, 1999). Various indigenous hair sheep breeds from the Caribbean and mixed Martinican farms were grouped to form a population of Martinik hair sheep. The breeding goal was defined from a technical approach, according to the commercial objectives of the breeders: to improve the nursing ability of the dams, and growth and body conformation of the lambs. The aim was to sustain adaptation to the tropical climate –

use of pasture, resistance to worms; and good reproductive characters – prolificacy and de-seasonality. On-farm performance recording and selection of rams in a breeding station started since 1995 with the same criteria applied: number of lambing per year, litter size, viability of the lambs, live weight of the litter at 30 days of age, individual growth rate at 30 and 70 days, estimated live weight at 70 days and visual assessment of body conformation. Separate indexes are used for ewes on litter size and nursing ability. Dissemination of selected animals is organized by the breeding association and consists of young rams from the station and ewes from the elite farms. The selection base remains open, in order to include new farms and breeding animals in the population under selection. The backbone of the success of this programme was the existence of a strong professional structure (breeders association) for the maintenance and management of the sheep, active technical extension services, and initial funding from European structural funds. In Guadeloupe, the main difficulties in setting up the programmes were the absence of professional structures and lack of public financial support to initiate the operations.

A breeding programme involving the indigenous Damara sheep breed was started in Namibia in 1954 (von Wielligh, 2001). The initial stock, kept at Omatjenne Research station near Otjwarongo, was founded from many animals confiscated by the then German colonial government from commercial farmers illegally grazing on restricted disease-free areas. The breed is adapted to arid and semi-arid conditions (< 500 mm of rainfall annually). It is resistant to most diseases, tolerant to internal parasite, has good feed conversion efficiency and a varied diet (grass, bushes and shrubs). The breed has been selected for mutton under bushveld savanna area without losing its main characteristics and adaptive traits. It has shown significant increases in fertility and growth rates. For instance, from 1956 to 2000, the average weaning mass at 100 days increased from 22.8 to 24.6 kg and 24.0 kg, for ewe and lambs, respectively. The breed has

gained immense popularity with the commercial farmers, and is even being exported from South Africa to other African countries, and embryos to Australia. A breeders association has been instrumental in popularizing the breed by dissemination of valuable information on the breed to commercial farmers through breeding journals and information profiles, extension officers, meetings and courses.

A breeding programme for improving the trypanotolerant Djallonke sheep and the West African Dwarf goat for low-input management systems was started at the international trypanotolerance centre (ITC) in the Gambia in 1994 (Dempfle and Jaitner, 1999). The programme aimed at increasing the efficiency of meat production in combination with improvement of trypanotolerance trait for the two breeds. Currently, the scheme operates at a capacity of 200 breeding females and six breeding males for each species. The breeding goals were established through participatory rural appraisal with the farmers (Bennison, Barton and Jaitner, 1997). Performance testing, data and pedigree recording have been implemented and breeding value estimations based on growth traits have been developed and are now used for selection. Establishment of multiplication tiers started since 2000 in close collaboration with the government`s department of livestock services (DLS) (Kosgey, 2004). Then programme operates as an open nucleus, with ITC providing technical assistance to participating farmers, through DLS, on flock management and recording. No other incentives are offered. Farmers enter into a contract with ITC to use males from the nucleus provided that they eliminate all other males in the flock. The selected commercial flocks have males screened annually for breeding in the nucleus. The programme is young and still has to rely on donor support, although the objective is to see it taken over by the government, and eventually by the farmers. It is difficult to state clearly its fate at the moment. However, given the approach–farmers involvement, choice of

local breeds, selection under low-input conditions, and no free incentives to the farmers (Iniguaez, 1998) – the programme has potential for success.

2.11.3 Schemes without Nucleus

In northern Togo, an FAO/Togolese government funded sheep husbandry development project started in 1980 and involved individual and groups of men, appeared to have faired on well (van Vlaenderen, 1985; FAO, 1988). The project aimed to tackle a wide range of major aspects that constrained village-based sheep production. A key element in the success of the project was the development/extension strategy followed which not only emphasized simple technologies and easy to understand training methods but also focused on needs of specific target groups. Women`s groups played a big part in the focus and success of the project (FAO, 1988). In terms of breeding, the project bought the best male lambs sired by the selected rams from the flocks in the project to avoid unintentional selection for growth rate due to the tendency to first slaughter or sell the fastest growing male lambs. The groups were encouraged to sell their best three-month-old lambs to the project by a favorable selling price and by including this sale as an obligatory part of the ram contract. All other males in the flock had to be castrated at the age of 3 months. The selected male lambs were kept by the project until they were distributed at the age of almost 18 months to flocks distant from their flocks of origin to avoid inbreeding. To improve immediate profitability of new groups, the project, on contract, lend young ewes to them, to be paid back by the same number of young ewes (6-12 months old and $\geq$ 18 kg) within a period of 4 years, starting after one year.

An on-going sheep and goats project in south and south-east Asia using an integrated approach to the control of gastro-intestinal parasites with the aim of reducing mortality in young goats is purportedly successful (Kosgey, 2004). The underlying principles and approaches of the

project is that each country develops its activities in the most appropriate way, following a pathway that meets the local needs and conditions. A basket of technology option are introduced to the farmers revolving around worm control but holistic enough to include all aspect of goat production and health. Aware of their needs, farmers chose not just one technology mixed and matched options to fit their situations. Some have also been very keen in revising some recommendations to better fit the conditions and situations in the field, and the project has implemented some of these technologies. The breeding component of the technology has benefit well, for instant, in Vietnam good bucks of the adapted native goat breed (Bach thao) were provided to farmers to improve breeding in the focus farms. Farmers were informed on the negative effect of inbreeding and introduced to animal management and control breeding. For improvement in management, farmers needed to build houses. Farmers were sponsored 30% of the total value of the buck while very poor farmers were supplied with 100%. After two years bucks were transferred to other farms. All male kids' 5-months onwards were managed and grazed in separate areas. After two years the results of using the improved goat breed showed increased production in general (e.g., reduced mortality and increased growth rate). Farmers paid more attention to this option after seeing the results. It has shown a good impact on production in rural farms (Kosgey, 2004).

2.11.4 Failures of Programmes

This highlights the key points of failures of within-breed genetic improvement strategies for indigenous small ruminants in the tropics. It is important to concede that this criterion of failures could be contentious, considering there could be points of view – that of the farmer and that of the scientist and /or policy maker (Kosgey, Baker, Udo, and van Arendonk, 2006).

2.11.5 Nucleus Based Breeding Schemes

A breeding and improvement programme for the D`man sheep breed in Morocco was started in the late 1970`s, based on open nucleus scheme with the aim of conserving the breed, which was threatened by drought and mismanagement, and to evaluate its performance under improved management (Darfaoui, 2000). Selection programmes initiated were intended to maintain ewes prolificacy rate at high levels and increase lamb growth rate to the level of the remaining national breeds. In the design of the programme, the development agency ignored the non-organized farmers (≈ 90% of the total farmers) and therefore the farmers benefited very little from animals produced by the multipliers. Most breeding animals ended up in slaughterhouses or as sacrifices during religious or other ceremonies instead of improving non-organized farmers flocks. Lack of continual monitoring to determine the proportion of animals maintained in the multiplier level or disseminated to the non-organized farmers hindered the progress of the scheme. In addition, it is debatable if selection for high prolificacy was desired in an environment prone to droughts.

In Senegal a programme was initiated to increase the productivity of the local Sahelian breeds (Peul, Touabire) and the trypanotolerant Djallonke sheep in the semi-arid and sub-humid areas, so as to increase meat supply, and subsequently reduce import of sheep from neighbouring countries to celebrate religious ceremonies (Fall, 1999). Initially a nucleus flock was reared on a state-owned research station but later extend to village flocks to expand the selection base of Peul sheep. A top-down approach was used to establish breeding goals, i.e., breeding goals were set by government technicians through interpretation of national objectives to increase meat supply. Due to insufficient involvement of farmers, opinions on constraints imposed by the livestock production system were not taken into account. Consequently, involvement of village

flocks was not sustained. Shortage of financial and logistic resources contributed more to the un-sustainability of the project.

CHAPTER THREE

MATERIALS AND METHODS

3.1 STUDY SITES

The survey was conducted in some selected Local Government Areas (LGA) of Kano State. The selected LGAs were Shanono, Dawakin Kudu, Dambatta, Wudil and Bebeji. The State lies between longitude 9^{o} 30' and 12^{o} 30' north and latitude 9^{o} 30' and 8^{o} 42' east (KNARDA, 2001). The area has two distinct seasons; a wet season (May-Sept) and dry season (October-April). Annual rainfall and temperature ranges between 787 mm-960 mm and 21^{o}C and 39^{o}C, respectively (KNARDA, 2001).

3.2 SAMPLING PROCEDURE

A multistage sampling was adopted in this study. Five local government areas in Kano State namely Shanono, Dawakin kudu, Dambatta, Wudil and Bebeji (Figure 1) were purposively selected. Two villages were also purposively selected from each local government area. The Local Government Areas and the villages were selected based on their suitability for sheep production, market and road access and willingness of people to participate in the program. Thirty Five households that owned Sheep and willing to participate from each village were also purposively selected.

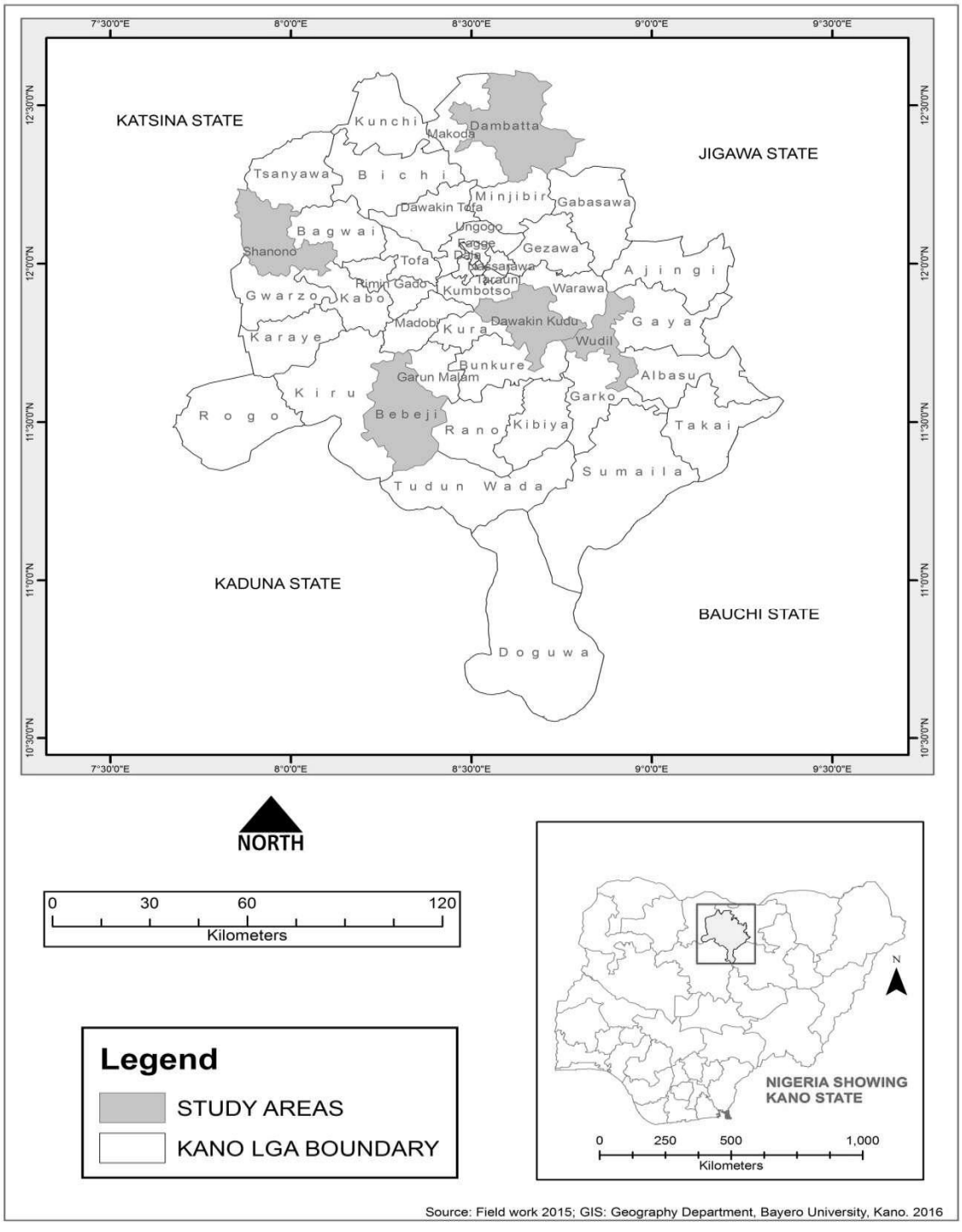

Figure 1: Map of Kano State showing the Location of Study Areas.

3.3 DATA COLLECTION

Before commencement of the actual interview with selected farmers, a reconnaissance tour was conducted and structured questionnaire was pre-tested on a small number of selected farmers from each site. Information from the pre-tested was used to improve the questionnaires. The questionnaire was used to obtain information on socio-economic characteristics of the households, breed and origin of sheep, flock size and structure, breeding objectives and practices, farmer trait preferences and selection criteria.

3.4 DATA ANALYSIS

Data collected from the five locations were analyzed using Statistical Package for Social Sciences (SPSS, 2007); Cross tabulation procedure was used to calculate the percentages of discrete variables, flock size and structure were presented mainly in the form of descriptive statistics and Chi-square test was employed to test the for the level of significance of flock sizes of the respondents.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1 Socioeconomic Characteristics of Sheep Owners Based on location

The socioeconomic characteristic of sheep owners in the study area are presented in Table 1. Three hundred and fifty households (seventy from each of five local government areas) participated in this work.

Gender

Bulk (94.28%, 87.14%, 81.43% and 55.71% in Dawakin kudu, Wudil, Shanono, and Dambatta) of the respondents was males with the exception of Bebeji in which the proportion of males was lower (38.57%).

Position of Respondents

Ownership of flock by household heads was more prominent in all the locations (72.86%, 67.14%, 57.14%, and 45.71% in Wudil, Dawakin Kudu, Shanono and Dambatta, respectively) with the exception of Bebeji where the proportion was lower (30.00%). Ownership by spouses was greatest in Bebeji (60.00%) followed by Dambatta (38.57%) , Shanono (15.71%), Wudil (12.86%) and Dawakin Kudu (5.71%), while the proportions of other members that owned sheep were higher in Shanono and Dawakin Kudu (27.14% each) compared to Dambatta (15.71%) Wudil (14.28%) and Bebeji (10.00%). Overall, the percentage of respondents that were household heads was the highest (54.6%) followed by housewives (26.6%) and those that were ordinary members of the household was the lowest (18.6%).

Age group

Majority of the respondents were within the age ranges of 15-30, 31-45 and greater than 45 years. Respondents with age range of 15-30 had the highest proportion in Dawakin Kudu

(38.57%), Shanono (35.71%), and Dambatta (34.28%) while Wudil and Bebeji had the lower proportion (17.14% and 15.71% respectively). Respondents that were within the age range of 31-45 were more rampant in Bebeji, Shanono, Wudil and Dawakin Kudu with proportions of 47.14%, 37.14%, 31.43% and 28.57% ,respectively, while Dambatta had the lowest proportion (22.86%). Those respondents that were within the age group of greater than 45 years were found to be larger in Wudil, Dambatta and Bebeji with proportions of 51.43%, 42.86% and 37.14% respectively but lower proportion of 28.57% and 24.28% was observed in Dawakin Kudu and Shanono respectively. Small proportions of respondents that were within the age group of less than 15 years were only found in Dawakin Kudu (4.28%) and Shanono (2.86%). Furthermore, comparing the age groups regardless of locations, majority (36.9%) of the respondents were above 45 years, followed by those that were 31-45, 15-30, and less than 15 years were the least, with proportions of 33.4%, 28.3% and 1.4%, respectively.

Marital status

In all the locations, respondents that were married were more than those that were not married with the highest proportion (90%) in Bebeji followed by Wudil (88.57%), Dambatta (80.00%), Dawakin Kudu (74.28%) and Shanono (68.57%). Overall, across the locations, respondents that were married had proportion of 80.3% while those that were singled had proportion of 19.7%.

Contact with extension agent

Those respondents that had no contact with extension agents were higher in Bebeji, Dambatta and Wudil with proportions of 65.71%, 65.71%, and 58.57%, respectively but lower in Shanono and Dawakin Kudu (32.86% and 48.57%, respectively). Similarly, across the locations,

the total proportion of those that had no contact with extension agents (54.3%) was greater than respondents that had contact (45.7%).

Occupation

The proportion of respondents that were farmers was higher in all the locations (58.57%, 55.71%, 44.28% and 42.86% in Wudil, Dambatta, Shanono and Dawakin Kudu, respectively) with the exception of Bebeji where their proportion was second to the highest proportion. Civil servants were more involved in sheep breeding in Shanono (31.43%) than in other locations (8.57%, 7.14%, 2.86% and 2.86% in Wudil, Dambatta, Dawakin Kudu and Bebeji, respectively). Respondents that were engaged in trading and kept sheep were more numerous in Dawakin kudu and Wudil with proportions of 32.86% and 18.57% respectively while lower proportions (8.56%, 7.14%, 2.86%) were recorded in Dambatta, Shanono and Bebeji ,,respectively.The proportion of student respondents was greater in Dawakin Kudu (20.00%) and Shanono (17.14%) but considerably lower in Dambatta (10.00%), Wudil (5.71%) and Bebeji (2.86%). Greater proportion of respondents that engaged in other activities (driving, fishing, house wife, building) were found in Bebeji (58.57%) and Dambatta (18.57%) while lower proportion was observed in Wudil (8.57%) and Dawakin Kudu (1.43%). Respondents in Shanono were not engaged in any other activity. Generally respondents that practiced farming as their sole occupation tended to be the majority (46.9%), followed by those that were engaged in other business activities (17.4%), traders (14.0%), students (11.1%) and civil servants (10.6%).

Educational Background

With the exception of Shanono where they had a comparatively lower proportion, respondents that had only Islamic education were more rampant than those with other educational backgrounds. The proportion was found to be 67.14%, 67.14%, 60.00%, 44.28%,

and 21.43% in Bebeji, Dambatta, Wudil, Dawakin Kudu and Shanono, respectively. The respondents that had tertiary education had the highest percentage in Shanono. The proportion was found to be 37.14%, 12.86%, 11.43%, 5.71% and 1.43% in Shanono, Dambatta, Wudil, Dawakin kudu and Bebeji, respectively. Similarly, respondents with secondary education were substantial in all the locations with Dambatta recording the lowest. The proportions were, 40.00%, 35.71%, 22.85%, 21.43% and 11.43% in Dawakin Kudu, Shanono, Bebeji, Wudil and Dambatta, respectively. Respondents with primary education were comparatively few in all the locations with proportion of 8.57%, 8.57%, 7.14%, 5.71% and 4.28% in Dawakin Kudu, Dambatta, Wudil, Shanono and Bebeji, respectively while respondents with no educational background were only found in Dawakin Kudu (1.43%) and Bebeji (4.28%). In general, there was greater proportion of respondents with Islamic education (52.0%), followed by those with secondary (26.3%), tertiary (13.7%), primary (6.9%) and none literates (1.1%).

Table 1: Socioeconomic Characteristics of Sheep Owners based on location

	Location					
Variables	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Gender						
Male	57(81.43)	66(94.28)	39(55.71)	61(87.14)	27(38.57)	250(71.4)
Female	13(18.57)	04(5.71)	31(44.28)	09(12.86)	43(61.43)	100(28.6)
PR						
Head	40(57.14)	47(67.14)	32(45.71)	51(72.86)	21(30.00)	191(54.6)
Spouse	11(15.71)	04(5.71)	27(38.57)	09(12.86)	42(60.00)	93(26.6)
Member	19(27.14)	19(27.14)	11(15.71)	10(14.28)	07(10.00)	66(18.6)
Age group						
< 15	02(2.86)	03(4.28)	0 (00)	0 (00)	0 (00)	05(1.4)
15 -30	25(35.71)	27(38.57)	24(34.28)	12(17.14)	11(15.71)	99(28.3)
31 -45	26(37.14)	20(28.57)	16(22.86)	22(31.43)	33(47.14)	117(33.4)
> 45	17(24.28)	20(28.57)	30(42.86)	36(51.43)	26(37.14)	129(36.9)
MS						
Married	48(68.57)	52(74.28)	56 (80.00)	62(88.57)	63(90.00)	281(80.3)
Single	22(31.43)	18(25.71)	14(20.00)	08(11.43)	07(10.00)	69(19.7)
CEA						
Yes	47(67.14)	36(51.43)	24(34.28)	29(41.43)	24(34.28)	160(45.7)
No	23(32.86)	34(48.57)	46(65.71)	41(58.57)	46(65.71)	190(54.3)
Occupation						
Farmer	31(44.28)	30(42.86)	39(55.71)	41(58.57)	23(32.86)	164(46.9)
C/servant	22(31.43)	02(2.86)	05(7.14)	06(8.57)	02(2.86)	37(10.6)
Trader	05(7.14)	23(32.86)	06(8.57)	13(18.57)	02(2.86)	49(14.0)
Student	12(17.14)	14(20.00)	07(10.00)	04(5.71)	02(2.86)	39(11.1)
Others	0 (00)	01(1.43)	13(18.57)	06(8.57)	41(58.57)	61(17.4)
EB						
Islamic	15 (21.43)	31(44.28)	47(67.14)	42(60.00)	47(67.14)	182(52.0)
Primary	04 (5.71)	06(8.57)	06(8.57)	05(7.14)	03(4.28)	24(6.9)
Secondary	25 (35.71)	28(40.00)	08(11.43)	15(21.43)	16(22.85)	92(26.3)
Tertiary	26 (37.14)	04(5.71)	09(12.86)	08(11.43)	01(1.43)	48(13.7)
None formal education	0 (00)	01(1.43)	0 (00)	0 (00)	03(4.28)	04(1.1)

SNN = Shanono, DKD = Dawakin kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji, PR= Position of respondent, MS= Marital status, CEA= Contact with extension agent, EB= Educational background n= number of respondents. The figure outside the parenthesis is the number of respondent. The figure in parenthesis is the proportion in percent.

4.1.2 Breed types owned by the respondents in the locations

The breed types as owned by respondents are presented in Table 2. Yankasa sheep were the most abundant in all the locations with proportion of 100%, 90.00%, 80.00%, 78.57%, and 77.14% in Bebeji, Wudil, Dawakin kudu, Shanono and Dambatta respectively. Uda breed was observed in Shanono, Dawakin Kudu, and Danbatta only with proportions of 2.86%, 5.71% and 2.86 respectively. Balami breed was only recorded in Dambatta with a proportion of 7.14%. The respondents that owned a combination of all the three breeds (Yankasa, Uda and Balami) in their flocks were also observed in all the locations with the exception of Bebeji where only Yankasa breed was observed. The proportion was 5.71%, 5.71%, 1.43% and 1.43% in Shanono, Dawakin Kudu, Dambatta and Wudil, respectively. In all the locations, some of the sheep owners had a combination of Yankasa and Uda breeds in their flock with the highest proportion observed in Shanono (10%) while Dambatta, Dawakin Kudu, and wudil had lower proportions of 5.71%, 4.28% and 4.28%, respectively, and none was found in Bebeji. Some of the famers owned a combination of Yankasa and Balami in the locations with the exception of Bebeji. The proportion was found to be 5.71%, in Dambatta which was the greatest followed by, Dawakin Kudu (4.28%), Wudil (4.28%) and the least proportion (2.86%) was found in Shanono. In general, respondents with Yankasa breeds were greater across locations with proportion of 85.1%, followed by those with Yankasa and Uda (4.9%), Yankasa and Balami (3.4%), those with all the three breeds (2.9%), those with Uda (2.3%) and those with Balami were the lowest (1.4%).

Table 2: Breed Types Owned by the Respondents in the Locations

	Locations					
Breed	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Yankasa	55(78.57)	56(80.00)	54(77.14)	63(90.00)	70(100.00)	298(85.1)
Uda	02(2.86)	04(5.71)	02(2.86)	0 (00)	0 (00)	08(2.3)
Balami	0 (00)	0 (00)	05(7.14)	0 (00)	0 (00)	05(1.4)
All	04(5.71)	04(5.71)	01(1.43)	01(1.43)	0 (00)	10(2.9)
Yks/uda	07(10.00)	03(4.28)	04(5.71)	03(4.28)	0 (00)	17(4.9)
Yks/blm	02(2.86)	03(4.28)	04(5.71)	03(4.28)	0 (00)	12(3.4)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, Yks= Yankasa, blm= Balami

4.1.3 Flock Size and Structure of Sheep Owned by Respondents in the Locations

The flock sizes and structure of surveyed sheep flocks in the five locations are presented in Table 3. Breeding ewes dominated breeding rams in each flock in all the locations with an overall ratio of 9:1, respectively. On location basis, the highest recorded numbers of breeding ewes (334) and breeding rams (94) were observed in Shanono with a ratio of 4:1 , followed by those of Dambatta with 254 breeding ewes and 63 breeding rams (4:1), Dawakin Kudu with a ratio of 4:1 (229 breeding ewes and 78 breeding rams), wudil (229 breeding ewes and 37 breeding rams) and Bebeji (174 breeding ewes and 23 breeding rams) both with a ratio of 9:1. In general, females represented approximately 64% of the total flock of sheep in the study areas, while males accounted for 36% (ratio of 3:2 of females to males), whereas breeding ewes and breeding rams accounted for about 38% and 5%, respectively of the total flocks.

The flock size of respondents significantly ($p < 0.001$) differed across location. Farmers that had sheep flock size ranging from 1 to 5 sheep were the highest across the location with a total number of respondents of 154 (44%). On location basis, for farmers that had 1-5 sheep in their flock, 57 were observed in bebeji, 37 in wudil, while 30, 19 and 11 were recorded in Dawakin Kudu, Dambatta and Shanono, respectively. Respondents with flock size ranging from 6-10 heads (which was 29.1% of the total population of respondents) were the next class in terms of number with significant ($p < 0.001$) variations across locations. The highest number of respondents in this category was observed in Dambatta (33) followed by Shanono (22), Dawakin kudu (20), Wudil (18) while Bebeji recorded the least. Farmers with size of sheep flocks ranging from 11 to 15 heads and numbered up to 50 (14.1% of the total number of respondents interviewed) were the next .Their average numbers varied significantly ($p < 0.001$) across the locations with 15 respondents as the highest record observed in Dambatta. This was followed by

Shanono (14 in number), Dawakin Kudu and Wudil (both with 9 respondents) while least number of respondent (3) that fall in this class was found in Bebeji. The number of famers that had more than 15 sheep in their flocks was 44 (12.6% of the total number of respondents) significantly ($p < 0.001$) varied across locations. The highest number of respondents in this class (23) was found in Shanono, followed by Dawakin Kudu (11), Wudil (6) Dambatta(3) and the least was recorded in Bebeji(1).

Table 3: Flock Size and Structure of Sheep Owned by Respondents in the Locations

	Location						
	DKD (n= 70)	SNN (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	TOTAL (n= 350)	X^2 VALUE
Flock Class							
1-5	30	11	19	37	57	154	
6-10	20	22	33	18	9	102	99.7***
11-15	9	14	15	9	3	50	
>15	11	23	3	6	1	44	
Breeding Ewe to Breeding Ram Ratio							
Breeding Ram	78	94	63	37	23	165	
Breeding Ewe	229	334	254	229	174	1220	
TOTAL	307	428	317	266	194	1385	
RATIO	4 :1	4 :1	4: 1	9:1	9:1	9:1	
Female to Male Ratio							
Female			2034				
Male			1141				
Total			3175				
Ratio			3 : 2				

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji, ***= P<0.001, n= Number of respondent, breeding ram = ram >12 months old, breeding ewe= ewe >12 months old, x^2 = chi-square

4.1.4 Breeding Practices of Sheep Owners in the Locations

The breeding practices of Sheep Owners in the Locations are shown in Table 4.The ratio of farmers that had no breeding ram at all, were greater in all the locations with the exception of Dawakin kudu. The overall ratio of those famers that had no breeding ram to those that owned one and those with more than one was found to be 5:3:2. The ratio was 5:2:3 in Shanono, 3:4:3 in Dawakin Kudu, 6:2:2 in Danbatta, 6:3:1 in Wudil and 7:2:1 in Bebeji.

The greater proportions of respondents that had their breeding ram from their own flock were found in Dawakin Kudu (72.86%) and Wudil (55.71%) while they had lower proportions in Shanono (38.57%), Dambatta (37.14%) and Bebeji (31.43%). Famers that had their breeding ram from their neighbor flock had higher proportions in Bebeji (68.57%), Dambatta (42.86%) Shanono (42.86%) and Wudil (40.00%), while the lowest proportion was recorded in Dawakin Kudu (20.00%).While the number of respondents that had their breeding ram (source) from market were lower in all the locations, yet the proportion was considerable in Dambatta (20.00%), and totally absent in Bebeji. Respondents that had their breeding ram from all the sources were only found in Shanono and Dawakin Kudu with proportion of 15.71% and 1.43% respectively. Irrespective of locations, the proportion of respondents that had their breeding ram from their own flock was the highest (47.1%) , followed by those that had it from neighbor flock (42.9%), from the market (6.6%) ,while those that obtained the rams from all the sources had the lowest proportion (3.4%).

Breeding and fattening purpose for keeping ram was given higher priority in all the locations except in Wudil were the proportion was the lowest. The highest proportion was recorded to be 90% in Dawakin Kudu, followed by Bebeji with 82.86%, Shanono (77.14), Dambatta (52.86%) and Wudil (35.71%) while famers that were keeping ram for the purpose of

breeding and socio-cultural reason were only found in Shanono, Dawakin Kudu and Dambatta with little proportion of 7.14%, 2.86% and 5.71%, respectively. The reason for keeping ram for the purpose of all the reason stated above (breeding, fattening and socio-cultural) was greater by the respondents of wudil with proportion of 64.28% but lower in all the locations. The proportion was recorded to be 41.43%, 17.14%, 7.14%, and 3.1% in Dambatta, Bebeji, Dawakin kudu and Shanono, respectively. Similarly, across the locations, respondent that kept ram for breeding and fattening were greater in proportion (67.7%), followed by those that kept it for breeding, fattening and socio-cultural reason (29.1%) and those that kept it for breeding and socio-cultural reason where the lowest (3.1%).

Table 4: Breeding Practices of Sheep Owners in the Locations

		Location					
Breeding Practice.	**Variable**	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Ram possession	NONE	35(50.00)	23(32.86)	40(57.14)	39(55.71)	52(74.28)	189(54.2)
	1	16(22.86)	27(38.57)	13(18.57)	23(32.86)	13(18.57)	92(26.28)
	> 1	19(27.14)	20(28.57)	17(24.28)	08(11.43)	05(7.14)	68(19.8)
	RATIO	5: 2 : 3	3 : 4 : 3	6 : 2 : 2	6 : 3 : 1	7 : 2 : 1	5 : 3 : 2
Source of Breeding ram	OF	27(38.57)	51(72.86)	26(37.14)	39(55.71)	22(31.43)	165(47.1)
	NF	30(42.86)	14(20.00)	30(42.86)	28(40.00)	48(68.57)	150(42.9)
	MKT	02(2.86)	04(5.71)	14(20.00)	03(4.28)	0 (00)	23(6.6)
	All	11(15.71)	01(1.43)	0 (00)	0 (00)	0 (00)	12(3.4)
	RATIO	4 : 4 : 0 : 2	7 : 2 : 1 : 0	4 : 4 : 2 : 0	6 : 4 : 0 : 0	3 : 7 : 0 : 0	5 : 4 : 1 : 0
Purpose of keeping ram	BF	54(77.14)	63(90.00)	37(52.86)	25(35.71)	58(82.86)	237(67.7)
	BS	05(7.14)	02(2.86)	04(5.71)	0 (00)	0 (00)	11(3.1)
	All	11(3.1)	05(7.14)	29(41.43)	45(64.28)	12(17.14)	102(29.1)
	RATIO	8 : 1 : 1	9 : 0 : 1	5 : 1 : 4	4 : 0 : 6	8 : 0 : 2	7 : 0 : 3

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, OF = own flock, NF = neighbor flock, MKT = market, BF = breeding and fattening, BS = breeding and socio-cultural, all ratios are in ascending order.

4.1.5 Purpose of Keeping Sheep in the Locations

The purposes of keeping sheep by farmers in the study area are presented in Table5. Majority (38.0%) of the respondents across the locations kept sheep as a means of savings with greater proportions in Bebeji (92.86%) and Dambatta (42.86%), while lower proportions were recorded in Wudil (24.28%) and Shanono (21.43%). However, an exceptionally lower proportion (8.57%) was observed in Dawakin Kudu. The second highest objective of rearing sheep across locations was to gain all the advantages (savings, socio-cultural reasons, manure, meat and commercial) with an overall proportion of 30.0% .Location wise, the highest proportion was found in Shanono (48.57%), and Wudil (48.57%), while Dambatta, Dawakin Kudu and Bebeji had lower proportions of 37.14%, 14.28% and 2.86%, respectively. The next purpose in ranking is the overall percentage of farmers that kept sheep solely as business (27.1%) with the largest proportion of respondents in Dawakin Kudu (75.71%) followed by Shanono (27.14%) while lower proportions were observed in Wudil (17.14%), Dambatta (11.43%) and Bebeji (4.28%). The overall proportion of those respondents that kept sheep for socio- cultural reasons was only 4.0% with Wudil recording the highest proportion (10.0%) followed by Dambatta, Shanono and Dawakin Kudu with proportion of 5.71% , 2.86% and 1.43% respectively, while Bebeji had none. Farmers that kept sheep as a source of manure only and those that kept them as source of meat for home consumption only, were found in Dambatta only with proportion of 1.43% each within the location, and overall percentages of 0.3 each.

Table 5: Purpose of Keeping Sheep in the Locations

Purpose	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
commercial	19(27.14)	53(75.71)	08(11.43)	12(17.14)	03(4.28)	95(27.1)
Meat	0 (0)0	0 (00)	01(1.4.3)	0 (00)	0 (00)	01(0.3)
Manure	0 (00)	0 (00)	01(1.43)	0 (00)	0 (00)	01(0.3)
SC	02(2.86)	01(1.43)	04(5.71)	07(10.00)	0 (00)	14(4.0)
Savings	15(21.43)	06(8.57)	30(42.86)	17(24.28)	65(92.86)	133(38.0)
All	34(48.57)	10(14.28)	26(37.14)	34(48.57)	02(2.86)	106(30.0)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, SC = socio-cultural,

4.1.6 Trait Preferences for Breeding Purpose of Sheep Owners in the Locations

Trait Preferences of sheep owners in the locations are presented in Table 6. Adaptability and feed shortage resistance was the most preferred trait in all the locations with the largest proportion in Bebeji (100%) followed by Dawakin Kudu (84.28%),Wudil (82.86%), Shanono (81.43%), and Dambatta (77.14%). The percentage of respondents who considered resistance to disease as the most important trait was greatest in Dambatta, followed by that of Shanono and wudil with proportions of 4.28%, 2.86% and 2.86% respectively, while the least proportion was found in Dawakin Kudu (1.43%) whereas Bebeji had none. The highest proportion of farmers that preferred body size were found in Dambatta (10%) followed by Shanono (4.28%), Wudil (4.28%), and Dawakin Kudu (2.86%), while Bebeji recorded the least (0.0%). Farmers that preferred prolificacy as the choice trait were only recorded in Dawakin Kudu with a proportion of 1.43%. Respondents that preferred longevity were only found in Dambatta with proportion of 4.28% and those that preferred fast growth were recorded in Dambatta, Dawakin Kudu, and Wudil with proportions of 2.86%, 1.43% and 1.43% respectively. The proportion of farmers that considered all the traits as important was greatest in Shanono (11.43%), followed by Dawakin Kudu (8.57%) and Wudil (8.57%), while Dambatta had the lowest (1.43%) and Bebeji had none. Generally, majority (85.14%) of the respondents preferred sheep with high level of adaptability and feed shortage resistance.

Table 4.1.6: Trait preference for breeding purpose of sheep owners in the locations

Trait	Location					
	SNN (n= 70)	DKD (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	TOTAL (n=350)
AFSR	57(81.43)	59(84.28)	54(77.14)	58(82.86)	70(100.00)	298(85.14)
RD	02(2.86)	01(1.43)	03(4.28)	02(2.86)	0 (00)	08(2.3)
Body size	03(4.28)	02(2.86)	07(10.00)	03(4.28)	0 (00)	15(4.3)
Prolificacy	0 (00)	01(1.43)	0 (00)	0 (00)	0 (00)	01(0.3)
Longevity	0 (00)	0 (00)	03(4.28)	0 (00)	0 (00)	03(0.9)
Fast growth	0 (00)	01(1.43)	02(2.86)	01(1.43)	0 (00)	04(1.1)
All	08(11.43)	06(8.57)	01(1.43)	06(8.5.7)	0 (00)	21(6.0)

AFSR= Adaptability and feed shortage resistance, RD = Resistance to disease, SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji.

4.1.7 Breeding Practice of Sheep Owners in the locations

Table 7 presents the breeding practices of sheep owners in the selected locations. Most of the farmers in Shanono and Dambatta practiced controlled breeding with proportions of 61.43% and 68.57%, respectively, while the least proportions were found in Dawakin Kudu (37.14%), Wudil (20.00%) and Bebeji (7.14%).Those respondents that practiced uncontrolled breeding were greater in Bebeji (92.86%), followed by Wudil (80.00%), Dawakin Kudu (62.86%) and lower proportion as recorded in Shanono (38.57%) and Dambatta (31.43%). Irrespective of location, the percentage of respondents that were not controlling the breeding activities in their flocks was higher (61.14%) compared to those that practiced controlled breeding (38.86%).

For those farmers who practiced controlled breeding methods differed across locations with Dambatta having the proportion 66.66% that practiced tethering as a method of control, Shanono (67.44%), Dawakin Kudu (65.38%), Wudil (100%) and Bebeji (100%) as shown in Table 7. Those that practiced castration as a method of control were found to proportion in Dawakin Kudu (23.08%), followed by Dambatta (10.42%) and Shanono (2.32%) while Wudil and Bebeji respondents did not practice castration at all. Similarly only famers of Dambatta, Shanono and Dawakin Kudu practiced culling in controlling breeding with proportions of 22.92%, 23.25% and 11.54% respectively. Considering the whole locations, those respondents that practiced tethering were the highest in proportion (71.32%), followed by those that practiced culling (17.65%), castration (8.82%) whereas those that practiced other methods of control had the lowest proportion (2.21%).

Farmers awareness of inbreeding and its effects in the locations is also presented in Table 4.1.7, with Shanono, Dawakin Kudu, Dambatta and wudil having the proportions of those that were aware being 92.86%, 62.86%, 55.71% and 91.43%, respectively. In contrast, the proportion

of those that were aware about inbreeding in Bebeji was less than those that were not aware, being 38.57% and 61.43%, respectively.

Table 7: Breeding Practice of Sheep Owners in the locations

Variable	Location					
	SNN	**DKD**	**DBT**	**WDL**	**BBJ**	**TOTAL**
	(n= 70)	(n= 70)	(n= 70)	(n=70)	(n= 70)	(n= 350)
Breeding practice						
Controlled	43(61.43)	26(37.14)	48(68.57)	14(20.00)	05(7.14)	136(38.86)
Uncontrolled	27(38.57)	44(62.86)	22(31.43)	56(80.00)	65(92.86)	214(61.14)
Control method	(n=43)	(n=26)	(n=48)	(n=14)	(n=05)	(n=136)
Tethering	29(67.44)	17(65.38)	34(66.66)	14(100)	05(100)	97(71.32)
Castration	01(2.32)	06(23.08)	05(10.42)	0 (00)	0 (00)	12(8.82)
Culling	10(23.25)	03(11.54)	11(22.92)	0 (00)	0 (00)	24(17.65)
Inbreeding awareness	(n=70)	(n=70)	(n=70)	(n=70)	(n=70)	(n=350)
Aware	65(92.86)	44(62.86)	39(55.71)	64(91.43)	27(38.57)	239(68.28)
Not aware	05(7.14)	26(37.14)	31(44.28)	06(8.57)	43(61.43)	111(31.71)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji

4.1.8 Selection Criteria for breeding ram and breeding ewe in the Location

Selection Criteria for breeding ram and breeding ewe in the locations were presented in Tables 8a and 8b respectively. Traits like body size, coat texture, head morphology and body shape, mating ability, tail shape, and other traits were all considered as important in both of the locations and given due emphasis in selecting breeding rams. Among selection criteria considered, body size (ram that had large body) was the major trait for selecting breeding rams by majority of the respondents in all the locations with the exception of Shanono. The proportion was highest in Dawakin Kudu (95.71%) followed by Bebeji (85.71%), Wudil (51.43%), Dambatta (44.28%) and the lowest was found in Shanono (22.86%). Head morphology (long and somewhat droopy ears, wide set noses, curved horns and long face) and body shape (long withers height and heavy weight at maturity, body frame and tall back) had the highest proportion (65.71%) by respondents of Shanono while in other locations it was also given due emphasis in selecting breeding ram with high proportions in Dambatta (42.86%), Wudil (24.28%) and lower proportions in Bebeji (10.00) and Dawakin Kudu (2.86%). Coat texture was only considered by few farmers in only Wudil, Dambatta, and Bebeji with proportions of 11.43%, 1.43% and 1.43%, respectively while mating ability was considered by few respondents in only Shanono (2.86%) and Wudil (2.86%). Those that considered all the traits were only found with little proportions in Shanono (5.71%) and Wudil (2.86%) while those respondents that considered other less frequently mentioned desirable traits like shape of the testicles (either compact or pendulous) were observed also in small proportions in Dambatta (8.57%), Wudil (7.14%) and Shanono (2.86%). Generally, the highest overall trait of consideration while selecting breeding rams across the locations is body size (60.00%), followed by head morphology and body shape (29.1%), with the remaining traits being in smaller proportions.

Body size was the major selection criteria in all the location for selecting breeding ewes. The highest proportion of respondents that selected their breeding ewe based on body size was recorded in Dawakin Kudu (100%), followed by Bebeji (97.14%), Shanono (87.14%) and Dambatta (87.14%) while Wudil had the lowest (47.14%). A small proportion of respondents that preferred coat texture were found in Wudil, Dambatta and Shanono with proportions of 15.72%, 2.86% and 2.86% respectively. Mothering ability was also used by small proportion of respondents in Shanono (4.28%) and Bebeji (2.86%) whereas lambing interval was only recorded in Dambatta with little proportion (2.86%).Those respondents that used twinning as a criterion for selecting breeding ewes were only found in Wudil but in small proportion (2.86%).Farmers that used all the traits as selection criteria were also found in Shanono (2.86%), Dambatta (7.14%) and Wudil (1.43%).

Table 8a: Selection Criteria for Breeding Ram in the Locations

Selection criteria	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
Body size	16(22.86)	67(95.71)	31(44.28)	36(51.43)	60(85.71)	210(60.0)
Coat texture	0 (00)	0 (00)	01(1.43)	08(11.43)	01(1.43)	10(2.9)
HMBS	46 (65.71)	02(2.86)	30(42.86)	17(24.28)	07(10.00)	102(29.1)
Mating ability	02(2.86)	0 (00)	0 (00)	02(2.86)	0 (00)	04(1.1)
Tail shape	0 (00)	01(1.43)	02(2.86)	0 (00)	02(2.86)	05(1.4)
All	04(5.71)	0 (00)	0 (00)	02(2.86)	0 (00)	06(1.7)
Others	02(2.86)	0 (00)	06(8.57)	05(7.14)	0 (00)	13(3.8)

HMBS= Head morphology and body shape, SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji..

Table 8b: Selection Criteria for breeding ewe in the Locations

Selection criteria	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
Body size	62(88.57)	70(100)	61(87.14)	56(80.00)	68(97.14)	317(90.57)
Coat texture	02(2.86)	0 (00)	02(2.86)	11(15.71)	0 (00)	15(4.28)
Mothering ability	03(4.28)	0 (00)	0 (00)	0 (00)	02(2.86)	05(1.43)
Age at first lambing	01(1.43)	0 (00)	0 (00)	0 (00)	0 (00)	01(0.28)
Lambing interval	0 (00)	0 (00)	02(2.86)	0 (00)	0 (00)	02(0.57)
Twinning	0 (00)	0 (00)	0 (00)	02(2.86)	0 (00)	02(0.57)
All	02(2.86)	0 (00)	05(7.14)	01(1.43)	0 (00)	08(2.28)

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji

4.1.9 Flock Improvement Methods of Sheep Owners in the Locations

Table 9 presents the flock improvement activities of the sheep owners in the selected locations. Improvement methods were higher across locations with those improving their flock by crossing with local breeds having higher proportion within locations in Dawakin Kudu (79.59%), Wudil (66.66%) Shanono (60.94%), Dambatta (53.49%), and Bebeji had none. The highest proportion of respondents that cross with exotic breeds were recorded in Dambatta (11.63%), followed by Bebeji (33.33%), Dawakin Kudu (2.04) and Shanono (1.56%).The higher proportion of famers that practiced line breeding within locations were recorded in Bebeji (66.66%), followed by Dambatta (34.89%), Shanono (29.69%), Wudil (27.27%), and Dawakin Kudu (16.32%). Little proportion of the respondent in Shanono (7.81%) and Wudil (6.06%) employed all the three methods and were not found in other locations. In the total study locations, respondents that cross with local breeds were higher in proportion (64.4%) followed by those that practiced line breeding (27.75%), crossed with exotic (4.19%) and those that employed all the three methods (3.66%).

Furthermore, the proportion of those involved in genetic improvement of their flocks was higher than those that were not in Shanono, Dawakin Kudu, and Dambatta with proportions of 91.43%, 68.57%, 61.43%, respectively. However, the reverse was the case in Wudil and Bebeji, where the proportions of those not involved in any form of breeding technique were higher, being 52.86% and 95.71%, respectively.

Table 9: Flock Improvement and Improvement Method of Sheep Owners in the Locations

	Location					
Flock improvement	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
YES	62(91.43)	48(68.57)	43(61.43)	33(47.14)	03(4.28)	191(54.57)
NO	06(8.57)	22(31.43)	27(38.57)	37(52.86)	67(95.71)	159(45.43)
Improvement method						
Cross with exotic	01(1.43)	01(1.43)	05(7.14)	0 (00)	01(1.43)	08(2.3)
Cross with local	39(55.71)	39(55.71)	23(32.86)	22(31.43)	0 (00)	123(35.4)
Line breeding	19(27.14)	08(11.43)	15(21.43)	09(12.86)	02(2.86)	53(15.3)
All the 3 methods	05(7.14)	0 (00)	0 (00)	02(2.86)	0 (00)	07(2.0)

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji

4.2 Discussion

4.2.1 Socio-economic Characteristic of Respondents

The majority of respondents were engaged full-time in other income-generating activities (crop farming, civil servants, trading and other petty businesses) in the locations, indicating that sheep keeping is a secondary activity. It is noteworthy that majority of sheep owners in the study location were predominantly males with the exception of Bebeji in which females were the majority due to the fact that this location had more characteristics of rural areas were by male where engaged in arable crop farming and other business activities and leaving small ruminants rearing for female which was also observed by Jaitner, Sowe, Secka-Njie, Dempfle (2001). This observation agrees with reports from Adesehinwa, Okunola, and Adewumi (2004) in Southwestern Nigeria; Dossa, Sangaré, Buerkert, and Schlecht, (2015) in Kano, Nigeria, Bobo Diaoulasso, Burkina Fasso and Sikasso, Mali; Baah, Tuah, Addah and Tait (2012) from Ghana; Lawal-Adebowale (2012) in various cities in Nigeria and Kagira and Kanyari (2010) from Kenya, which indicated that sheep farmers in these parts of Africa were predominantly males. However, earlier studies from rural areas in West Africa (Jaitner, Sowe, Secka-Njie and Dempfle, 2001; Dossa, Rischkowsky, Birner and Wollny, 2008; Smith, Sones, Grace, MacMillan, Tarawali and Herrero, 2013) found small ruminant keeping to be closely associated with women as was also observed in the present study in Bebeji. This may reflect the transformation of rural small ruminant keeping from a subsistence activity associated with women to a commercially viable enterprise in which men dominate as was similarly observed with respect to urban gardening sector by Freidberg (2001) in Bobo Dioulasso, Burkina Fasso and Wooten (2003) in Bamako, Mali.

The fact that majority of sheep owners were between the ages of 15 and 45 years indicates that rural sheep keepers were mainly people of middle age. This finding is in agreement with that of Dossa, Sangaré, Buerkert and Schlecht (2015) who found that the average age of small ruminant owners was 44 years in urban cities of Kano, Bobo Dioulasso and Sikasso in West Africa. On the other hand, Adesehinwa, Okunola and Adewumi (2004), reported that about 50 percent of sheep owners in South-Western Nigeria were between 51 and 60 years.

The greater proportion of sheep owners of older ages in Dambatta and Wudil compared to Shanono, Dawakin Kudu and Bebeji is indicative of a higher potential for improved management practices in Shanono, Dawakin kudu and Bebeji considering the fact that young people are generally more receptive to innovations and new technologies than old ones (Adesina, Mbila, Nkamleu and Endamana, 2000). Furthermore, by considering the important functions of insurance and economic security of sheep, the relatively young age of sheep owners irrespective of location, and the important number among them who engaged in this activity for many years, it can be argued that this activity will continue to flourish in the surveyed areas and probably elsewhere in rural areas of Kano State.

4.2.2 Flock Size and Structure:

The fact there were higher numbers of female animals than males in all the locations could be due to the fact that mature males were sold or used during the Eid el-Kabir festival as Kano State is a predominantly Muslim state. Similarly, the fact that there were more breeding ewes than breeding rams in all locations could also be due to this reason, as well as because keeping more of breeding ewes will increase their flock size after the festival. This observation was also made by Fsahatsion, Melesse and Banerjee (2013) in Gamogofa Zone, Southern Ethiopia, which they attributed to the prevalent practice of keeping growing ewes as

replacements for breeding purpose while rams were sold when money is needed, during festivals or slaughtered during ceremonies. A similar flock structure was observed in Menz sheep by Getachew *et al.* (2010) where breeding ewes were dominant.

4.2.3 Breed types owned by the respondents in the locations

The fact that most farmers kept the Yankasa breed was similarly observed by Hassan, Mbap and Naibi (2015) in Lafia LGA of Nasarawa State. This could be because Yankasa sheep are easily reared on free–range, less costly, in addition to the fact that the study area is a suitable ecological environment for the breed. The exorbitant price of the Balami sheep could also be a good reason for the few number of respondents that owned the breed. However some of the sheep farmers tended to keep animals of improved genotypes, mainly crossbred; alternatively several genotypes (some of which were brought from Sudan and Mali while some of the famers Combined Balami, Uda and Yankasa in their flock) were kept in the same flock by some of the farmers in the locations with the exception of Bebeji where only Yankasa sheep were kept. This practice could reflect the market and non-market preferences for improved and non-local breeds of sheep which are influenced by both culture and religion (Brisebarre and Kuczynski, 2009).

4.2.4 Purpose of keeping sheep and farmers trait of preferences

Breed and trait preferences are useful to make better informed decisions in developing interventions to improve the contribution of sheep to livelihoods of their keepers (Tassew, Kefelegn, Yoseph and Bosenu, 2014). Adaptability and feed shortage tolerance were given higher emphasis in selecting replacement stocks in the locations. The fact that farmers in the study areas kept sheep mainly as source of cash income is because it can be immediately sold for quick cash at the local markets (Judith, 2006) and had short generation interval and require low initial capital.

The results of this research revealed the multi-functionality of sheep among rural dwellers in the five locations, whereby their financial functions were ranked as of paramount importance. This finding is consistent with what was stated in other studies by Touré and Ouattara (2001), Ajala, Lamidi and Otaru (2008) and Baah, Tuah, Addah and Tait (2012) in selected urban communities in Côte d'Ivoire, Nigeria and Ghana, respectively. Similar findings were made by Judith (2006) and Gizaw (2008), who observed that cash income source and insurance were the principal objectives why barley farmers also keep the animals in a sheep-barley system. However reports by Thys and Ekembe (1992) and Lawal-Adebowale (2012) indicated that urban small ruminants were mainly raised for home consumption. The remarkable variations of the breeding purpose across locations observed in the current study are likely to be related to differences in social and economic contexts. For example, the objective "Sale of live animals for extra cash during Eid el-Kabir" for sheep production was of higher importance in Dawakin Kudu compared to the other locations, probably because it is nearer to Kano city as compared to the rest and therefore easier to access markets in the city which had higher proportion of Muslims and thus higher demand for sheep during the occasion. The objective of keeping sheep as a way to save money was of higher importance in Dambatta and Bebeji. This could be related to the fact that there were higher proportions of female respondents in these locations due to the fact that these locations had more characteristics of rural areas where by male were engaged in arable crop farming and other business activities and leaving small ruminants rearing for females which was also observed by Jaitner, Sowe, Secka-Njie and Dempfle, 2001, and Female of the rural areas were more accessible by the researcher due to religion issues. Female sheep owners save money in form of sheep because it can be sold for immediate cash when needed as explained by Judith (2006).

4.2.5 Breeding Management

Most of the respondents were keeping ram for the purpose of breeding and fattening in all the locations, indicating their primary objective which was for sales and savings and also shows the improvement of rural sheep owners from subsistence to commercial sheep farming which will in turn increase their commercial status and improve their standard of living.

Those farmers who did not own breeding rams indicated that they use neighboring rams or their ewe mate with breeding rams from other flock during grazing. Some of the respondents attributed the absence of breeding rams in their flocks to the fact that the rams were sold during the Eid el-Kabir festival. By doing so however, they were unintentionally selecting against fast-growing desirable genotypes with remarkable features and large body sizes.

Since there were no controlled breeding practices by most of the respondents, rams which were not sold because of poor growth and conformation had the best chances to mate with females in the flocks thus increasing their gene frequencies.

The fact that used rams for breeding either born in their flocks or from neighboring flocks may result in reduction of genetic diversity and probably increased rate of inbreeding and its related consequences.

4.2.6 Breeding practice and Selection criteria

Taking into consideration the small flock sizes, the low practice of castration, especially among sheep farmers, and the complete lack of keeping breeding records, the selection of replacement animals from within the flock as observed among the surveyed farmers represents a high risk of inbreeding of which they were probably not aware or they were aware but do not have any means to prevent it.

Farmers in study areas were well experienced in selection of future breeding ewes and rams from their own flocks, market or neighbor flocks of sheep. Almost all the farmers in the locations practiced selection. Males were selected at 8.87 months to 9.0 months. The corresponding figures for females were 7.93 to 10.21 months. As revealed by the results of the current study, irrespective of locations and breeds, replacement animals were selected mainly on the basis of their general appearance and conditions. However if farmers are encouraged to keep records, it will enable farmers to shift from the current practice to a selection of better performing animals for replacement, based on pedigree information and breeding performances. The lower proportion of breeding rams and rams (less than a year) as compared to other age categories and lower practicing of castration as compared to tethering and other control methods could probably be explained by the objectives among sheep farmers irrespective of locations, and this is due to the fact that a ram for "Eid al-Kabir" (the Islamic festival of sacrifice) needs to be intact, i.e. not castrated. The complete lack of breeding males in several sheep flocks is also associated to the above reason stated. In all the locations ram lambs were kept to select future breeding ram.

Although certain beliefs regarding raising and/or eating meat of animals of certain coat color are widespread across many West African societies (Brisebarre and Kuczynski 2009) and elsewhere in Africa (Gwaze *et al*. 2009), they were given little emphasis among respondents in all the locations and could be explained by cultural differences across Nigeria and Africa in general. Some of the respondents were selecting their breeding rams on the basis of their desirable traits such as consideration of the testicles where they preferred rams with compact testicles and avoiding those with pendulous testicles due to their reason that the former had greater mating ability. Those farmers that considered head morphology preferred rams with long

and somewhat droopy ears, wide set noses, curved horns and long face, large heads and large horns, explaining that these rams had more market value and were good looking.

When selecting female replacement animals on the basis of their mothering abilities, farmers showed a strong preference for reproductive traits such as fertility and prolificacy irrespective of breed and location. This reflects the farmers' general objective which was to increase flock size and overall flock productivity.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The study was conducted in five selected Local Government Areas of Kano State, namely Shanono, Dawakin kudu, Danbatta, Wudil and Bebeji to assess the traditional breeding practices and selection criteria for indigenous sheep breeds and identify aspects of traditional sheep breeding to be improved based on farmers' trait preferences. Purposive sampling technique was employed to select 350 farmers (71.43% of which were males) from five locations (two villages from each location). A structured questionnaire and focused group discussions were used to generate the required data. Sheep were kept for a variety of reasons including income generation, economic security (savings) and social/religious functions. Farmers reared sheep primarily for income generation. Female animals represented approximately 64% of the total flock of sheep in the study areas and male animals accounted for 36% (ratio of 3:2 of female to male). Breeding ewes dominated Breeding rams in each flock in all the locations with overall ratio of 9:1, respectively. The flock size of respondents was significantly ($p < 0.001$) differ across location. Famers that had sheep flock size ranging from 1 to 5 sheep were the highest across the location with total number of respondents of 154 which was up to 44% followed by Respondents with flock size ranging from 6-10 heads (which was 29.1% of the total population of respondents), those with 11 to 15 heads and numbered up to 50 which makes 14.1% of the total number of respondents, famers with more than 15 (>15) sheep in their flock and had 44 as the total number of respondents accounted for 12.6% of the total number of respondents .The predominant breed of sheep in all locations was Yankasa while the least prominent was the Balami. Keeping crossbred animals and/or maintaining more than one genotype in the same flock was practiced by

few of the respondents. The reason for breed preference by most of the farmers was adaptability and feed shortage resistance. Although a considerable proportion (68.28%) of the respondents indicated awareness of inbreeding, mating was predominantly uncontrolled (61.14%). Body size, head morphology and body shape and appearance were the most frequently reported traits in selecting breeding rams across the locations; whereas body size was mentioned as the trait given due emphasis in choosing future breeding ewes. Majority (54.3%) of the respondents had no contact with extension agents while some of them explained that health related issues were basically areas where they benefited from visits by extension agents. None of them received any guidance related to genetic improvement strategies of their flocks.

These findings provide evidence that preferential selection of breeding animals is a common practice among rural sheep farmers, mainly because of the high cultural and economic values of sheep. This leads to the hypothesis that irrespective of the locations, sheep farmers would be more interested to adopt improved breeding practices and to participate in the development and implementation of carefully designed genetic and breeding improvement programme.

5.2 CONCLUSION

Sheep have multipurpose functions for the livelihoods of rural people in Kano, even though they are predominantly kept for financial and cultural reasons. Rural sheep keeping is dominated by men in most of the study areas indicating its significance as a major source of income. In all the locations, the predominant sheep reared were of the Yankasa breed, while the least prominent breed was the Balami. However, keeping crossbred animals and/or maintaining more than one genotype in the same flock was practiced by few sheep keepers. The reason for breed preference by most of the farmers was adaptability and feed shortage resistance. Breeding

ewes dominated flocks in all the locations, while more than half of the respondents had no breeding rams. Mating was predominantly uncontrolled, although a considerable number of the respondents knew about inbreeding. Body size, head morphology , body shape and appearance were the most frequently reported traits in selecting breeding rams across the locations; whereas body size was mentioned as the trait given due emphasis in choosing future breeding ewes. Majority of the respondents had no contact with extension agents, while none of them was aware of any existing breeding program aimed at improving sheep productivity in the study area. Due to poor sheep breeding practices, there is a possibility of inbreeding and loss of productive animals. There is therefore the need for a planned sheep breeding system which will take into account the socio-economic norms, existing breeding practices, selection criteria and trait preferences of the farmers in the communities.

5.3 RECOMMENDATION

1. Farmers should be encouraged to keep other breeds of sheep apart from Yankasa in order to increase biodiversity.
2. Awareness should be created among farmers on the need to retain superior rams for breeding rather than sell them indiscriminately during festivities.
3. Farmers should be educated about the implications of inbreeding and the need for controlled mating.
4. A planned community based sheep breeding program which will take into account the socio-economic norms, existing breeding practices, selection criteria and trait preferences of the communities should be implemented.

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Appendix 1: Sample Questionnaire

ACCESSMENT OF TRADITIONAL BREEDING PRACTICES AMONG SHEEP OWNERS IN SOME SELECTED LOCAL GOVERNMENT AREAS OF KANO STATE.

(Household Questionnaire)

2015

SECTION A:

GENERAL INFORMATION

1. LGA ----------

2. Name of village ----------
3. Household number
……
4. Name of the respondent ----------
5. Position of respondent in the household. Head [ ] spouse [ ] member [ ]
6. Date of the interview ----------

SECTION B:

SOCIOECONOMIC CHARACTERISTICS OF RESPONDENT

1. Gender: male [ ] female [ ]
2. Age: <15 [ ] 15-30 [ ] 31-45 [ ] > 45 [ ]
3. Ethnic group: …….
4. Marital status: married [ ] single [ ]
5. Household size: < 5 [ ] 5-10 [ ] > 10 [ ]
6. Number of adults in the household: male……. Female…….
7. Contact with extension agent, NGO or researcher: Yes [ ] No [ ]
8. Occupation: farmer [ ] civil servant [ ] trading [ ] student [ ] others ……
9. Educational background: None [ ] primary [ ] secondary [ ] tertiary [ ] Adult education [ ] Islamic education [ ]

SECTION C:

QUESTIONS ABOUT FLOCK MANAGEMENT AND BREEDING PRACTICES OF SHEEP OWNERS

1. Which breed do you keep? Yankasa [ ] Uda [ ] Balami [ ] all of the above [ ]

Yankasa and uda [ ] yankasa and balami [ ] Balami and Uda [ ]

2. What is the structure of your flock?
   Total flock size…….
   Ram lamb (<6 months old)……...
   Ram (6-12 months old)……..
   Breeding ram (>12 months old)…….
   Castrates (older than 1 year)…….
   Ewe lamb (<6 months old)…….
   Ewe (6-12 months old)……..
   Breeding ewe (>12 months old)……..
3. What is your objective for keeping sheep?
   a. Sale(income source) [ ]
   b. Meat [ ]
   c. Manure [ ]
   d. Social and cultural reasons [ ]
   e. Savings [ ]
   f. All [ ]
4. Why do you keep your breed of preference? Adaptability and feed shortage resistance[ ] resistance to diseases [ ] body size [ ] meat [ ] prolificacy [ ] feed shortage resistance [ ] coat color [ ] longevity [ ] fast growth [ ] all [ ] others [ ]
5. What type of breeding do you practice? Controlled [ ] uncontrolled [ ]
6. If you practice control breeding, how do you control it? Tethering [ ] castration [ ] culling [ ] others ……
7. Are you aware about inbreeding? Yes [ ] no [ ]
8. Are you improving your flock? Yes [ ] no [ ]
   9. If yes, which method do you employed? Crossing with exotic breed [ ] Crossing with local breed [ ] Line breeding [ ] All [ ]
10. What are your selection criteria for breeding ram? Body size [ ] Coat color [ ] Head morphology and body shape [ ] Ear length [ ] Fast growth [ ] Mating ability [ ] Tail size and shape [ ] all [ ] others [ ] (specify)----------
11. What are your selection criteria for breeding ewe? Size [ ] Coat color [ ] Mothering ability [ ] Age at first lambing [ ] Lambing interval [ ] Twining [ ] Tail size and shape [ ] Longevity [ ] all [ ] others [ ] (specify) ----------
12. How many breeding rams do you own? Having no breeding ram [ ] Having one breeding ram [ ] having more than one ram [ ]
13. What is your source of breeding ram? own flock [ ] Neighbor flock [ ] Market [ ] all [ ] others [ ] (specify)----------
14. What is your purpose of keeping ram? breeding and fattening [ ] Breeding only [ ] Breeding and socio-cultural reasons [ ] All the 4 aspects are important [ ]

CHAPTER ONE

INTRODUCTION

1.1BACKGROUND OF THE STUDY

Nigeria possesses vast resources in livestock comprising cattle, sheep, goats, poultry horses, donkeys, camels, rabbits and fish. The immense position of livestock farming in this country cannot be over emphasized. Among all the livestock that make up the farm animals in Nigeria, ruminants, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system. 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. The larger proportion of these animals population are however largely concentrated in the northern region of the country than the southern region (Adebowale, 2012). Specifically about 90 percent of the country's cattle population and 70 percent of the sheep and goat populations are concentrated in Northern region of the country. Concentration of Nigeria's livestock-base in the northern region is most likely to have been influenced by the ecological condition of the region which is characterized by low rainfall duration, lighter sandy soils and longer dry season. This submission is predicated by the fact that drier tropics or semi-arid regions are more favorable to the ruminants (Yemi, 2010).

The livestock sub-sector is contributing significantly to the Nigerian economy considering the population figure of 2010 stated above. In monetary terms, the value of Nigerian livestock resources, based on prevailing market prices in mid 1991, was conservatively estimated to be in the order of US $6 billion (Bourn, Wint, Blench, and Woolley, 1992). Small ruminants (sheep and goats) have a unique niche in smallholder agriculture from the fact that they require

small investments; have shorter production cycles, faster growth rates and greater environmental adaptability as compared to large ruminants. They are important protein sources in the diets of the poor and help to provide extra income and support survival for many farmers in the tropics and sub-tropics (Tibbo, Philipsson and Ayalew, 2006).

Small ruminants are widespread in the tropics and contribute to the subsistence, economic and social livelihood of a large human population. They are a source of tangible benefits (i.e., cash income from animal sales, meat for home consumption, manure, fiber and skins) and intangible benefits (e.g., savings, insurance, culture and ceremonial purposes). The main beneficiaries are the women, children and the aged, who are often the most vulnerable members of the society in terms of under – nutrition and poverty (Kosgey, 2004). Besides, small ruminants complement other livestock in the utilization of available feed resources and provide one of the practical means of using vast areas of natural grassland in regions where crop production is impractical, such as arid and semi-arid areas, and hilly and rocky grounds. Despite the large number and importance of these animal species in the tropics, good definitions of comprehensive breeding objectives are rare. In addition, sustainable breeding programmes using indigenous breeds are scarce. The developing countries in the tropics currently experience high increases in human population, dramatic urbanization, increasing monetarization of their economies and income change. Consequently, there is need to address issues related to under-nutrition, food security, rural poverty and rates and patterns of agricultural growth that contribute to overall economic development, and protection of the environment. Sustainable breeding programmes can make a significant contribution (Kosgey, 2004).

The tropical sheep breeds as we see today have evolved as the result of several generations of human and natural selection, predominantly for traits related to

adaptation/survival under several natural challenges (Fsahatsion, Aberra and Banerjee, 2013; Markos, Ayalew, Awgichew, Ermias and Rege, 2004). In spite of the several constraints, they have been able to contribute significantly to the income of the small holder farmers/ pastoralists and also help in poverty alleviation schemes (Kosgey and Okeyo, 2007) as mentioned earlier. Therefore, genetic improvement of the indigenous livestock through appropriate techniques or selection and breeding programme is the need of the day especially under such constraints (Yakubu, 2010).

1.2 PROBLEM STATEMENT

The productivity of sheep as in case of most of the ruminants is markedly low due to several genetic and environmental factors besides the institutional, environmental and infrastructure constraints (Markos, Ayalew, Awgichew, Ermias, and Rege, 2004; Kosgey,and Okeyo, 2007).

Unfortunately, attempts to improve small ruminants in the tropics including Nigeria so far faced several constraints mainly due to weak planning, poor involvement of livestock owners and implementing livestock improvement programs without taking into consideration all the needs of farmers (Sölkner, Nakimbigwe, and Valle-Zarate, 1998; Tibbo, Philipsson and Ayalew, 2006).

1.3 JUSTIFICATION OF THE STUDY

Considering the above problem stated, there is therefore, the need for new thinking and developing breeding programs with the consultation and involvement of all stakeholders from the planning to implementation phase. Sölkner, Nakimbigwe and Valle-Zarate (1998) proposed a new approach, which is a community based breeding program. Detailed and up-to-date information on production system, indigenous knowledge of managing the breed, identification

of important traits for selection with full participation of farmers are prerequisites (Sölkner, Nakimbigwe and Valle-Zarate, 1998; Kosgey, Baker, Udo, and van Arendonk, 2006). Assessment of the sheep breeds, breeding system and flock structure in the smallholder production system is important to bring improvement in sheep productivity (Yenesew, Solomon and Azage, 2013).

1.4 OBJECTIVES OF THE STUDY

The broad objective of this work is to assess indigenous breeding strategies of farmers in the study area towards improving productivity of Nigerian indigenous sheep. The specific objectives are:

I. To determine the socio-economic characteristics of sheep owners in the study areas
II. To identify the breeds of sheep being reared
III. To assess the flock size and structure
IV. To assess the breeding objectives and traits of preference of farmers
V. To assess the breeding practices and selection criteria of farmers
VI. To identify aspects of traditional sheep breeding to be improved based on farmers traits preference

CHAPTER TWO

LITERATURE REVIEW

2.1 THE BASIS FOR DESIGNING COMMUNITY-BASED BREEDING PROGRAMME

The bases for designing community-based breeding programs are the farmers' and pastoralists' indigenous breeding strategies and the resultant mode of livestock production. Farmers' and pastoralists' strategies arise from their indigenous knowledge of animal breeding and management. Farmers' and pastoralists' strategies are expressed in their indigenous breeding and management practices, breeding/production objectives, and marketing strategies (Gizaw *et al*., 2013). The indigenous strategies of the farmers and pastoralists take into account the production environment, long-standing tradition of livestock production practices, management skills, socio-economic and cultural factors, and the availability of inputs and services. The mode of livestock production practiced by a farming community has a direct bearing on the design of livestock development strategies. Thus, the production system in a target area needs to be characterized and understood in order to design a suitable breeding program (Gizaw *et al*., 2013). Community-based sheep breeding requires a full description of the existing environment, the current level of productivity, breeding objectives, and the selection criteria of sheepherders, available indigenous knowledge and breeding practices, and the full participation from the beginning of the farmers and pastoralists (Sölkner, Nakimbigwe and Valle-Zarate, 1998; Kosgey, Baker, Udo and van Arendonk, 2006). The approach to designing breeding programs should attempt to fit new breeding strategies into the indigenous breeding strategies of the target farmers and pastoralists, rather than forcing exotic methods and products as is the case with the conventional top–down design of breeding programs.

2.2 SMALL RUMINANTS POPULATION IN NIGERIA

Small ruminants are almost as ubiquitous as poultry, though not so numerous. Nationally there are estimated to be a total of 56.6million heads, with goats out numbering sheep by three to two, although some seasonal movement of pastoral sheep does take place (Bourn, Wint, Blench and Woolley, 1992). The great majority of small ruminants are sedentary village livestock and their pattern of distribution mirrors that of human settlement (Adebowale, 2012).

Small ruminant flock holding sizes are larger in the drier north than in the south (Adebowale, 2012). In south Eastern Nigeria (Adebowale, 2012) reported that goats were more widely owned than sheep. Sheep were owned by 28% of the households contrary to 92% goats' ownership. In south western Nigeria, average flock size is in the range of 2-5 animals per owner with goats being also more common than sheep (Matthewmann, 1977); he also reported in two villages in the south western Nigeria approximately 60% of the households owned goats and 22% owned sheep.

The population of the major domestic animal species found in the semi-arid zone of west African region is said to have increased in the last 30 years (Jean, 2008). According to Gerdiner and Devendra (1995), the population of cattle, sheep and goats increased by 0.5, 2.2 and 1.7% per year, respectively between 1961-63 and 1991-93. Small ruminants, comprising sheep and goats dominated the livestock population. Cattle, sheep and goat distribution in Nigeria is limited by tsetse fly incidence and by the availability of forage. The semiarid ecological zone is virtually tsetse fly free, but has the lowest forage resources, carry over 70% of the total population of livestock in Nigeria are concentrated in the Guinea and Sudan zones (Adu and Ngere, 1979).

2.3 THE PLACE OF SMALL RUMINANTS IN NIGERIAN AGRICULTURE

Small ruminant animals continue to make substantial contribution to the economy of Nigeria as supplies of food, raw materials and foreign earning. Oni (2002) reported that sheep and goats account for about 36% of total national meat supply and they have tremendous potential for growth. Goats also feature prominently in the economic and social lives of Nigerians. They serve as a quick source of income and play a role in dowry, ceremonies and ritual sacrifices. Goats have successfully served mankind with meat, milk, hair, leather and other products including manure, even though they are frequently objects of neglect and prejudice (Lamorde, 1993). Sheep and goats with their small body, high reproductive capacity and rapid growth rates in some instances are ideally suited to production by resource poor small holders. They can be integrated into overall production system, absorbing surplus labour and consuming small amounts of otherwise unused feed. The low capital requirement for starting or expanding small ruminant production means that risks are low and that the enterprise is well suited to low input system (Lamorde, 1993).

Small ruminant livestock under small holder systems were considered as scavengers, surviving on crop residues, household wastes and natural vegetation regardless of their quality. However, the economic importance of livestock especially small ruminants (sheep and goats) in mixed farming systems is now receiving attention. In small holder production systems, sheep and goats are important because they require less initial capital and maintenance costs, are able to use marginal land and crop residues; produce meat and milk in readily usable quantities; easily cared for by most family members; are prolific and require only short periods to increase flock sizes after natural disasters such as diseases or drought as a result of increased demand and market

prices. The rate of return on investment under good management is high (3 5%) for goats and 55% for sheep (Lamorde, 1993).

Sheep contribute enormously towards promotion of livelihoods security and as an insurance cover to crop with crop failures particularly for rural landless, small and marginal female farmers (Adeloye, 1998). Sheep farming is also increasingly being taken up by peril-urban poor population due to market access and as a source of nutritional security for the household (Oni, 2002). Sheep are favored because of low investments, easy to raise and manage, low feed requirement compared to cattle, ability to thrive different flora, high disease resistance, and superior market potential (Oni, 2002).

2.4 BREEDS OF SHEEP IN NIGERIA

Sheep are kept everywhere in Nigeria, with a broad distinction between their importance and ubiquity in the north, and the more dispersed populations of the humid zone. Sheep and goats are seen as having secondary importance in relation to crops. Sheep are the second most numerous pastoral species, and small flocks accompany many cattle herds in the north and in the Middle Belt (Bourn, Wint, Blench and Woolley, 1994). There are generally considered to be four breeds or races of sheep native to Nigeria, the Balami, Uda, Yankasa and West African Dwarf (WAD) (Adu and Ngere, 1979).

2.4.1 Balami

Balami is the largest bodied native sheep in Nigeria. As a pastoral animal, it is confined to the semi arid north but it is favored as a stall fed breed by muslims throughout the Nigerian middle belt. It is white and hairy with pendulous ears, long-leg and a long thin tail (Adu and Ngere, 1979). Rams are horned but ewes are normally polled. Another feature that makes the Balami distinctly recognisable is its Roman, bulbous nose that distinguishes it from the Yankasa

(Adu and Ngere, 1979). It has good potential as a meat producer and milk yield per lactation lies between 28 and 33 kg in 70 days.

2.4.2 Uda

Also Known By: Oudah bicolore (French), Bali-Bali, Bororo, Fellata, Foulbe, Houda, Louda, North Nigerian Fulani, Ouda, Pied.

The Uda is one of the hair sheep breeds of the Sahel type. Haumesser and Gerbaldi (1980) studied traditionally-managed Uda flocks in Niger Republic; Wilson and Durkin (1983a, b) and Wilson and Light (1986) report on related sheep production systems in central Mali. It is a meat breed. It is a long-legged breed of sheep with distinctive coat colour of brown or black anterior and white posterior. They are large with straight and long face. The rams of the Uda are horned (Adu and Ngere, 1979) and the ewes are usually polled. Milk yield per lactation lies between 32 and 36 kg for an average lactation length of 91 days.

2.4.3 Yankasa

Also Known By: Hausa, White Fulani, Y'ankasa

The Yankasa is a meat breed found in north and north central Nigeria. In size it is intermediate between Uda and the west African Dwarf sheep. The milk yield (kg) per lactation is between 30 and 56 kg and has a lactation length of 91 days. The peak milk yield per day is 960 grammes (Adu and Ngere, 1979). The coat colour of Yankasa is typically white with black patches around the eyes, ear, muzzle and sometimes the feet. The tail is long and thin, the ears moderately long and somewhat droopy. Rams have curved horns and a hairy white mane and ewes are polled (Aganga, Umunna, Oyedipe and Okoh, 1988).

2.4.4 West African Dwarf

Also Known By: Cameroons Dwarf, Djallonké, Forest-type, Fouta Djallon, Futa Jallon,

Guinean, Kirdi, Kirdimi, Lakka, Nigerian Dwarf, Pagan, Savannah-type, Southern, West African Maned

The West African Dwarf is small bodied, compact breed which may be all white, black, brown or spotted black or brown on a white coat. Its variation in colour and patchy distribution make it difficult to distinguish it clearly from the Yankasa. Adult males weight approximately 37 kg. They have a well-developed throat ruff and are horned. Ewes have mature weights of 25 kg. The females are usually polled. Adu and Ngere (1979) reported that different types exist, mentioning the 'Pagan' variety on the Jos Plateau, and the 'Umuahia' variety near the Confluence, but there is no published account of such varieties. Devendra and McLeroy (1982) argue that the WAD breed cannot be sub categorized on the basis of appearance, and no performance data is available. They can be bred at the age of 7 to 8 months. They tend to have a short lambing interval. The prolificacy of adult ewes is low to moderate ranging from 1.15 to 1.50 lambs per lambing. At less than 100 g per day under good feed conditions, their growth rate is low and lamb mortality is high.

2.5 DISTRIBUTION OF SHEEP IN NIGERIA

Sheep are kept everywhere in Nigeria, with a broad distinction between their importance and ubiquity in the north, and the more dispersed populations of the humid zone. Sheep and goats are seen as having secondary importance in relation to crops. Sheep are the second most numerous pastoral species, and small flocks accompany many cattle herds in the north and in the Middle Belt (Bourn, Wint, Blench and Woolley, 1994). Sheep and Goats were spread all over Nigeria in the pre-colonial era, and West African Dwarf (WAD) types dominated the forest and derived savannah (Blench, 1993).

Sheep are kept both in villages and by pastoralists in the north, and along the northern borders of Nigeria, there are occupationally specialized pastoralists who depend on very large herds of sheep for subsistence (Adu and Ngere, 1979). Sheep are more prestigious than goats in Islamic ceremonies and substantial changes in price within the ritual year encourage sheep-production.

The West African Dwarf is the predominant breed of the humid tropics from southern West Africa through central Africa. The West African dwarf sheep is widely distributed in the southern Nigeria (Adu and Ngere, 1979), these seem to have had the same advantages as taurines, the ability to digest a broad diet and resistant to high-humidity pathogens. In the south, the traditional purpose of sheep was as sacrifices at social and religious ceremonies, and they do not form a regular source of protein in human diet, Long-legged savannah breeds are being crossed with WAD goats and sheep or are (Adu and Ngere, 1979) thriving in purebred form in regions far south of their previous limit.

The Yankasa breed is widely distributed in the northern part of Nigeria (Adu and Ngere, 1979). Balami is most predominant in the North eastern part of Nigeria. As a pastoral animal, it is confined to the semi arid north but it is favored as a stall fed breed by muslims throughout the Nigerian middle belt (Adu and Ngere, 1979). The Uda is found in northern Nigeria, southern Niger, central Chad, northern Cameroon and western Sudan, Uda breed occurs throughout the Sahelo-sudan vegetation zone of Nigeria. Uda Sheep are adapted to long-distance transhumance and are less popular for fattening. Recent years have seen a considerable expansion in the distribution of this breed, since it apparently resists foot rot and other high-humidity pathogens considerably better than the Sahel sheep. Pastoralists have been exploiting the derived savannah

in the south-west of Nigeria, bringing Uda down to the edge of the forest, thereby bringing the flocks close to the large urban markets of the south (Adu and Ngere, 1979).

2.6 MORPHOMETRIC CHARACTERISTICS OF BREEDS OF SHEEP IN NIGERIA

In the research conducted by Yunusa, Salako, and Oladejo (2013), Tail length was found to be the most discriminating character followed by ear length, rump width, hock length, rear leg length, heart girth, wither height and shoulder width 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 Northern sheep southwards.

Rump width was the only character that was apart between Uda and Balami, it also differentiated between Yankasa and WAD. Distinguishing Yankasa and WAD from Balami. The highest discriminating power of Tail length observed by Yunusa, Salako, and Oladejo, 2013; Yakubu, A., 2011 brought to light that the Northern and Southern sheep of Nigeria can best be distinguished with Tail length and This result is partly in variance with the findings of Salako and Ngere (2002) where Tail length was obtained as the most discriminating character between Yankasa and WAD sheep. Agievezor et al. (2012) also reported tail length, rump height, chest girth, ear length and chest depth as the most discriminating variables to separate WAD, Yankasa, Uda and Balami sheep. Uda has the tallest ear length and Tail Length, followed by Balami, Yankasa and WAD. While Balami has taller rump height, chest girth, followed by Uda, Yankasa and WAD (Yunusa, Salako, and Oladejo, 2013; Yakubu, A., 2011).

The weight of mature males of Balami ranges from 40 to 80 kg while that of female lies between 30 and 40 kg. The Uda is slightly smaller bodied than the Balami, although their size ranges overlap. The weight of mature females could be 30 to 40 kg while mature rams weigh 30 to 60 kg (Adu and Ngere, 1979). Yankasa rams stand 70 to 80 cm at the withers and weigh 55 to

60 kg at maturity. Mature females could weigh 25 to 40 kg while male weighs between 35 and 50 kg (Adu and Ngere, 1979). West African Dwarf Sheep are those whose average shoulder height does not exceed 50 cm (Oseni and Ajayi, 2014).

2.7 REPRODUCTION OF NIGERIAN BREEDS OF SHEEP

Sheep attain puberty at 5-6 months, sexual organ of rams are already functional at this time. However, rams should not be used before age of one and half years while ewe lamb could be bred at 9-12 months. It is good practice to replace breeding rams with newly selected ones after each breeding season. A minimum of 6 rams should be in a flock of 100 ewes. Feeding of breeding rams should be improved 6 weeks before the breeding season (Adu and Ngere, 1979).

The estrous cycle in the ewe is 16-17 days with estrous duration being 20-42 hours i.e. approximate 1-2 days average being 30 hours. Ovulation occurs in the ewe from about 24-30 hours after the onset of estrous after 16-17 days. There are no visible signs of heat in the sheep except the acceptance of the ram or teaser with an apron. This is the only external detection of heat in ewes. In flock mating, rams should be left in flock for 6-8 weeks to ensure (3 estrous cycles) that all ewes are bred. After that, they are withdrawn (Adu and Ngere, 1979). Rams should be joined with ewes 2 weeks after lambing. The ewes will still be nursing their lambs at this stage, but this does not prevent them from getting pregnant. Batch lambing could be ensured by synchronization using progestogen virginal sponges. Ewes lambing within 2-3 weeks interval would be synchronized. This consists of inserting the progestogen in-plants into their vaginal for 12 days. Introduction of rams to treated flock 2 days before sponge removal would enhance ovulation. Mating does not begin until sponge removal. Estrous normally spread over 4 days following sponge removal. Non-pregnant ewes would return to estrous 16-21 days following sponge removal (Adu and Ngere, 1979). Gestation period in ewes is about 5 months i.e. 152

days. Repeat breeder ewes, those weaning poor weight lambs and old ewes above 7 years should be culled.

Nutrition exerts some influence on the reproductive performance of the sheep. The practice of flushing ewes i.e. feeding these ewes more generously 2-3 weeks before breeding would improve lamb crop by 15-30% and make rebreeding easier. Flushing could be accomplished by feeding concentrate or providing lush pasture or range. Steaming is done to pregnant ewes 6-8 weeks to parturition or prior to lambing to increase parturition rate and lactogenesis or milk production (Adu and Ngere, 1979). Fat ewes are conditioned by exercise. Undernourishment during late pregnancy may cause pregnancy toxaemia (a metabolic disease), low birth weight and poor lamb survival. Undernourishment during lactation and rebreeding may result in depressed lactation, delay estrous, lower ovulation rate and poor fertility. Survival rates, weaning weights of lambs of undernourished ewes are poor. Good nutrition and management ensures about 80% lambing rates of bred ewes with 25% twinning rate (Adu and Ngere, 1979).

2.8 ADAPTIVE CHARACTERISTICS OF BREEDS OF SHEEP IN NIGERIA

Concentration of Nigeria's livestock-base in the northern region is most likely to have been influenced by the ecological condition of the region which is characterized by low rainfall duration, lighter sandy soils and longer dry season. This submission is predicated by the fact that drier tropics or semi-arid regions are more favorable to the ruminants, notwithstanding this situation, certain breeds of sheep and goats, particularly the West African Dwarf (WAD) species, are peculiarly adapted to the southern (humid) region of the country and are commonly reared by rural households in the region (Lawal-Adebowale, 2012).

Particular feed preferences are usually ascribed to individual breeds which make them appropriate for certain environments. These are a major factor in determining breed distribution,

but also in interpreting ‘interlocking’ distributions; two or more breeds can exploit the same ecozone by making different use of feed resources. As the vegetation gradually changes, due to both climatic and anthropic factors, producers must adapt either the breeds they use or bring in new ones (Blench, 1999).

Uda sheep are adapted to long-distance transhumance and are less popular for fattening. Recent years have seen a considerable expansion in the distribution of this breed, since it apparently resists foot rot and other high-humidity pathogens considerably better than the Sahel sheep. Pastoralists have been exploiting the derived savannah in the south-west of Nigeria, bringing Uda down to the edge of the forest, thereby bringing the flocks close to the large urban markets of the south (Blench, 1999).

The Yankasa are distributed in the Northern part of Nigeria and due to their high adaptation to the ecological constraints of this region, they dominated all breeds of sheep in the region (Adu and Ngere, 1979). Yankasa Sheep do not need daily watering in the wet season and watering once a day suffices in the dry season (Aganga, Umunna, Oyedipe and Okoh, 1988).

West African Dwarf Sheep Years of adaptation and natural selection under humid tropical conditions made this breed highly adapted to the humid forest zone (Oseni and Ajayi, 2014). These Sheep are present in all of humid Africa, from Southern Sudan to the west coast areas that are noticeably humid and warm, and characterized by dense vegetation ranging from swamp mangrove to rainforest and derived savannah. In these zones, ambient temperature and relative humidity are notably high all year round (Adu and Ngere, 1979).

West African Dwarf are highly prolific, can be bred all year round, with up to three parturitions in two years. The sheep are hardy, with the ability to thrive and survive under harsh environmental conditions of heat and humidity, ability to digest a broad range of diets and

resistance to high-humidity pathogens and haemonchosis, tolerant of gastro-intestinal nematodes and trypanosomiasis (Oseni and Ajayi, 2014) and the ability to thrive in tse-tse fly infested humid forests and guinea savannah zones.

2.9 STRATEGIES FOR IMPROVEMENT OF TROPICAL SMALL RUMINANTS

2.9.1 Improvement Pathways

Conventionally three main pathways have been considered for the genetic improvement of livestock: (1) selection between breeds (or stains), (2) crossbreeding, and (3) selection within breeds (stains) Baker and Gray (2003). For any of these strategies to be effective it is important to have a clear view of what traits are important in small ruminants for the particular environment being considered (Carles, 1983; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Consequently, it is logical to first choose the most appropriate breed or cross, and then to consider whether this breed, or the `parent` breeds in the case of crossbred animals, can be improved further by within-breed selection. Selection between breeds (or strains) can achieve dramatic and rapid genetic change when there are large genetic differences between breeds (population) in traits of importance (Simm, Conington, Bishop, Dwyer, and pattinson, 1996). However, it is costly when you need to replace males as well as females, and not always feasible to replace whole flocks of animals. In practice, ` grading up` or repeated crossing to the new breed leads to more gradual changes. It is often only involve the use of males and/or semen (where artificial insemination is feasible) of the new breed. In the tropics, breed substitution of exotics for the indigenous breeds and crossbreeding with breeds from temperate regions have been widely used, but have invariably been unsuccessful or unsustainable in long-term. This is due to incompatibility of the genotypes with the breeding objectives and management approaches of the prevailing low-input traditional production systems in these areas (Rowe,

Ogore, and Kahi, 2002; Ayalew, Rischkowsky, King, and Bruns, 2003). Within- breed selection of the adapted indigenous genotypes could be a viable option.

Within-breed selection is a strategy of genetic improvement usually carried out in individual populations. Selection within breeds or strains is intended to increase the average level of genetic merit of the population. Objectives within-breed selection usually involves measuring and selecting on productivity (e.g., litter size, growth of the young and mature size). However, effective small ruminant breeding methods in smallholder production systems in the tropics are constrained by small animal populations, single sire flocks, lack of systematic animal identification, inadequate animal performance and pedigree recording, low levels of literacy and organizational shortcomings (Turner, 1977; Kiwuwa, 1990; Jaitner, Sowe, Secka-Njie, Dempfle, 2001; Wollny, Banda, Mlewah, and Phoya, 2002). In addition to the factors constraining successful small ruminant breeding strategies in smallholder production systems, apart from small animal population and probably single sire flocks face a problem of mobility. The infrastructure necessary for collection of reliable pedigree and performance data does not exist to set up a breeding programme involving the populations maintained by the mobile pastoral communities (Franklin, 1986; Kiwuwa, 1990).

Traits that represent a comprehensive breeding goal are mostly complex with components of production and reproduction, e.g., number or weight of offspring per year (Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Recording of such traits and individual animal identification is in many cases difficult under traditional smallholder and pastoral conditions. The difficulty to measure and value the intangible benefits (e.g., savings, insurance, ceremonial and prestige) derived from the animals presents more complications (Roeleveld, 1996).Strategies for genetic improvement that overcome these problems need to be considered. In this regard,

nucleus schemes have been proposed as a good strategy for genetic improvement of small ruminants in developing countries (Turner, 1982; Hodges, 1990; Kiwuwa, 1990).

2.9.2 Breeding Programmes of Sheep

Two activities need to be distinguished in breeding programmes (Van Arendonk and Bijma, 2003).the first is the generation of genetic improvement by selecting animals based on their estimated breeding value for the relevant traits. Secondly, there is dissemination of the improved animals to the commercial population. In large scale small ruminant production, for instance in Australia or Newzealand, there could be millions of animals in the population. It is not worth or practical including them all in the active part of the breeding programme due to measurement costs, recording costs and lack of proper control (Kinghorn, 2000). Whereas flocks are not that large in developing countries in the tropics, resources are scarce and it is critical to optimize the little that is available. This is possible if the genetic improvement is generated in a small fraction of the population (referred to as the nucleus), while at the same time controlling the pedigree (i.e., inbreeding). All recording and genetic evaluation is done in the nucleus. Recording is not needed for the remainder of the population. The genetic progress is disseminated to the commercial population through use of males and/or semen (where artificial insemination is feasible) originating from the nucleus.

Basically, a nucleus breeding unit would require the pooling of superior animals with the highest genetic merit from many sources to form the foundation animals. Depending on the complexity and requirement of the breeding programme, a nucleus scheme can have different numbers of tiers and migration policies. Van der Werf (1999) summarized the roles of the different tiers of nucleus scheme in a livestock breeding structure. Generally, the central nucleus and the multiplier flocks generate sires for distribution to commercial farmers. a crucial point for

the successful implementation of distribution of breeding scheme in smallholder and pastoral production circumstances is adequate interaction between nucleus and farmers` flocks, in a technical as well as socio-economic sense. It is always important to bear in mind that nucleus breeding objectives impact on the whole scheme. The nucleus should therefore be set up with the breeding objectives of the farmers in mind. The nucleus could be open or closed. In a closed nucleus there is no upward migration of animals from the lower tiers to the nucleus, and all recording is confined to the nucleus. On the other hand, an open nucleus allows animals of higher merit to be migrated up for breeding in the nucleus. Open nucleus breeding schemes have been recommended for small ruminants in the tropics (Jasiorowski, 1990). An open nucleus breeding schemes, from a genetic point of view is more interesting because it affords selection in larger population, but this has consequences for infrastructure and costs because naturally it would involve some pedigree or performance recording in the lower tiers.

Small ruminant breeding programmes found in the tropics differ in design. Some are three-tiered with a nucleus, pre-nucleus (multiplier) and a base population (Kosgey, 2004) while others are two-tiered, involving only a central performance evaluation station (nucleus) and farmer flocks (base) (Yapi – Gnoare, Rege, Oya, Alemayehu, 1997). Some do not operate a nucleus at all (FAO, 1988). Certain programmes select only males (Yapi-Gnoara, 1999) while others select both sexes (Darfaoui, 1999). It is apparent that the design of the breeding programme will depend on the ecological region and on the production system the breeding programme is aimed at (Van der Waaij, 2001).

The design of the breeding scheme has an impact on the anticipated result. For instant, selection of both male and female animals in an open nucleus would generate more genetic progress than selection of males alone. If lower tiers buy average males (and no females) from

the tier above, they will be lag behind the tier above by 2 generations (about 7 years in sheep and goats) of selection response (Bichard, 1971). Opening the nucleus pushes it to progress more quickly, and this benefits the whole scheme as the base will move as fast as the nucleus when the nucleus runs smoothly (Kinghorn, 2000). Overall response in 2-tiers schemes is 10-15% faster than in closed schemes when optimal design, from the genetic point of view and not necessarily cost, is applied, i.e., about 10% of the population in the nucleus and about 50% of the nucleus mated females born in base (James, 1977). An open nucleus in form of geographically diffused flocks could be used. It involves creating elite `nucleus` mating in the flocks of birth of female partner, with migration of males and/or semen to these flocks (Kinghorn, 2000). This relies on good pedigree information, and may not be easy to effect in traditional animal production systems.

The dilemma in genetic improvement programmes in developing countries in the tropics is on how to: effectively organize breeding schemes involving farmers at the village level; and record such flocks and monitor progress (Osinowo and Abubakar, 1988). To involve farmers, it is advisable to back the breeding programme with an effective extension service for maximum effect. The selection programme should be preceded with several years of extension work to train the farmers and boost their experiences and skills in small ruminant production techniques (Yapi-Gnore, 1999). During that period farmers should be made aware of the benefits derived from the recording activity (Moioli, Astruc, and Sanna, 2002). Another possible problem with breeding programmes in developing countries is the frequently long and complicated bureaucracy involved in the distribution of improved animals from the nucleus to co-operating farmers. The procedure is often subjected to abuse by those in authority or those with powerful connections. A fair system of distributing animals, for instance on a `first-come-first-served`

basis, needs to be agreed upon and made a policy where facilities and resources allow, institutional nucleus farms could be expanded to generate more breeding stock to meet the demands of the commercial farmers. A point to note is that unless due consideration is made, selection of animals under institutional management is not likely to reflect the management conditions of commercial farms, resulting in genotype by environment interactions and wastage of selection opportunities due to ill-adapted animals to the local low input conditions. Assuming the breeding programme is successfully launched, immediate returns to the farmer would likely emanate from non-genetic factors as the program picks ups.

2.9.3 Non-Genetic Gains from Breeding Programmes

The motivation for rearing small ruminants and their functions are geared to natural and economic conditions and thus correspond to the requirements of the farmer (Peters, 1988), which in most cases are livelihood oriented. The breeding programme in principle must have expected outputs consistent with the producer`s objectives and would be driven by incentives (i.e., expected returns from the producers) to justify the producer`s investments – e.g., they and their families labor, hired labor and other costs, including the difficulties of controlled breeding required of the programme.

Much as within breed genetic improvement can enhance output and profitability at all levels of production, from smallholder to large livestock enterprises (Holst, 1999), results in the traditional low-input management systems of the tropics may seem too long-term to be felt (Gatenby, 1986; Ponzoni, 1992). It seems therefore that immediate to medium-term returns or perceived returns on investments in improvement programmes, will likely result from non-genetic gains, i.e., improved husbandry practices, and conflict resolution in terms of farmer`s expectations and involvement in the breeding programme (Van Vlaenderen, 1985; Wollny,

Banda, Mlewah, and Phoya, 2002; Ayalew, Rischkowsky, King, and Bruns, 2003). Consequently, any improvement of small ruminants through breeding would have to account for other intervening factors likely to interfere with any progress made (Mwendia, 1997). There would be little value in implementing a carefully designed breeding programme if managerial, nutritional and animal health aspects are not being attended to in the environment in question (Ponzoni, 1992). For example, manipulation of the management system could easily result in improved reproductive performance for indigenous type of small ruminants as long as their current productivity and functions are well understood. Generally, knowledge of the production objectives of the traditional small ruminant systems and how these may impact upon genetic improvement programmes would be necessary when deciding breeding programmes to adopt.

2.10 THE ROLE OF SMALL RUMINANTS IN TRADITIONAL FARMING SYSTEMS

2.10.1 Crop-Livestock Production Systems

Crop-livestock mixed farming systems comprise sedentary smallholder farmers carrying out mixed crop and livestock farming concurrently as the main activity. The mixed farming systems of the developing world contain about 64 percent of the small ruminants of the world (Steinfeld, de Haan, and Blackburn, 1996). These farming systems are a predominant feature and continue to develop with human population pressure increasing further (De Haan, Steinfeld, Blackburn, 1996). Sheep and goat numbers are growing fastest in the mixed farming system, and most rapidly in the humid/sub humid areas, underlining how human population pressure is reducing farm size and access to and use of resources (Steinfeld, de Haan, and Blackburn, 1996). In the tropics, the crop-livestock mixed farmers are found mainly in medium to high potential areas (Rege, 1992) and they own small size of land. The animal are confined to small areas for grazing or left to wander freely around villages scavenging for feed (Gatenby, 1986). In some

cases stall-feeding is livelihood oriented. Unlike commercial farmers, smallholders tend to keep animals for family needs, rather than purely as an economic enterprise. Animals have intangible roles to the farmer (e.g., savings, insurance, cultural, ceremonial and prestige) and farmers expect their animals to fulfill these traditional functions (Peters, Dei chert, Drewes, Fitcher, and Moll, 1981; Wilson, 1985; Agishi, 1988; Peters, 1988; Ayalew, Rischkowsky, King, and Bruns, 2003). Survival of animals in the face of multiple stresses (heat, parasites and disease, and poor nutrition) is one the most important traits, while increasing growth rate is of less value (Upton, 1985; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Therefore, adaptability traits such as survival rates and reproductive performances become important (Franklin, 1986; Osinowo and Abubakar, 1988; Ponzoni, 1992). It is important to note that matings within smallholder flocks are largely uncontrolled and organized mating would naturally demand more labour, which is a serious problem at the time of land preparation for sowing and harvesting of crops (Gatenby, 1986). In addition, farmers may be keeping a mixture of breeds and would be difficult to sort out animals for pure-breeding.

2.10.2 Pastoral Production Systems

Pastoral farming systems are found mainly in the medium to low potential areas where crop production is difficult due to low rainfall and high evapotranspiration. In these systems, livestock forms an integral part of the socio-cultural life of the people. Pastoral farmers rely on livestock as their main source of livelihood, and usually own relatively large numbers of animals under extensive or communal grazing and management. Most of the livelihood is directly from livestock use and sales or exchange (Adu and Lakpini, 1988). Pastoral communities often herd cattle, camels, donkeys, sheep and goats together. Only a few herd or raise sheep and/or goats exclusively (Adu and Lakpini, 1988; Peters, 1988).the mixed species approach is to ensure

complementarily in forage use and direct benefit to the household in terms of tangible and intangible requirements (Adu and Lakpini, 1988). The animals therefore need to fit in the production system. Nomadic life, overgrazing and low production are common features of pastoral systems, especially in the arid areas. In recent times pastoral communities, especially in the medium potential areas, have changed a lot and are now tending towards sendentarized agro-pastoral systems compared to previously when they purely kept livestock. Encroachment of crop farmers from other communities, and adoption of crop-based foods by the pastoral communities, is now evident in some areas of the tropics.

Risk avoidance is an important integral part of breeding objectives in marginal areas (Jahnke, 1982; Sölkner, Nakimbigwe, and Valle-Zarate, 1998). Due to the fluctuating harsh environment, both individual and flock survival are important. The farmers adopt a two-pronged approach. First, in addition to stock diversification, pastoral communities use mobility to counter problems of uncertainty in the timing and distribution of rainfall and hence availability of forages, water shortage and incidence of diseases (Adu and Lakpini, 1988). Secondly, farmers use adapted breeds that survive and thrive in the environment (Mason and Buvannendran, 1982). Therefore, survival (e.g., pre-weaning, post-weaning and adult animal) traits and reproductive traits (e.g., litter size and lambing frequency) are important under this system. Many of the pastoral communities have their own breeding methods (Carles, 1983; Gatenby, 1986) and they have different cultural and social values by which to judge, appraise and decide on animals used for breeding (Sölkner, Nakimbigwe, and Valle-Zarate, 1998). For instant, in a study of nomads in northern Somalia it was observed that the breeding ram or buck has to posses specific qualities (Mirreh, 1978 cited by Sölkner, Nakimbigwe, and Valle-Zarate, 1998): mostly female offspring,

be well built, strong, a good fighter able to assert himself in the flock and offspring should be healthy, able to withstand the dry period and have a good record of milk production.

2.11 GENETIC IMPROVEMENT PROGRAMMES

2.11.1 Successes of Programmes

This highlights the key points of success of within-breed genetic improvement strategies for indigenous small ruminants in the tropics. The criterion is if the improvement project achieved its objective. It is important to concede that this criterion of success could be contentious, considering there could be points of view of the farmer and the scientist and /or policy maker (Kosgey, Baker, Udo, and van Arendonk, 2006).

2.11.2 Nucleus-Based Breeding Schemes

In response to declined animal imports from within the region due to drought, a national sheep selection programme was initiated in Ivory Coast in 1983 with the aim of improving grouth and live weight of the local Djallonke sheep breed (Oya, 1990; Yapi – Gnoare, Oya, 1994; Yapi – Gnoare, Rege, Oya, Alemayehu, 1997; Yapi-Gnoare, 2000).Only males were selected under a 2-tier open nucleus-breeding scheme. Involvement of experienced farmers and availability of technical support ensured the success of the project. However, no justification was given for selection of the traits or the definition of the breeding objective – improvement of growth and live weight of the local breed, while reproduction and adaptation were neglected (Sölkner, Nakimbigwe, and Valle-Zarate, 1998).

A nucleus breeding scheme involving the indigenous locally adapted Deccani sheep was initiated in the semi-arid Deccan plateau in Maharashra, India in 1993, although breeding of animals started in 1996 (Nimbkar, Ghalsasi, Walkden-Brown, and Kahn, 2002). The aim is to get a sheep with a modest to manageable prolificacy and an optimum body size for meat

production in the local environment, as well as being worm-resistant. The first step was introgression of the fecundity (FecB) gene into the Deccani breed from the Garole breed. Following successful establishment of a direct DNA test for the FecB gene (Wilson et al., 2001), there is now selection of those individuals with the gene and backcrossing them to the Daccani to reduce the proportion of the Garole genes further. Garole is native to a hot humid region and is not well adapted to semi-arid Daccan plateau, has a small size, poor milk yield (Nimbkar, Ghalsasi, Walkden-Brown, and Kahn, (2002) and is susceptible to infections such as pneumonia. The programme is still at the nascent stage and it is difficult to clearly state its fate at the moment, because the resulting genotypes are yet to be assessed for their suitability to the local production system. However, given the approach –the direct involvement of researchers with the local shepherd community, use of indigenous genetic resources, and no provision of free incentives, the programme has potential for success (Iniguez, 1998).Setback in the programme include diseases resulting in lamb mortality and abortions, shortage of man power, and inadequate feed for the animals. Other within breed selection programmes in India involves important indigenous sheep breeds – Malpura, Sonadi, Muzzaffanagari, Mandras Red, Mandya and Nellore are purportedly successful (Arora, Sharma and Khan, 2002). Rams of these breeds are reportedly available for enhancing mutton production in farmer`s flock.

A very active Martinik hair sheep programme was initiated in French West Indies 1n the 1990`s (Naves, Leimbacher, Alexandra and Mandonnet, 1999). Various indigenous hair sheep breeds from the Caribbean and mixed Martinican farms were grouped to form a population of Martinik hair sheep. The breeding goal was defined from a technical approach, according to the commercial objectives of the breeders: to improve the nursing ability of the dams, and growth and body conformation of the lambs. The aim was to sustain adaptation to the tropical climate –

use of pasture, resistance to worms; and good reproductive characters – prolificacy and de-seasonality. On-farm performance recording and selection of rams in a breeding station started since 1995 with the same criteria applied: number of lambing per year, litter size, viability of the lambs, live weight of the litter at 30 days of age, individual growth rate at 30 and 70 days, estimated live weight at 70 days and visual assessment of body conformation. Separate indexes are used for ewes on litter size and nursing ability. Dissemination of selected animals is organized by the breeding association and consists of young rams from the station and ewes from the elite farms. The selection base remains open, in order to include new farms and breeding animals in the population under selection. The backbone of the success of this programme was the existence of a strong professional structure (breeders association) for the maintenance and management of the sheep, active technical extension services, and initial funding from European structural funds. In Guadeloupe, the main difficulties in setting up the programmes were the absence of professional structures and lack of public financial support to initiate the operations.

A breeding programme involving the indigenous Damara sheep breed was started in Namibia in 1954 (von Wielligh, 2001). The initial stock, kept at Omatjenne Research station near Otjwarongo, was founded from many animals confiscated by the then German colonial government from commercial farmers illegally grazing on restricted disease-free areas. The breed is adapted to arid and semi-arid conditions (< 500 mm of rainfall annually). It is resistant to most diseases, tolerant to internal parasite, has good feed conversion efficiency and a varied diet (grass, bushes and shrubs). The breed has been selected for mutton under bushveld savanna area without losing its main characteristics and adaptive traits. It has shown significant increases in fertility and growth rates. For instance, from 1956 to 2000, the average weaning mass at 100 days increased from 22.8 to 24.6 kg and 24.0 kg, for ewe and lambs, respectively. The breed has

gained immense popularity with the commercial farmers, and is even being exported from South Africa to other African countries, and embryos to Australia. A breeders association has been instrumental in popularizing the breed by dissemination of valuable information on the breed to commercial farmers through breeding journals and information profiles, extension officers, meetings and courses.

A breeding programme for improving the trypanotolerant Djallonke sheep and the West African Dwarf goat for low-input management systems was started at the international trypanotolerance centre (ITC) in the Gambia in 1994 (Dempfle and Jaitner, 1999). The programme aimed at increasing the efficiency of meat production in combination with improvement of trypanotolerance trait for the two breeds. Currently, the scheme operates at a capacity of 200 breeding females and six breeding males for each species. The breeding goals were established through participatory rural appraisal with the farmers (Bennison, Barton and Jaitner, 1997). Performance testing, data and pedigree recording have been implemented and breeding value estimations based on growth traits have been developed and are now used for selection. Establishment of multiplication tiers started since 2000 in close collaboration with the government`s department of livestock services (DLS) (Kosgey, 2004). Then programme operates as an open nucleus, with ITC providing technical assistance to participating farmers, through DLS, on flock management and recording. No other incentives are offered. Farmers enter into a contract with ITC to use males from the nucleus provided that they eliminate all other males in the flock. The selected commercial flocks have males screened annually for breeding in the nucleus. The programme is young and still has to rely on donor support, although the objective is to see it taken over by the government, and eventually by the farmers. It is difficult to state clearly its fate at the moment. However, given the approach–farmers involvement, choice of

local breeds, selection under low-input conditions, and no free incentives to the farmers (Iniguaez, 1998) – the programme has potential for success.

2.11.3 Schemes without Nucleus

In northern Togo, an FAO/Togolese government funded sheep husbandry development project started in 1980 and involved individual and groups of men, appeared to have faired on well (van Vlaenderen, 1985; FAO, 1988). The project aimed to tackle a wide range of major aspects that constrained village-based sheep production. A key element in the success of the project was the development/extension strategy followed which not only emphasized simple technologies and easy to understand training methods but also focused on needs of specific target groups. Women`s groups played a big part in the focus and success of the project (FAO, 1988). In terms of breeding, the project bought the best male lambs sired by the selected rams from the flocks in the project to avoid unintentional selection for growth rate due to the tendency to first slaughter or sell the fastest growing male lambs. The groups were encouraged to sell their best three-month-old lambs to the project by a favorable selling price and by including this sale as an obligatory part of the ram contract. All other males in the flock had to be castrated at the age of 3 months. The selected male lambs were kept by the project until they were distributed at the age of almost 18 months to flocks distant from their flocks of origin to avoid inbreeding. To improve immediate profitability of new groups, the project, on contract, lend young ewes to them, to be paid back by the same number of young ewes (6-12 months old and $\geq$ 18 kg) within a period of 4 years, starting after one year.

An on-going sheep and goats project in south and south-east Asia using an integrated approach to the control of gastro-intestinal parasites with the aim of reducing mortality in young goats is purportedly successful (Kosgey, 2004). The underlying principles and approaches of the

project is that each country develops its activities in the most appropriate way, following a pathway that meets the local needs and conditions. A basket of technology option are introduced to the farmers revolving around worm control but holistic enough to include all aspect of goat production and health. Aware of their needs, farmers chose not just one technology mixed and matched options to fit their situations. Some have also been very keen in revising some recommendations to better fit the conditions and situations in the field, and the project has implemented some of these technologies. The breeding component of the technology has benefit well, for instant, in Vietnam good bucks of the adapted native goat breed (Bach thao) were provided to farmers to improve breeding in the focus farms. Farmers were informed on the negative effect of inbreeding and introduced to animal management and control breeding. For improvement in management, farmers needed to build houses. Farmers were sponsored 30% of the total value of the buck while very poor farmers were supplied with 100%. After two years bucks were transferred to other farms. All male kids' 5-months onwards were managed and grazed in separate areas. After two years the results of using the improved goat breed showed increased production in general (e.g., reduced mortality and increased growth rate). Farmers paid more attention to this option after seeing the results. It has shown a good impact on production in rural farms (Kosgey, 2004).

2.11.4 Failures of Programmes

This highlights the key points of failures of within-breed genetic improvement strategies for indigenous small ruminants in the tropics. It is important to concede that this criterion of failures could be contentious, considering there could be points of view – that of the farmer and that of the scientist and /or policy maker (Kosgey, Baker, Udo, and van Arendonk, 2006).

2.11.5 Nucleus Based Breeding Schemes

A breeding and improvement programme for the D`man sheep breed in Morocco was started in the late 1970`s, based on open nucleus scheme with the aim of conserving the breed, which was threatened by drought and mismanagement, and to evaluate its performance under improved management (Darfaoui, 2000). Selection programmes initiated were intended to maintain ewes prolificacy rate at high levels and increase lamb growth rate to the level of the remaining national breeds. In the design of the programme, the development agency ignored the non-organized farmers (≈ 90% of the total farmers) and therefore the farmers benefited very little from animals produced by the multipliers. Most breeding animals ended up in slaughterhouses or as sacrifices during religious or other ceremonies instead of improving non-organized farmers flocks. Lack of continual monitoring to determine the proportion of animals maintained in the multiplier level or disseminated to the non-organized farmers hindered the progress of the scheme. In addition, it is debatable if selection for high prolificacy was desired in an environment prone to droughts.

In Senegal a programme was initiated to increase the productivity of the local Sahelian breeds (Peul, Touabire) and the trypanotolerant Djallonke sheep in the semi-arid and sub-humid areas, so as to increase meat supply, and subsequently reduce import of sheep from neighbouring countries to celebrate religious ceremonies (Fall, 1999). Initially a nucleus flock was reared on a state-owned research station but later extend to village flocks to expand the selection base of Peul sheep. A top-down approach was used to establish breeding goals, i.e., breeding goals were set by government technicians through interpretation of national objectives to increase meat supply. Due to insufficient involvement of farmers, opinions on constraints imposed by the livestock production system were not taken into account. Consequently, involvement of village

flocks was not sustained. Shortage of financial and logistic resources contributed more to the un-sustainability of the project.

CHAPTER THREE

MATERIALS AND METHODS

3.1 STUDY SITES

The survey was conducted in some selected Local Government Areas (LGA) of Kano State. The selected LGAs were Shanono, Dawakin Kudu, Dambatta, Wudil and Bebeji. The State lies between longitude 9^{o} 30' and 12^{o} 30' north and latitude 9^{o} 30' and 8^{o} 42' east (KNARDA, 2001). The area has two distinct seasons; a wet season (May-Sept) and dry season (October-April). Annual rainfall and temperature ranges between 787 mm-960 mm and 21^{o}C and 39^{o}C, respectively (KNARDA, 2001).

3.2 SAMPLING PROCEDURE

A multistage sampling was adopted in this study. Five local government areas in Kano State namely Shanono, Dawakin kudu, Dambatta, Wudil and Bebeji (Figure 1) were purposively selected. Two villages were also purposively selected from each local government area. The Local Government Areas and the villages were selected based on their suitability for sheep production, market and road access and willingness of people to participate in the program. Thirty Five households that owned Sheep and willing to participate from each village were also purposively selected.

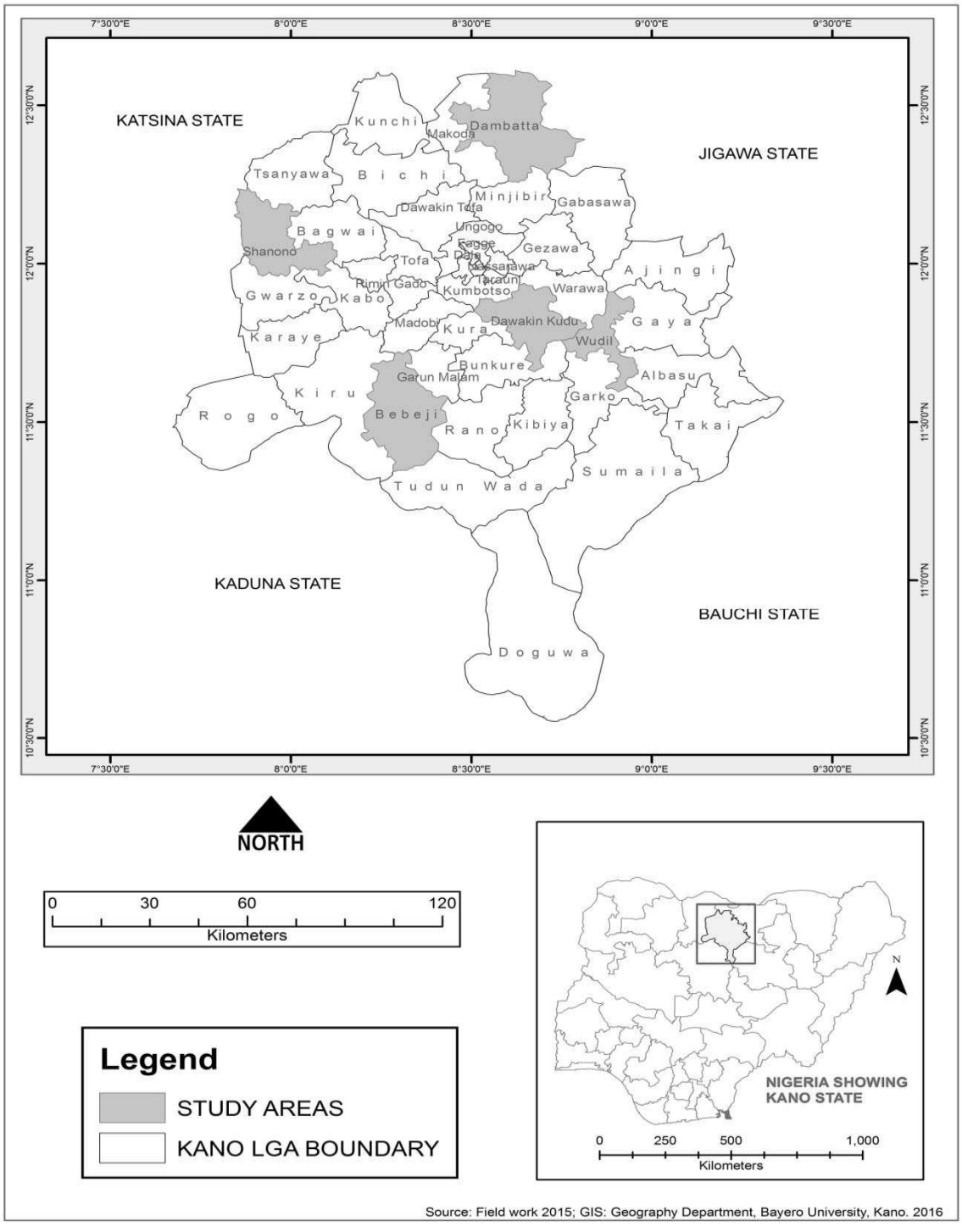

Figure 1: Map of Kano State showing the Location of Study Areas.

3.3 DATA COLLECTION

Before commencement of the actual interview with selected farmers, a reconnaissance tour was conducted and structured questionnaire was pre-tested on a small number of selected farmers from each site. Information from the pre-tested was used to improve the questionnaires. The questionnaire was used to obtain information on socio-economic characteristics of the households, breed and origin of sheep, flock size and structure, breeding objectives and practices, farmer trait preferences and selection criteria.

3.4 DATA ANALYSIS

Data collected from the five locations were analyzed using Statistical Package for Social Sciences (SPSS, 2007); Cross tabulation procedure was used to calculate the percentages of discrete variables, flock size and structure were presented mainly in the form of descriptive statistics and Chi-square test was employed to test the for the level of significance of flock sizes of the respondents.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1 Socioeconomic Characteristics of Sheep Owners Based on location

The socioeconomic characteristic of sheep owners in the study area are presented in Table 1. Three hundred and fifty households (seventy from each of five local government areas) participated in this work.

Gender

Bulk (94.28%, 87.14%, 81.43% and 55.71% in Dawakin kudu, Wudil, Shanono, and Dambatta) of the respondents was males with the exception of Bebeji in which the proportion of males was lower (38.57%).

Position of Respondents

Ownership of flock by household heads was more prominent in all the locations (72.86%, 67.14%, 57.14%, and 45.71% in Wudil, Dawakin Kudu, Shanono and Dambatta, respectively) with the exception of Bebeji where the proportion was lower (30.00%). Ownership by spouses was greatest in Bebeji (60.00%) followed by Dambatta (38.57%) , Shanono (15.71%), Wudil (12.86%) and Dawakin Kudu (5.71%), while the proportions of other members that owned sheep were higher in Shanono and Dawakin Kudu (27.14% each) compared to Dambatta (15.71%) Wudil (14.28%) and Bebeji (10.00%). Overall, the percentage of respondents that were household heads was the highest (54.6%) followed by housewives (26.6%) and those that were ordinary members of the household was the lowest (18.6%).

Age group

Majority of the respondents were within the age ranges of 15-30, 31-45 and greater than 45 years. Respondents with age range of 15-30 had the highest proportion in Dawakin Kudu

(38.57%), Shanono (35.71%), and Dambatta (34.28%) while Wudil and Bebeji had the lower proportion (17.14% and 15.71% respectively). Respondents that were within the age range of 31-45 were more rampant in Bebeji, Shanono, Wudil and Dawakin Kudu with proportions of 47.14%, 37.14%, 31.43% and 28.57% ,respectively, while Dambatta had the lowest proportion (22.86%). Those respondents that were within the age group of greater than 45 years were found to be larger in Wudil, Dambatta and Bebeji with proportions of 51.43%, 42.86% and 37.14% respectively but lower proportion of 28.57% and 24.28% was observed in Dawakin Kudu and Shanono respectively. Small proportions of respondents that were within the age group of less than 15 years were only found in Dawakin Kudu (4.28%) and Shanono (2.86%). Furthermore, comparing the age groups regardless of locations, majority (36.9%) of the respondents were above 45 years, followed by those that were 31-45, 15-30, and less than 15 years were the least, with proportions of 33.4%, 28.3% and 1.4%, respectively.

Marital status

In all the locations, respondents that were married were more than those that were not married with the highest proportion (90%) in Bebeji followed by Wudil (88.57%), Dambatta (80.00%), Dawakin Kudu (74.28%) and Shanono (68.57%). Overall, across the locations, respondents that were married had proportion of 80.3% while those that were singled had proportion of 19.7%.

Contact with extension agent

Those respondents that had no contact with extension agents were higher in Bebeji, Dambatta and Wudil with proportions of 65.71%, 65.71%, and 58.57%, respectively but lower in Shanono and Dawakin Kudu (32.86% and 48.57%, respectively). Similarly, across the locations,

the total proportion of those that had no contact with extension agents (54.3%) was greater than respondents that had contact (45.7%).

Occupation

The proportion of respondents that were farmers was higher in all the locations (58.57%, 55.71%, 44.28% and 42.86% in Wudil, Dambatta, Shanono and Dawakin Kudu, respectively) with the exception of Bebeji where their proportion was second to the highest proportion. Civil servants were more involved in sheep breeding in Shanono (31.43%) than in other locations (8.57%, 7.14%, 2.86% and 2.86% in Wudil, Dambatta, Dawakin Kudu and Bebeji, respectively). Respondents that were engaged in trading and kept sheep were more numerous in Dawakin kudu and Wudil with proportions of 32.86% and 18.57% respectively while lower proportions (8.56%, 7.14%, 2.86%) were recorded in Dambatta, Shanono and Bebeji ,,respectively.The proportion of student respondents was greater in Dawakin Kudu (20.00%) and Shanono (17.14%) but considerably lower in Dambatta (10.00%), Wudil (5.71%) and Bebeji (2.86%). Greater proportion of respondents that engaged in other activities (driving, fishing, house wife, building) were found in Bebeji (58.57%) and Dambatta (18.57%) while lower proportion was observed in Wudil (8.57%) and Dawakin Kudu (1.43%). Respondents in Shanono were not engaged in any other activity. Generally respondents that practiced farming as their sole occupation tended to be the majority (46.9%), followed by those that were engaged in other business activities (17.4%), traders (14.0%), students (11.1%) and civil servants (10.6%).

Educational Background

With the exception of Shanono where they had a comparatively lower proportion, respondents that had only Islamic education were more rampant than those with other educational backgrounds. The proportion was found to be 67.14%, 67.14%, 60.00%, 44.28%,

and 21.43% in Bebeji, Dambatta, Wudil, Dawakin Kudu and Shanono, respectively. The respondents that had tertiary education had the highest percentage in Shanono. The proportion was found to be 37.14%, 12.86%, 11.43%, 5.71% and 1.43% in Shanono, Dambatta, Wudil, Dawakin kudu and Bebeji, respectively. Similarly, respondents with secondary education were substantial in all the locations with Dambatta recording the lowest. The proportions were, 40.00%, 35.71%, 22.85%, 21.43% and 11.43% in Dawakin Kudu, Shanono, Bebeji, Wudil and Dambatta, respectively. Respondents with primary education were comparatively few in all the locations with proportion of 8.57%, 8.57%, 7.14%, 5.71% and 4.28% in Dawakin Kudu, Dambatta, Wudil, Shanono and Bebeji, respectively while respondents with no educational background were only found in Dawakin Kudu (1.43%) and Bebeji (4.28%). In general, there was greater proportion of respondents with Islamic education (52.0%), followed by those with secondary (26.3%), tertiary (13.7%), primary (6.9%) and none literates (1.1%).

Table 1: Socioeconomic Characteristics of Sheep Owners based on location

	Location					
Variables	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Gender						
Male	57(81.43)	66(94.28)	39(55.71)	61(87.14)	27(38.57)	250(71.4)
Female	13(18.57)	04(5.71)	31(44.28)	09(12.86)	43(61.43)	100(28.6)
PR						
Head	40(57.14)	47(67.14)	32(45.71)	51(72.86)	21(30.00)	191(54.6)
Spouse	11(15.71)	04(5.71)	27(38.57)	09(12.86)	42(60.00)	93(26.6)
Member	19(27.14)	19(27.14)	11(15.71)	10(14.28)	07(10.00)	66(18.6)
Age group						
< 15	02(2.86)	03(4.28)	0 (00)	0 (00)	0 (00)	05(1.4)
15 -30	25(35.71)	27(38.57)	24(34.28)	12(17.14)	11(15.71)	99(28.3)
31 -45	26(37.14)	20(28.57)	16(22.86)	22(31.43)	33(47.14)	117(33.4)
> 45	17(24.28)	20(28.57)	30(42.86)	36(51.43)	26(37.14)	129(36.9)
MS						
Married	48(68.57)	52(74.28)	56 (80.00)	62(88.57)	63(90.00)	281(80.3)
Single	22(31.43)	18(25.71)	14(20.00)	08(11.43)	07(10.00)	69(19.7)
CEA						
Yes	47(67.14)	36(51.43)	24(34.28)	29(41.43)	24(34.28)	160(45.7)
No	23(32.86)	34(48.57)	46(65.71)	41(58.57)	46(65.71)	190(54.3)
Occupation						
Farmer	31(44.28)	30(42.86)	39(55.71)	41(58.57)	23(32.86)	164(46.9)
C/servant	22(31.43)	02(2.86)	05(7.14)	06(8.57)	02(2.86)	37(10.6)
Trader	05(7.14)	23(32.86)	06(8.57)	13(18.57)	02(2.86)	49(14.0)
Student	12(17.14)	14(20.00)	07(10.00)	04(5.71)	02(2.86)	39(11.1)
Others	0 (00)	01(1.43)	13(18.57)	06(8.57)	41(58.57)	61(17.4)
EB						
Islamic	15 (21.43)	31(44.28)	47(67.14)	42(60.00)	47(67.14)	182(52.0)
Primary	04 (5.71)	06(8.57)	06(8.57)	05(7.14)	03(4.28)	24(6.9)
Secondary	25 (35.71)	28(40.00)	08(11.43)	15(21.43)	16(22.85)	92(26.3)
Tertiary	26 (37.14)	04(5.71)	09(12.86)	08(11.43)	01(1.43)	48(13.7)
None formal education	0 (00)	01(1.43)	0 (00)	0 (00)	03(4.28)	04(1.1)

SNN = Shanono, DKD = Dawakin kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji, PR= Position of respondent, MS= Marital status, CEA= Contact with extension agent, EB= Educational background n= number of respondents. The figure outside the parenthesis is the number of respondent. The figure in parenthesis is the proportion in percent.

4.1.2 Breed types owned by the respondents in the locations

The breed types as owned by respondents are presented in Table 2. Yankasa sheep were the most abundant in all the locations with proportion of 100%, 90.00%, 80.00%, 78.57%, and 77.14% in Bebeji, Wudil, Dawakin kudu, Shanono and Dambatta respectively. Uda breed was observed in Shanono, Dawakin Kudu, and Danbatta only with proportions of 2.86%, 5.71% and 2.86 respectively. Balami breed was only recorded in Dambatta with a proportion of 7.14%. The respondents that owned a combination of all the three breeds (Yankasa, Uda and Balami) in their flocks were also observed in all the locations with the exception of Bebeji where only Yankasa breed was observed. The proportion was 5.71%, 5.71%, 1.43% and 1.43% in Shanono, Dawakin Kudu, Dambatta and Wudil, respectively. In all the locations, some of the sheep owners had a combination of Yankasa and Uda breeds in their flock with the highest proportion observed in Shanono (10%) while Dambatta, Dawakin Kudu, and wudil had lower proportions of 5.71%, 4.28% and 4.28%, respectively, and none was found in Bebeji. Some of the famers owned a combination of Yankasa and Balami in the locations with the exception of Bebeji. The proportion was found to be 5.71%, in Dambatta which was the greatest followed by, Dawakin Kudu (4.28%), Wudil (4.28%) and the least proportion (2.86%) was found in Shanono. In general, respondents with Yankasa breeds were greater across locations with proportion of 85.1%, followed by those with Yankasa and Uda (4.9%), Yankasa and Balami (3.4%), those with all the three breeds (2.9%), those with Uda (2.3%) and those with Balami were the lowest (1.4%).

Table 2: Breed Types Owned by the Respondents in the Locations

	Locations					
Breed	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Yankasa	55(78.57)	56(80.00)	54(77.14)	63(90.00)	70(100.00)	298(85.1)
Uda	02(2.86)	04(5.71)	02(2.86)	0 (00)	0 (00)	08(2.3)
Balami	0 (00)	0 (00)	05(7.14)	0 (00)	0 (00)	05(1.4)
All	04(5.71)	04(5.71)	01(1.43)	01(1.43)	0 (00)	10(2.9)
Yks/uda	07(10.00)	03(4.28)	04(5.71)	03(4.28)	0 (00)	17(4.9)
Yks/blm	02(2.86)	03(4.28)	04(5.71)	03(4.28)	0 (00)	12(3.4)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, Yks= Yankasa, blm= Balami

4.1.3 Flock Size and Structure of Sheep Owned by Respondents in the Locations

The flock sizes and structure of surveyed sheep flocks in the five locations are presented in Table 3. Breeding ewes dominated breeding rams in each flock in all the locations with an overall ratio of 9:1, respectively. On location basis, the highest recorded numbers of breeding ewes (334) and breeding rams (94) were observed in Shanono with a ratio of 4:1 , followed by those of Dambatta with 254 breeding ewes and 63 breeding rams (4:1), Dawakin Kudu with a ratio of 4:1 (229 breeding ewes and 78 breeding rams), wudil (229 breeding ewes and 37 breeding rams) and Bebeji (174 breeding ewes and 23 breeding rams) both with a ratio of 9:1. In general, females represented approximately 64% of the total flock of sheep in the study areas, while males accounted for 36% (ratio of 3:2 of females to males), whereas breeding ewes and breeding rams accounted for about 38% and 5%, respectively of the total flocks.

The flock size of respondents significantly ($p < 0.001$) differed across location. Farmers that had sheep flock size ranging from 1 to 5 sheep were the highest across the location with a total number of respondents of 154 (44%). On location basis, for farmers that had 1-5 sheep in their flock, 57 were observed in bebeji, 37 in wudil, while 30, 19 and 11 were recorded in Dawakin Kudu, Dambatta and Shanono, respectively. Respondents with flock size ranging from 6-10 heads (which was 29.1% of the total population of respondents) were the next class in terms of number with significant ($p < 0.001$) variations across locations. The highest number of respondents in this category was observed in Dambatta (33) followed by Shanono (22), Dawakin kudu (20), Wudil (18) while Bebeji recorded the least. Farmers with size of sheep flocks ranging from 11 to 15 heads and numbered up to 50 (14.1% of the total number of respondents interviewed) were the next .Their average numbers varied significantly ($p < 0.001$) across the locations with 15 respondents as the highest record observed in Dambatta. This was followed by

Shanono (14 in number), Dawakin Kudu and Wudil (both with 9 respondents) while least number of respondent (3) that fall in this class was found in Bebeji. The number of famers that had more than 15 sheep in their flocks was 44 (12.6% of the total number of respondents) significantly ($p < 0.001$) varied across locations. The highest number of respondents in this class (23) was found in Shanono, followed by Dawakin Kudu (11), Wudil (6) Dambatta(3) and the least was recorded in Bebeji(1).

Table 3: Flock Size and Structure of Sheep Owned by Respondents in the Locations

	Location						
	DKD (n= 70)	SNN (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	TOTAL (n= 350)	X^2 VALUE
Flock Class							
1-5	30	11	19	37	57	154	
6-10	20	22	33	18	9	102	99.7***
11-15	9	14	15	9	3	50	
>15	11	23	3	6	1	44	
Breeding Ewe to Breeding Ram Ratio							
Breeding Ram	78	94	63	37	23	165	
Breeding Ewe	229	334	254	229	174	1220	
TOTAL	307	428	317	266	194	1385	
RATIO	4 :1	4 :1	4: 1	9:1	9:1	9:1	
Female to Male Ratio							
Female			2034				
Male			1141				
Total			3175				
Ratio			3 : 2				

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji, ***= P<0.001, n= Number of respondent, breeding ram = ram >12 months old, breeding ewe= ewe >12 months old, x^2 = chi-square

4.1.4 Breeding Practices of Sheep Owners in the Locations

The breeding practices of Sheep Owners in the Locations are shown in Table 4.The ratio of farmers that had no breeding ram at all, were greater in all the locations with the exception of Dawakin kudu. The overall ratio of those famers that had no breeding ram to those that owned one and those with more than one was found to be 5:3:2. The ratio was 5:2:3 in Shanono, 3:4:3 in Dawakin Kudu, 6:2:2 in Danbatta, 6:3:1 in Wudil and 7:2:1 in Bebeji.

The greater proportions of respondents that had their breeding ram from their own flock were found in Dawakin Kudu (72.86%) and Wudil (55.71%) while they had lower proportions in Shanono (38.57%), Dambatta (37.14%) and Bebeji (31.43%). Famers that had their breeding ram from their neighbor flock had higher proportions in Bebeji (68.57%), Dambatta (42.86%) Shanono (42.86%) and Wudil (40.00%), while the lowest proportion was recorded in Dawakin Kudu (20.00%).While the number of respondents that had their breeding ram (source) from market were lower in all the locations, yet the proportion was considerable in Dambatta (20.00%), and totally absent in Bebeji. Respondents that had their breeding ram from all the sources were only found in Shanono and Dawakin Kudu with proportion of 15.71% and 1.43% respectively. Irrespective of locations, the proportion of respondents that had their breeding ram from their own flock was the highest (47.1%) , followed by those that had it from neighbor flock (42.9%), from the market (6.6%) ,while those that obtained the rams from all the sources had the lowest proportion (3.4%).

Breeding and fattening purpose for keeping ram was given higher priority in all the locations except in Wudil were the proportion was the lowest. The highest proportion was recorded to be 90% in Dawakin Kudu, followed by Bebeji with 82.86%, Shanono (77.14), Dambatta (52.86%) and Wudil (35.71%) while famers that were keeping ram for the purpose of

breeding and socio-cultural reason were only found in Shanono, Dawakin Kudu and Dambatta with little proportion of 7.14%, 2.86% and 5.71%, respectively. The reason for keeping ram for the purpose of all the reason stated above (breeding, fattening and socio-cultural) was greater by the respondents of wudil with proportion of 64.28% but lower in all the locations. The proportion was recorded to be 41.43%, 17.14%, 7.14%, and 3.1% in Dambatta, Bebeji, Dawakin kudu and Shanono, respectively. Similarly, across the locations, respondent that kept ram for breeding and fattening were greater in proportion (67.7%), followed by those that kept it for breeding, fattening and socio-cultural reason (29.1%) and those that kept it for breeding and socio-cultural reason where the lowest (3.1%).

Table 4: Breeding Practices of Sheep Owners in the Locations

		Location					
Breeding Practice.	**Variable**	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
Ram possession	NONE	35(50.00)	23(32.86)	40(57.14)	39(55.71)	52(74.28)	189(54.2)
	1	16(22.86)	27(38.57)	13(18.57)	23(32.86)	13(18.57)	92(26.28)
	> 1	19(27.14)	20(28.57)	17(24.28)	08(11.43)	05(7.14)	68(19.8)
	RATIO	5: 2 : 3	3 : 4 : 3	6 : 2 : 2	6 : 3 : 1	7 : 2 : 1	5 : 3 : 2
Source of Breeding ram	OF	27(38.57)	51(72.86)	26(37.14)	39(55.71)	22(31.43)	165(47.1)
	NF	30(42.86)	14(20.00)	30(42.86)	28(40.00)	48(68.57)	150(42.9)
	MKT	02(2.86)	04(5.71)	14(20.00)	03(4.28)	0 (00)	23(6.6)
	All	11(15.71)	01(1.43)	0 (00)	0 (00)	0 (00)	12(3.4)
	RATIO	4 : 4 : 0 : 2	7 : 2 : 1 : 0	4 : 4 : 2 : 0	6 : 4 : 0 : 0	3 : 7 : 0 : 0	5 : 4 : 1 : 0
Purpose of keeping ram	BF	54(77.14)	63(90.00)	37(52.86)	25(35.71)	58(82.86)	237(67.7)
	BS	05(7.14)	02(2.86)	04(5.71)	0 (00)	0 (00)	11(3.1)
	All	11(3.1)	05(7.14)	29(41.43)	45(64.28)	12(17.14)	102(29.1)
	RATIO	8 : 1 : 1	9 : 0 : 1	5 : 1 : 4	4 : 0 : 6	8 : 0 : 2	7 : 0 : 3

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, OF = own flock, NF = neighbor flock, MKT = market, BF = breeding and fattening, BS = breeding and socio-cultural, all ratios are in ascending order.

4.1.5 Purpose of Keeping Sheep in the Locations

The purposes of keeping sheep by farmers in the study area are presented in Table5. Majority (38.0%) of the respondents across the locations kept sheep as a means of savings with greater proportions in Bebeji (92.86%) and Dambatta (42.86%), while lower proportions were recorded in Wudil (24.28%) and Shanono (21.43%). However, an exceptionally lower proportion (8.57%) was observed in Dawakin Kudu. The second highest objective of rearing sheep across locations was to gain all the advantages (savings, socio-cultural reasons, manure, meat and commercial) with an overall proportion of 30.0% .Location wise, the highest proportion was found in Shanono (48.57%), and Wudil (48.57%), while Dambatta, Dawakin Kudu and Bebeji had lower proportions of 37.14%, 14.28% and 2.86%, respectively. The next purpose in ranking is the overall percentage of farmers that kept sheep solely as business (27.1%) with the largest proportion of respondents in Dawakin Kudu (75.71%) followed by Shanono (27.14%) while lower proportions were observed in Wudil (17.14%), Dambatta (11.43%) and Bebeji (4.28%). The overall proportion of those respondents that kept sheep for socio- cultural reasons was only 4.0% with Wudil recording the highest proportion (10.0%) followed by Dambatta, Shanono and Dawakin Kudu with proportion of 5.71% , 2.86% and 1.43% respectively, while Bebeji had none. Farmers that kept sheep as a source of manure only and those that kept them as source of meat for home consumption only, were found in Dambatta only with proportion of 1.43% each within the location, and overall percentages of 0.3 each.

Table 5: Purpose of Keeping Sheep in the Locations

Purpose	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n=350)
commercial	19(27.14)	53(75.71)	08(11.43)	12(17.14)	03(4.28)	95(27.1)
Meat	0 (0)0	0 (00)	01(1.4.3)	0 (00)	0 (00)	01(0.3)
Manure	0 (00)	0 (00)	01(1.43)	0 (00)	0 (00)	01(0.3)
SC	02(2.86)	01(1.43)	04(5.71)	07(10.00)	0 (00)	14(4.0)
Savings	15(21.43)	06(8.57)	30(42.86)	17(24.28)	65(92.86)	133(38.0)
All	34(48.57)	10(14.28)	26(37.14)	34(48.57)	02(2.86)	106(30.0)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, SC = socio-cultural,

4.1.6 Trait Preferences for Breeding Purpose of Sheep Owners in the Locations

Trait Preferences of sheep owners in the locations are presented in Table 6. Adaptability and feed shortage resistance was the most preferred trait in all the locations with the largest proportion in Bebeji (100%) followed by Dawakin Kudu (84.28%),Wudil (82.86%), Shanono (81.43%), and Dambatta (77.14%). The percentage of respondents who considered resistance to disease as the most important trait was greatest in Dambatta, followed by that of Shanono and wudil with proportions of 4.28%, 2.86% and 2.86% respectively, while the least proportion was found in Dawakin Kudu (1.43%) whereas Bebeji had none. The highest proportion of farmers that preferred body size were found in Dambatta (10%) followed by Shanono (4.28%), Wudil (4.28%), and Dawakin Kudu (2.86%), while Bebeji recorded the least (0.0%). Farmers that preferred prolificacy as the choice trait were only recorded in Dawakin Kudu with a proportion of 1.43%. Respondents that preferred longevity were only found in Dambatta with proportion of 4.28% and those that preferred fast growth were recorded in Dambatta, Dawakin Kudu, and Wudil with proportions of 2.86%, 1.43% and 1.43% respectively. The proportion of farmers that considered all the traits as important was greatest in Shanono (11.43%), followed by Dawakin Kudu (8.57%) and Wudil (8.57%), while Dambatta had the lowest (1.43%) and Bebeji had none. Generally, majority (85.14%) of the respondents preferred sheep with high level of adaptability and feed shortage resistance.

Table 4.1.6: Trait preference for breeding purpose of sheep owners in the locations

Trait	Location					
	SNN (n= 70)	DKD (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	TOTAL (n=350)
AFSR	57(81.43)	59(84.28)	54(77.14)	58(82.86)	70(100.00)	298(85.14)
RD	02(2.86)	01(1.43)	03(4.28)	02(2.86)	0 (00)	08(2.3)
Body size	03(4.28)	02(2.86)	07(10.00)	03(4.28)	0 (00)	15(4.3)
Prolificacy	0 (00)	01(1.43)	0 (00)	0 (00)	0 (00)	01(0.3)
Longevity	0 (00)	0 (00)	03(4.28)	0 (00)	0 (00)	03(0.9)
Fast growth	0 (00)	01(1.43)	02(2.86)	01(1.43)	0 (00)	04(1.1)
All	08(11.43)	06(8.57)	01(1.43)	06(8.5.7)	0 (00)	21(6.0)

AFSR= Adaptability and feed shortage resistance, RD = Resistance to disease, SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji.

4.1.7 Breeding Practice of Sheep Owners in the locations

Table 7 presents the breeding practices of sheep owners in the selected locations. Most of the farmers in Shanono and Dambatta practiced controlled breeding with proportions of 61.43% and 68.57%, respectively, while the least proportions were found in Dawakin Kudu (37.14%), Wudil (20.00%) and Bebeji (7.14%).Those respondents that practiced uncontrolled breeding were greater in Bebeji (92.86%), followed by Wudil (80.00%), Dawakin Kudu (62.86%) and lower proportion as recorded in Shanono (38.57%) and Dambatta (31.43%). Irrespective of location, the percentage of respondents that were not controlling the breeding activities in their flocks was higher (61.14%) compared to those that practiced controlled breeding (38.86%).

For those farmers who practiced controlled breeding methods differed across locations with Dambatta having the proportion 66.66% that practiced tethering as a method of control, Shanono (67.44%), Dawakin Kudu (65.38%), Wudil (100%) and Bebeji (100%) as shown in Table 7. Those that practiced castration as a method of control were found to proportion in Dawakin Kudu (23.08%), followed by Dambatta (10.42%) and Shanono (2.32%) while Wudil and Bebeji respondents did not practice castration at all. Similarly only famers of Dambatta, Shanono and Dawakin Kudu practiced culling in controlling breeding with proportions of 22.92%, 23.25% and 11.54% respectively. Considering the whole locations, those respondents that practiced tethering were the highest in proportion (71.32%), followed by those that practiced culling (17.65%), castration (8.82%) whereas those that practiced other methods of control had the lowest proportion (2.21%).

Farmers awareness of inbreeding and its effects in the locations is also presented in Table 4.1.7, with Shanono, Dawakin Kudu, Dambatta and wudil having the proportions of those that were aware being 92.86%, 62.86%, 55.71% and 91.43%, respectively. In contrast, the proportion

of those that were aware about inbreeding in Bebeji was less than those that were not aware, being 38.57% and 61.43%, respectively.

Table 7: Breeding Practice of Sheep Owners in the locations

Variable	Location					
	SNN	**DKD**	**DBT**	**WDL**	**BBJ**	**TOTAL**
	(n= 70)	(n= 70)	(n= 70)	(n=70)	(n= 70)	(n= 350)
Breeding practice						
Controlled	43(61.43)	26(37.14)	48(68.57)	14(20.00)	05(7.14)	136(38.86)
Uncontrolled	27(38.57)	44(62.86)	22(31.43)	56(80.00)	65(92.86)	214(61.14)
Control method	(n=43)	(n=26)	(n=48)	(n=14)	(n=05)	(n=136)
Tethering	29(67.44)	17(65.38)	34(66.66)	14(100)	05(100)	97(71.32)
Castration	01(2.32)	06(23.08)	05(10.42)	0 (00)	0 (00)	12(8.82)
Culling	10(23.25)	03(11.54)	11(22.92)	0 (00)	0 (00)	24(17.65)
Inbreeding awareness	(n=70)	(n=70)	(n=70)	(n=70)	(n=70)	(n=350)
Aware	65(92.86)	44(62.86)	39(55.71)	64(91.43)	27(38.57)	239(68.28)
Not aware	05(7.14)	26(37.14)	31(44.28)	06(8.57)	43(61.43)	111(31.71)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji

4.1.8 Selection Criteria for breeding ram and breeding ewe in the Location

Selection Criteria for breeding ram and breeding ewe in the locations were presented in Tables 8a and 8b respectively. Traits like body size, coat texture, head morphology and body shape, mating ability, tail shape, and other traits were all considered as important in both of the locations and given due emphasis in selecting breeding rams. Among selection criteria considered, body size (ram that had large body) was the major trait for selecting breeding rams by majority of the respondents in all the locations with the exception of Shanono. The proportion was highest in Dawakin Kudu (95.71%) followed by Bebeji (85.71%), Wudil (51.43%), Dambatta (44.28%) and the lowest was found in Shanono (22.86%). Head morphology (long and somewhat droopy ears, wide set noses, curved horns and long face) and body shape (long withers height and heavy weight at maturity, body frame and tall back) had the highest proportion (65.71%) by respondents of Shanono while in other locations it was also given due emphasis in selecting breeding ram with high proportions in Dambatta (42.86%), Wudil (24.28%) and lower proportions in Bebeji (10.00) and Dawakin Kudu (2.86%). Coat texture was only considered by few farmers in only Wudil, Dambatta, and Bebeji with proportions of 11.43%, 1.43% and 1.43%, respectively while mating ability was considered by few respondents in only Shanono (2.86%) and Wudil (2.86%). Those that considered all the traits were only found with little proportions in Shanono (5.71%) and Wudil (2.86%) while those respondents that considered other less frequently mentioned desirable traits like shape of the testicles (either compact or pendulous) were observed also in small proportions in Dambatta (8.57%), Wudil (7.14%) and Shanono (2.86%). Generally, the highest overall trait of consideration while selecting breeding rams across the locations is body size (60.00%), followed by head morphology and body shape (29.1%), with the remaining traits being in smaller proportions.

Body size was the major selection criteria in all the location for selecting breeding ewes. The highest proportion of respondents that selected their breeding ewe based on body size was recorded in Dawakin Kudu (100%), followed by Bebeji (97.14%), Shanono (87.14%) and Dambatta (87.14%) while Wudil had the lowest (47.14%). A small proportion of respondents that preferred coat texture were found in Wudil, Dambatta and Shanono with proportions of 15.72%, 2.86% and 2.86% respectively. Mothering ability was also used by small proportion of respondents in Shanono (4.28%) and Bebeji (2.86%) whereas lambing interval was only recorded in Dambatta with little proportion (2.86%).Those respondents that used twinning as a criterion for selecting breeding ewes were only found in Wudil but in small proportion (2.86%).Farmers that used all the traits as selection criteria were also found in Shanono (2.86%), Dambatta (7.14%) and Wudil (1.43%).

Table 8a: Selection Criteria for Breeding Ram in the Locations

Selection criteria	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
Body size	16(22.86)	67(95.71)	31(44.28)	36(51.43)	60(85.71)	210(60.0)
Coat texture	0 (00)	0 (00)	01(1.43)	08(11.43)	01(1.43)	10(2.9)
HMBS	46 (65.71)	02(2.86)	30(42.86)	17(24.28)	07(10.00)	102(29.1)
Mating ability	02(2.86)	0 (00)	0 (00)	02(2.86)	0 (00)	04(1.1)
Tail shape	0 (00)	01(1.43)	02(2.86)	0 (00)	02(2.86)	05(1.4)
All	04(5.71)	0 (00)	0 (00)	02(2.86)	0 (00)	06(1.7)
Others	02(2.86)	0 (00)	06(8.57)	05(7.14)	0 (00)	13(3.8)

HMBS= Head morphology and body shape, SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji..

Table 8b: Selection Criteria for breeding ewe in the Locations

Selection criteria	Location					
	SNN (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
Body size	62(88.57)	70(100)	61(87.14)	56(80.00)	68(97.14)	317(90.57)
Coat texture	02(2.86)	0 (00)	02(2.86)	11(15.71)	0 (00)	15(4.28)
Mothering ability	03(4.28)	0 (00)	0 (00)	0 (00)	02(2.86)	05(1.43)
Age at first lambing	01(1.43)	0 (00)	0 (00)	0 (00)	0 (00)	01(0.28)
Lambing interval	0 (00)	0 (00)	02(2.86)	0 (00)	0 (00)	02(0.57)
Twinning	0 (00)	0 (00)	0 (00)	02(2.86)	0 (00)	02(0.57)
All	02(2.86)	0 (00)	05(7.14)	01(1.43)	0 (00)	08(2.28)

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji

4.1.9 Flock Improvement Methods of Sheep Owners in the Locations

Table 9 presents the flock improvement activities of the sheep owners in the selected locations. Improvement methods were higher across locations with those improving their flock by crossing with local breeds having higher proportion within locations in Dawakin Kudu (79.59%), Wudil (66.66%) Shanono (60.94%), Dambatta (53.49%), and Bebeji had none. The highest proportion of respondents that cross with exotic breeds were recorded in Dambatta (11.63%), followed by Bebeji (33.33%), Dawakin Kudu (2.04) and Shanono (1.56%).The higher proportion of famers that practiced line breeding within locations were recorded in Bebeji (66.66%), followed by Dambatta (34.89%), Shanono (29.69%), Wudil (27.27%), and Dawakin Kudu (16.32%). Little proportion of the respondent in Shanono (7.81%) and Wudil (6.06%) employed all the three methods and were not found in other locations. In the total study locations, respondents that cross with local breeds were higher in proportion (64.4%) followed by those that practiced line breeding (27.75%), crossed with exotic (4.19%) and those that employed all the three methods (3.66%).

Furthermore, the proportion of those involved in genetic improvement of their flocks was higher than those that were not in Shanono, Dawakin Kudu, and Dambatta with proportions of 91.43%, 68.57%, 61.43%, respectively. However, the reverse was the case in Wudil and Bebeji, where the proportions of those not involved in any form of breeding technique were higher, being 52.86% and 95.71%, respectively.

Table 9: Flock Improvement and Improvement Method of Sheep Owners in the Locations

	Location					
Flock improvement	**SNN** (n= 70)	**DKD** (n= 70)	**DBT** (n= 70)	**WDL** (n= 70)	**BBJ** (n= 70)	**TOTAL** (n= 350)
YES	62(91.43)	48(68.57)	43(61.43)	33(47.14)	03(4.28)	191(54.57)
NO	06(8.57)	22(31.43)	27(38.57)	37(52.86)	67(95.71)	159(45.43)
Improvement method						
Cross with exotic	01(1.43)	01(1.43)	05(7.14)	0 (00)	01(1.43)	08(2.3)
Cross with local	39(55.71)	39(55.71)	23(32.86)	22(31.43)	0 (00)	123(35.4)
Line breeding	19(27.14)	08(11.43)	15(21.43)	09(12.86)	02(2.86)	53(15.3)
All the 3 methods	05(7.14)	0 (00)	0 (00)	02(2.86)	0 (00)	07(2.0)

SNN = Shanono, DKD = Dawakin Kudu, DBT = Dambatta, WDL = Wudil, BBJ = Bebeji

4.2 Discussion

4.2.1 Socio-economic Characteristic of Respondents

The majority of respondents were engaged full-time in other income-generating activities (crop farming, civil servants, trading and other petty businesses) in the locations, indicating that sheep keeping is a secondary activity. It is noteworthy that majority of sheep owners in the study location were predominantly males with the exception of Bebeji in which females were the majority due to the fact that this location had more characteristics of rural areas were by male where engaged in arable crop farming and other business activities and leaving small ruminants rearing for female which was also observed by Jaitner, Sowe, Secka-Njie, Dempfle (2001). This observation agrees with reports from Adesehinwa, Okunola, and Adewumi (2004) in Southwestern Nigeria; Dossa, Sangaré, Buerkert, and Schlecht, (2015) in Kano, Nigeria, Bobo Diaoulasso, Burkina Fasso and Sikasso, Mali; Baah, Tuah, Addah and Tait (2012) from Ghana; Lawal-Adebowale (2012) in various cities in Nigeria and Kagira and Kanyari (2010) from Kenya, which indicated that sheep farmers in these parts of Africa were predominantly males. However, earlier studies from rural areas in West Africa (Jaitner, Sowe, Secka-Njie and Dempfle, 2001; Dossa, Rischkowsky, Birner and Wollny, 2008; Smith, Sones, Grace, MacMillan, Tarawali and Herrero, 2013) found small ruminant keeping to be closely associated with women as was also observed in the present study in Bebeji. This may reflect the transformation of rural small ruminant keeping from a subsistence activity associated with women to a commercially viable enterprise in which men dominate as was similarly observed with respect to urban gardening sector by Freidberg (2001) in Bobo Dioulasso, Burkina Fasso and Wooten (2003) in Bamako, Mali.

The fact that majority of sheep owners were between the ages of 15 and 45 years indicates that rural sheep keepers were mainly people of middle age. This finding is in agreement with that of Dossa, Sangaré, Buerkert and Schlecht (2015) who found that the average age of small ruminant owners was 44 years in urban cities of Kano, Bobo Dioulasso and Sikasso in West Africa. On the other hand, Adesehinwa, Okunola and Adewumi (2004), reported that about 50 percent of sheep owners in South-Western Nigeria were between 51 and 60 years.

The greater proportion of sheep owners of older ages in Dambatta and Wudil compared to Shanono, Dawakin Kudu and Bebeji is indicative of a higher potential for improved management practices in Shanono, Dawakin kudu and Bebeji considering the fact that young people are generally more receptive to innovations and new technologies than old ones (Adesina, Mbila, Nkamleu and Endamana, 2000). Furthermore, by considering the important functions of insurance and economic security of sheep, the relatively young age of sheep owners irrespective of location, and the important number among them who engaged in this activity for many years, it can be argued that this activity will continue to flourish in the surveyed areas and probably elsewhere in rural areas of Kano State.

4.2.2 Flock Size and Structure:

The fact there were higher numbers of female animals than males in all the locations could be due to the fact that mature males were sold or used during the Eid el-Kabir festival as Kano State is a predominantly Muslim state. Similarly, the fact that there were more breeding ewes than breeding rams in all locations could also be due to this reason, as well as because keeping more of breeding ewes will increase their flock size after the festival. This observation was also made by Fsahatsion, Melesse and Banerjee (2013) in Gamogofa Zone, Southern Ethiopia, which they attributed to the prevalent practice of keeping growing ewes as

replacements for breeding purpose while rams were sold when money is needed, during festivals or slaughtered during ceremonies. A similar flock structure was observed in Menz sheep by Getachew *et al.* (2010) where breeding ewes were dominant.

4.2.3 Breed types owned by the respondents in the locations

The fact that most farmers kept the Yankasa breed was similarly observed by Hassan, Mbap and Naibi (2015) in Lafia LGA of Nasarawa State. This could be because Yankasa sheep are easily reared on free–range, less costly, in addition to the fact that the study area is a suitable ecological environment for the breed. The exorbitant price of the Balami sheep could also be a good reason for the few number of respondents that owned the breed. However some of the sheep farmers tended to keep animals of improved genotypes, mainly crossbred; alternatively several genotypes (some of which were brought from Sudan and Mali while some of the famers Combined Balami, Uda and Yankasa in their flock) were kept in the same flock by some of the farmers in the locations with the exception of Bebeji where only Yankasa sheep were kept. This practice could reflect the market and non-market preferences for improved and non-local breeds of sheep which are influenced by both culture and religion (Brisebarre and Kuczynski, 2009).

4.2.4 Purpose of keeping sheep and farmers trait of preferences

Breed and trait preferences are useful to make better informed decisions in developing interventions to improve the contribution of sheep to livelihoods of their keepers (Tassew, Kefelegn, Yoseph and Bosenu, 2014). Adaptability and feed shortage tolerance were given higher emphasis in selecting replacement stocks in the locations. The fact that farmers in the study areas kept sheep mainly as source of cash income is because it can be immediately sold for quick cash at the local markets (Judith, 2006) and had short generation interval and require low initial capital.

The results of this research revealed the multi-functionality of sheep among rural dwellers in the five locations, whereby their financial functions were ranked as of paramount importance. This finding is consistent with what was stated in other studies by Touré and Ouattara (2001), Ajala, Lamidi and Otaru (2008) and Baah, Tuah, Addah and Tait (2012) in selected urban communities in Côte d'Ivoire, Nigeria and Ghana, respectively. Similar findings were made by Judith (2006) and Gizaw (2008), who observed that cash income source and insurance were the principal objectives why barley farmers also keep the animals in a sheep-barley system. However reports by Thys and Ekembe (1992) and Lawal-Adebowale (2012) indicated that urban small ruminants were mainly raised for home consumption. The remarkable variations of the breeding purpose across locations observed in the current study are likely to be related to differences in social and economic contexts. For example, the objective "Sale of live animals for extra cash during Eid el-Kabir" for sheep production was of higher importance in Dawakin Kudu compared to the other locations, probably because it is nearer to Kano city as compared to the rest and therefore easier to access markets in the city which had higher proportion of Muslims and thus higher demand for sheep during the occasion. The objective of keeping sheep as a way to save money was of higher importance in Dambatta and Bebeji. This could be related to the fact that there were higher proportions of female respondents in these locations due to the fact that these locations had more characteristics of rural areas where by male were engaged in arable crop farming and other business activities and leaving small ruminants rearing for females which was also observed by Jaitner, Sowe, Secka-Njie and Dempfle, 2001, and Female of the rural areas were more accessible by the researcher due to religion issues. Female sheep owners save money in form of sheep because it can be sold for immediate cash when needed as explained by Judith (2006).

4.2.5 Breeding Management

Most of the respondents were keeping ram for the purpose of breeding and fattening in all the locations, indicating their primary objective which was for sales and savings and also shows the improvement of rural sheep owners from subsistence to commercial sheep farming which will in turn increase their commercial status and improve their standard of living.

Those farmers who did not own breeding rams indicated that they use neighboring rams or their ewe mate with breeding rams from other flock during grazing. Some of the respondents attributed the absence of breeding rams in their flocks to the fact that the rams were sold during the Eid el-Kabir festival. By doing so however, they were unintentionally selecting against fast-growing desirable genotypes with remarkable features and large body sizes.

Since there were no controlled breeding practices by most of the respondents, rams which were not sold because of poor growth and conformation had the best chances to mate with females in the flocks thus increasing their gene frequencies.

The fact that used rams for breeding either born in their flocks or from neighboring flocks may result in reduction of genetic diversity and probably increased rate of inbreeding and its related consequences.

4.2.6 Breeding practice and Selection criteria

Taking into consideration the small flock sizes, the low practice of castration, especially among sheep farmers, and the complete lack of keeping breeding records, the selection of replacement animals from within the flock as observed among the surveyed farmers represents a high risk of inbreeding of which they were probably not aware or they were aware but do not have any means to prevent it.

Farmers in study areas were well experienced in selection of future breeding ewes and rams from their own flocks, market or neighbor flocks of sheep. Almost all the farmers in the locations practiced selection. Males were selected at 8.87 months to 9.0 months. The corresponding figures for females were 7.93 to 10.21 months. As revealed by the results of the current study, irrespective of locations and breeds, replacement animals were selected mainly on the basis of their general appearance and conditions. However if farmers are encouraged to keep records, it will enable farmers to shift from the current practice to a selection of better performing animals for replacement, based on pedigree information and breeding performances. The lower proportion of breeding rams and rams (less than a year) as compared to other age categories and lower practicing of castration as compared to tethering and other control methods could probably be explained by the objectives among sheep farmers irrespective of locations, and this is due to the fact that a ram for "Eid al-Kabir" (the Islamic festival of sacrifice) needs to be intact, i.e. not castrated. The complete lack of breeding males in several sheep flocks is also associated to the above reason stated. In all the locations ram lambs were kept to select future breeding ram.

Although certain beliefs regarding raising and/or eating meat of animals of certain coat color are widespread across many West African societies (Brisebarre and Kuczynski 2009) and elsewhere in Africa (Gwaze *et al*. 2009), they were given little emphasis among respondents in all the locations and could be explained by cultural differences across Nigeria and Africa in general. Some of the respondents were selecting their breeding rams on the basis of their desirable traits such as consideration of the testicles where they preferred rams with compact testicles and avoiding those with pendulous testicles due to their reason that the former had greater mating ability. Those farmers that considered head morphology preferred rams with long

and somewhat droopy ears, wide set noses, curved horns and long face, large heads and large horns, explaining that these rams had more market value and were good looking.

When selecting female replacement animals on the basis of their mothering abilities, farmers showed a strong preference for reproductive traits such as fertility and prolificacy irrespective of breed and location. This reflects the farmers' general objective which was to increase flock size and overall flock productivity.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The study was conducted in five selected Local Government Areas of Kano State, namely Shanono, Dawakin kudu, Danbatta, Wudil and Bebeji to assess the traditional breeding practices and selection criteria for indigenous sheep breeds and identify aspects of traditional sheep breeding to be improved based on farmers' trait preferences. Purposive sampling technique was employed to select 350 farmers (71.43% of which were males) from five locations (two villages from each location). A structured questionnaire and focused group discussions were used to generate the required data. Sheep were kept for a variety of reasons including income generation, economic security (savings) and social/religious functions. Farmers reared sheep primarily for income generation. Female animals represented approximately 64% of the total flock of sheep in the study areas and male animals accounted for 36% (ratio of 3:2 of female to male). Breeding ewes dominated Breeding rams in each flock in all the locations with overall ratio of 9:1, respectively. The flock size of respondents was significantly ($p < 0.001$) differ across location. Famers that had sheep flock size ranging from 1 to 5 sheep were the highest across the location with total number of respondents of 154 which was up to 44% followed by Respondents with flock size ranging from 6-10 heads (which was 29.1% of the total population of respondents), those with 11 to 15 heads and numbered up to 50 which makes 14.1% of the total number of respondents, famers with more than 15 (>15) sheep in their flock and had 44 as the total number of respondents accounted for 12.6% of the total number of respondents .The predominant breed of sheep in all locations was Yankasa while the least prominent was the Balami. Keeping crossbred animals and/or maintaining more than one genotype in the same flock was practiced by

few of the respondents. The reason for breed preference by most of the farmers was adaptability and feed shortage resistance. Although a considerable proportion (68.28%) of the respondents indicated awareness of inbreeding, mating was predominantly uncontrolled (61.14%). Body size, head morphology and body shape and appearance were the most frequently reported traits in selecting breeding rams across the locations; whereas body size was mentioned as the trait given due emphasis in choosing future breeding ewes. Majority (54.3%) of the respondents had no contact with extension agents while some of them explained that health related issues were basically areas where they benefited from visits by extension agents. None of them received any guidance related to genetic improvement strategies of their flocks.

These findings provide evidence that preferential selection of breeding animals is a common practice among rural sheep farmers, mainly because of the high cultural and economic values of sheep. This leads to the hypothesis that irrespective of the locations, sheep farmers would be more interested to adopt improved breeding practices and to participate in the development and implementation of carefully designed genetic and breeding improvement programme.

5.2 CONCLUSION

Sheep have multipurpose functions for the livelihoods of rural people in Kano, even though they are predominantly kept for financial and cultural reasons. Rural sheep keeping is dominated by men in most of the study areas indicating its significance as a major source of income. In all the locations, the predominant sheep reared were of the Yankasa breed, while the least prominent breed was the Balami. However, keeping crossbred animals and/or maintaining more than one genotype in the same flock was practiced by few sheep keepers. The reason for breed preference by most of the farmers was adaptability and feed shortage resistance. Breeding

ewes dominated flocks in all the locations, while more than half of the respondents had no breeding rams. Mating was predominantly uncontrolled, although a considerable number of the respondents knew about inbreeding. Body size, head morphology , body shape and appearance were the most frequently reported traits in selecting breeding rams across the locations; whereas body size was mentioned as the trait given due emphasis in choosing future breeding ewes. Majority of the respondents had no contact with extension agents, while none of them was aware of any existing breeding program aimed at improving sheep productivity in the study area. Due to poor sheep breeding practices, there is a possibility of inbreeding and loss of productive animals. There is therefore the need for a planned sheep breeding system which will take into account the socio-economic norms, existing breeding practices, selection criteria and trait preferences of the farmers in the communities.

5.3 RECOMMENDATION

1. Farmers should be encouraged to keep other breeds of sheep apart from Yankasa in order to increase biodiversity.
2. Awareness should be created among farmers on the need to retain superior rams for breeding rather than sell them indiscriminately during festivities.
3. Farmers should be educated about the implications of inbreeding and the need for controlled mating.
4. A planned community based sheep breeding program which will take into account the socio-economic norms, existing breeding practices, selection criteria and trait preferences of the communities should be implemented.

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Appendix 1: Sample Questionnaire

ACCESSMENT OF TRADITIONAL BREEDING PRACTICES AMONG SHEEP OWNERS IN SOME SELECTED LOCAL GOVERNMENT AREAS OF KANO STATE.

(Household Questionnaire)

2015

SECTION A:

GENERAL INFORMATION

1. LGA ----------

2. Name of village ----------
3. Household number
……
4. Name of the respondent ----------
5. Position of respondent in the household. Head [ ] spouse [ ] member [ ]
6. Date of the interview ----------

SECTION B:

SOCIOECONOMIC CHARACTERISTICS OF RESPONDENT

1. Gender: male [ ] female [ ]
2. Age: <15 [ ] 15-30 [ ] 31-45 [ ] > 45 [ ]
3. Ethnic group: …….
4. Marital status: married [ ] single [ ]
5. Household size: < 5 [ ] 5-10 [ ] > 10 [ ]
6. Number of adults in the household: male……. Female…….
7. Contact with extension agent, NGO or researcher: Yes [ ] No [ ]
8. Occupation: farmer [ ] civil servant [ ] trading [ ] student [ ] others ……
9. Educational background: None [ ] primary [ ] secondary [ ] tertiary [ ] Adult education [ ] Islamic education [ ]

SECTION C:

QUESTIONS ABOUT FLOCK MANAGEMENT AND BREEDING PRACTICES OF SHEEP OWNERS

1. Which breed do you keep? Yankasa [ ] Uda [ ] Balami [ ] all of the above [ ]

Yankasa and uda [ ] yankasa and balami [ ] Balami and Uda [ ]

2. What is the structure of your flock?
   Total flock size…….
   Ram lamb (<6 months old)……...
   Ram (6-12 months old)……..
   Breeding ram (>12 months old)…….
   Castrates (older than 1 year)…….
   Ewe lamb (<6 months old)…….
   Ewe (6-12 months old)……..
   Breeding ewe (>12 months old)……..
3. What is your objective for keeping sheep?
   a. Sale(income source) [ ]
   b. Meat [ ]
   c. Manure [ ]
   d. Social and cultural reasons [ ]
   e. Savings [ ]
   f. All [ ]
4. Why do you keep your breed of preference? Adaptability and feed shortage resistance[ ] resistance to diseases [ ] body size [ ] meat [ ] prolificacy [ ] feed shortage resistance [ ] coat color [ ] longevity [ ] fast growth [ ] all [ ] others [ ]
5. What type of breeding do you practice? Controlled [ ] uncontrolled [ ]
6. If you practice control breeding, how do you control it? Tethering [ ] castration [ ] culling [ ] others ……
7. Are you aware about inbreeding? Yes [ ] no [ ]
8. Are you improving your flock? Yes [ ] no [ ]
   9. If yes, which method do you employed? Crossing with exotic breed [ ] Crossing with local breed [ ] Line breeding [ ] All [ ]
10. What are your selection criteria for breeding ram? Body size [ ] Coat color [ ] Head morphology and body shape [ ] Ear length [ ] Fast growth [ ] Mating ability [ ] Tail size and shape [ ] all [ ] others [ ] (specify)----------
11. What are your selection criteria for breeding ewe? Size [ ] Coat color [ ] Mothering ability [ ] Age at first lambing [ ] Lambing interval [ ] Twining [ ] Tail size and shape [ ] Longevity [ ] all [ ] others [ ] (specify) ----------
12. How many breeding rams do you own? Having no breeding ram [ ] Having one breeding ram [ ] having more than one ram [ ]
13. What is your source of breeding ram? own flock [ ] Neighbor flock [ ] Market [ ] all [ ] others [ ] (specify)----------
14. What is your purpose of keeping ram? breeding and fattening [ ] Breeding only [ ] Breeding and socio-cultural reasons [ ] All the 4 aspects are important [ ]