INFLUENCE OF SEASON ON MILK YIELD AND MILK COMPOSITION OF RED SOKOTO GOATS IN MUBI AREA OF ADAMAWA STATE, NIGERIA.

By

ALEXANDER MIDAU (B.Tech., M.Tech. FUTY)
M.Tech/AS/06/0091

BEING A THESIS SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE AND RANGE MANAGEMENT, FEDERAL UNIVERSITY OF TECHNOLOGY YOLA, IN PARTIAL FULFILMENT FOR THE AWARD OF M.Tech DEGREE IN ANIMAL PRODUCTION AND RANGE MANAGEMENT.

June, 2010

DECLARA

I hereby declare that this thesis presents original work written by me and has never been done before in the study area, it has not been presented before in previous application for a higher degree, it is a record of my own original research work.

……..

…….

Alexander Midau Date

(Student)

CERTIFICATION

This is to certify that this thesis titled "**Influence of Season on Milk yield and Milk composition of Red Sokoto (RS) goats in Mubi Area, Adamawa State, Nigeria"** by Alexander Midau (M.Tech/AS/06/0091) meets the requirements for the award of the degree of Masters of Technology (M.Tech) Degree in Animal Production and Management.

…… ……
Prof. A. Kibon Date
Major Supervisor

…… ……
Prof. C. Akosim Date
Internal Examiner

…… ……
Prof. I.S.R. Butswat Date
External Examiner

…… ……
Dr. M.B. Ardo Date
Head of Department

…… ……
Prof. A. Nur Date
Dean School of Post Graduate

DEDICATION

This research is dedicated to the ALMIGHTY GOD, my Parents, Brothers and Sisters, my Wife (Rifkatu) and my little Son and Daughter (Churchill and Christabel), and friends, whom in many ways contributed to this great achievement I Sincerely thank you.

ACKNOWLEDGEMENT

My sincere appreciation goes to my supervisors Professor A. Kibon, Professor. M.S. Yahaya and Professor C. Akosim for their help and

guidance from the beginning to the end of this research work. My thanks also go to the Head of Department Dr. M.B. Ardo and all the lecturers and staff of Animal Science and Range Management Department, FUT Yola. I sincerely wish to acknowledge Adamawa State University and its management for the great support given to me financially, morally and otherwise, I am pleased to say thank you. My appreciation also goes to all staff of Animal Production Department Adamawa State University especially the former H.O.D Dr. S.M. Moruppa and the present Head of Department, Dr. A.A Mubi, for their support during the course of this great achievement. My wife and my Children (Churchill and Christabel), I am saying thank you for your patience, during the toil which you missed me so much. I'm also indebted to Mr. Hassan Sule of Crop Production Department Adamawa State University, who assisted me in carrying out the statistical analysis, Mr. Abubakar Idris, which is one of the farmers that allowed me to use his animals for this research. My sincere thanks to my class mates whom we run together to this success and finally to my family friends that have contributed during this study.

ABSTRACT

The study was conducted to determine the yield, composition, consumption and level of acceptability of goat milk in Mubi area of Adamawa State. Purposeful, multistage and random sampling techniques

were used to select forty (40) lactating Red Sokoto does in wet and dry season in 2008, within Mubi area for the study. One hundred and fifty (150) structured questionnaires were randomly distributed to sampled farmers, to determine the level of consumption and acceptability of goat milk. The results showed that, the management systems were the seasonally confined and cut and carry systems, 10.4% of the respondents use goat milk and 89.6% of the respondents do not use goat milk for any purpose, reasons for non-consumption were based on; not drinkable, milk odor, small quantity of the milk obtained from the goats. Composition of milk were, 4.84, 17.86, 13.42, 0.17, 0.22, 0.14, 0.13 % and 2.08kg/week for fat, total solid, solid non fat, cholesterol, calcium, magnesium, phosphorus and milk yield in the dry season respectively. The mean values, 5.01, 16.58, 11.79, 0.18, 0.29, 0.15, 0.14% and 3.38kg/week for fat, total solid, solid non fat, cholesterol, calcium, magnesium, phosphorus and milk yield in the wet season respectively. Milk yield was significantly ($P<0.001$) affected by season. Fat, total solid, solid non fat were significantly ($P<0.001$) affected by parity. There was seasonal variation ($P<0.05$) on calcium, total solid and solid non fat content of the milk. Parity and season had no effect on cholesterol, magnesium and phosphorus. The composition of milk studied was comparable to the reported values of exotic breeds found in other countries. Although the milk yield is not comparable to the exotic breeds, its composition were similar; it was also found that goat milk utility was low.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE

1.0 INTRODUCTION

Adamawa state is divided into four pastoral blocks based largely on similarities in ecological conditions; they are Toungo, Jada-M/Belwa, Benue trough and Hong-Michika. Mubi area falls within Hong-Michka block; this block is estimated to have about 1.09 million goats (Adebayo and Tukur, 1999)

A goat which was known as "Wet nurse of infant" in United Kingdom and "Poor man's cow" in India was the first animal to be domesticated (Zeuner, 1963). The animal has been neglected all over the world, mostly in tropical countries like Nigeria. Goats contribute to the subsistence of small holder and landless rural poor. They are mainly kept for meat. Goat milk, skins and manure are often considered as by-products. Meat production is the main reasons for keeping goats in Nigeria (Payne, 1990).

Their milk is rarely used for human consumption. However there is a lot of information about the unique importance of goat milk for human nutrition and health (Parkash and Jenness, 1968; Haenlein, 1992). It is particularly rich in antibodies and low in bacteria count especially when freshly drown (Belanger, 1975), and sometimes recommended by the physician in the treatment of many human ailments such as hyperlipoproteinemia, intestinal reaction, coronary bypass, childhood epilepsy, cystic fibrosis, gallstones etc. (French, 1970; Haenlein, 1992).

While composition of goat milk in temperate countries has been extensively studied and reviewed (Jenness, 1980; Haenlein, 1992) little has been done in the tropics.

Goats play important role in income generation, capital storage, employment generation and improving house hold nutrition. Goat milk is easily digestible because of smaller sized fat globules making softer curd (Banerjee, 1998). It also has much less allergic problems than milk of other species of livestock (Banerjee, 1998). Goat can be milked as often as required, preventing milk storage problems. Goats are less prone to toxic effect of shrubs as judged by clinical symptoms. They have high dry matter and fibre digestibility and thus can subsists on poor woody vegetation which no other specie will consume (Banerjee, 1998).

Although there is similarity between cattle, goats, sheep and buffaloes in the genetics of milk production, there is evidence that on live weight basis, goat is more efficient milk producer than the other species (Malau-Aduli *et al.,* 2001). Goat also has higher feed conversion efficiency to meat and milk than cow, sheep and buffaloes (Okello and Obwolo, 1985).

There is also less risk in goat farming especially in drought prone areas, higher capacity of flock size recovery because of their higher prolificacy, fewer requirements in housing and management (Banerjee, 1998).

Globally goat production yields 60% of its value as milk, 35% as meat and 5% as skin (Davendra and Mcleroy, 1988; Malau-Aduli *et al*., 2001). Webster (1989) reported that countries like Iraq and Libya obtain half of their total milk requirements from goats.

1.2 Statement of Problem

Nigeria's population is growing at three percent per annum; urbanization at four percent; and, average increase in dairy consumption is five percent (Uche, 2006). Nigeria's market for imported dairy products is estimated at 240,000 metric tons, valued about $600 million (The Economist Intelligent Unit, 2005). From all indications, the supply of dairy products has consistently failed to catch up with demand over the last decade. Nigeria remains a net importer of dairy products due to declining livestock sector, growing population, increasing urbanization and wider use of dairy products ingredients. More emphasis has been placed on cow milk. Supply from other animals such as sheep, goats and camels are negligible. (Ibeawuchi and Dalyop, 1995).

1.3 Justification

Milk forms an important quality protein for humans, its composition and quality are important attributes that determine the nutritive value and acceptability (Zahraddeen, *et al.,* 2007). Most Nigerians consume far less than the recommended minimum daily animal protein requirement (Awotwi and Fynn, 1992).

Goats are prolific and multipurpose animals that thrive better in difficult conditions than other species of domestic livestock (FAO, 1980; Williamson and Payne, 1984; National Livestock Development Centre Lagos, 1984). A report has shown that apart from poultry, goats are the most numerous when compared to other domestic livestock species in Nigeria (Upton, 1985). Therefore goat milk if accepted will augment the protein requirement of the growing population. This study will serve as a source of awareness on the composition and nutritive value of goat milk.

1.4 Objectives of the study;

1. To determine the influence of season on milk yield and milk composition of Red Sokoto goat in Mubi area.
2. To assess the fat, total solid, solid non fat, cholesterol, calcium, phosphorus and magnesium values of the Red Sokoto goats' milk within Mubi area.
3. To determine the level of acceptability and consumption of goat milk in Mubi North and Mubi South Local government areas.

CHAPTER TWO

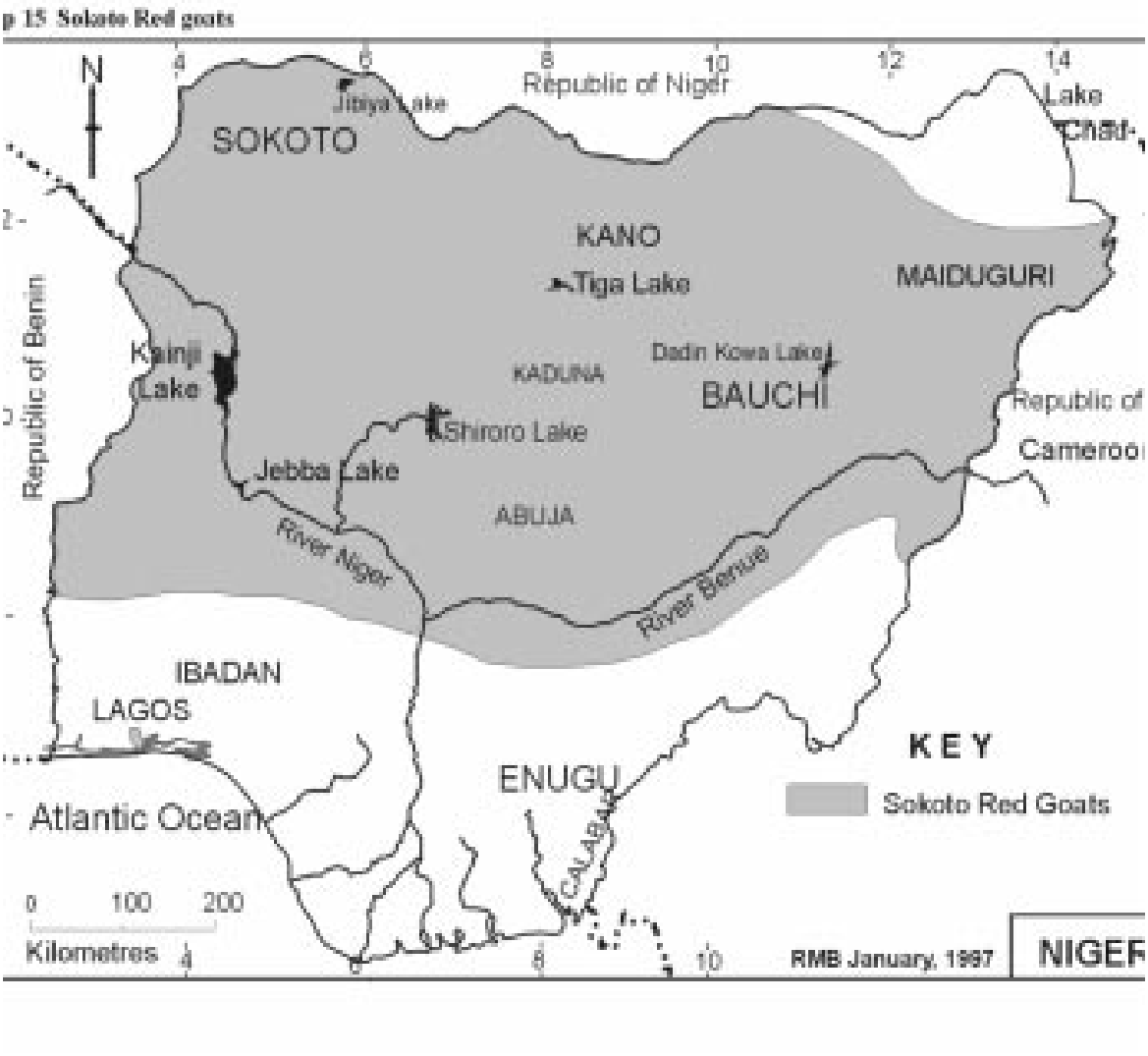
2.0 LITERATURE REVIEW

2.1 Goats breeds, population and distribution in Nigeria;

The only published characterization of the traditional breeds of goat in Nigeria is Ngere *et al*. (1984). Three main breeds of goat are recognized in Nigeria, the Sahel, Desert or West African long-legged goat, the Red Sokoto and the West African Dwarf. The Red Sokoto, is the most important goat breed in Nigeria, accounting for about 70% of the estimated 34.5 million goats in Nigeria (Osuhor *et al.,* 1998). The Red Sokoto, are sometimes referred to as Kano Brown or Maradi goat, is probably the most widespread and well-known type in Nigeria (Haumesser, 1975). It is the usual village goat in the northern two-thirds of the country (Fig 1.0), although it is less common with transhumant pastoralists. Ngere *et al.* (1984) argued that populations of the Red Sokoto spread south and east from Sokoto through the savanna belts giving rise to the Kano Brown and, further east.

The Sahelian or Desert goat is found along the northern border of Nigeria, particularly in Borno, although Mason (1988) uses 'Sahel', which seems appropriate, as this race is distributed from Senegal to Sudan. In Nigeria the Sahel goat is generally the breeds preferred by pastoralists.

Fig. 1.0 Map showing the distribution of Red Sokoto goats in Nigeria



Although the West African Dwarf (WAD) goat is found in 'many local types' (Ngere *et al.,* 1984), no published account differentiates them. Although they are stereotypically said to be native to the forest belts, their presence in Borno State and in adjacent Republics of Cameroon and Chad suggests that they were far more widespread until recently. They correspond to the West African Grassland Dwarf described for Cameroon by Ndamukong *et al.* (1989). Indeed, like Muturu cattle, they may once have been the main race of goat over most of Nigeria Just as the Zebu has

replaced the Muturu, so WAD goats have been driven to remote areas in the savannahs.

2.2 Milk yield and milk composition of local and exotic breeds.

In Nigeria the indigenous cattle has been the major source of meat and milk supply. Anon (1990) reported that the annual collectable milk from the national herds was approximately 555,000 tones and this might not have changed much.

Table 1.1 below shows the estimated human population and annual demand for and supply of milk from the national herds, given by the livestock Sub-sector review report number 102/92 CP-NIR 49 SR 5/8/92 from the year 2000 to 2005.

Table 1.1 Estimated human population and annual demand for and supply of milk from the Nigeria national herds, 2000 to 2005.

Year	Human population ($x10^6$)	Demand (t)	Supply (t)
2000	110.0	990,000	495,479
2001	112.75	1,014,750	515,291
2002	115.56	1,040,004	535,911
2003	118.45	1,066,050	557,347
2004	121.42	1,092,780	579,641
2005	124.45	1,120,005	606,827

Source: Livestock Sub-sector Review Report No: 102/92 CP-NIR 49 SR 5/8/92.

However there is growing awareness of the importance of goats as a source of milk for human consumption (Malau-Aduli *et al.,* 2001). Mc Donald and Low (1985) reported that in some tropical and temperate countries, the Anglo-nubian, Jamnapari, Saanen, Toggenburg, Lamancha, Alpine, Oberhasli, and few other breeds are used for milk production.

Existing work on milk yields of Nigerian goats has been confined to research stations and it has not been practical to measure the productivity of traditionally managed goats. Off-take is somewhat irregular in such goats, as the sale of milk is not commercialized in a standard way. Information was published on the milk yield and composition of Nigerian goats (Red Sokoto) and the result obtained was compared with standard figures for European goats. Milk yield of 3.8 litres/week, fat 4.75% and protein 3.83% (Ehoche and Buvanendran 1983), for Red Sokoto goats. Adu *et al.* (1979) reported mean weekly yield of 3.3 litres/week. Akinsoyinu *et al.*(1982), reported 3.3 litres/week, milk composition dry matter 15.7% , fat 4.6%, protein 4.7%, and energy 3.8 MJ/kg, as compared to European dairy goats which produce 15.4 litres/week, 13.2 dry matter, fat 4.5, protein 3.3 and energy 3.0 MJ/Kg. It is likely that yields for pastoral goats are lower than the value for station livestock.

Goat milk is more widely produced than sheep milk, and globally goats' production yields 60 per cent of its value as milk, 35 percent as

meat and 5 per cent as skin (Davendra and Mcleroy 1988; Malau-Aduli *et al.,* 2001). Webster (1989) reported that countries like Iraq and Libya obtain half their total milk requirement from goats. Although there is similarity between cattle, goats, sheep and buffaloes in the genetics of milk production, there is evidence that, on live weight basis the goat is much more efficient milk producer than the other species (Malau-Aduli *et al*., 2001).Goat has also higher feed conversion efficiency to meat and milk than cow sheep and buffaloes (Okello and Obwolo, 1985). Milk composition and quality are important attributes that determine the nutritive value and consumer acceptability (Zahraddeen *et al.,* 2007). Malau-Aduli *et al.* (2001) reported that goat milk yield and composition are affected by breeds, age, stage of lactation, season and plane of nutrition. Barnet and Fredrick (2000) showed that goat milk contains more fat and ash than cow milk. However as infant food, it is nearly as high in vitamin B6 and twice in vitamin B12 as human milk. They also reported that vitamin A in goats' milk exists exclusively in its true form and not as carotenoid pigments. Egbowon *et al.* (2005) reported the level of protein to be higher in the dry season than that of wet season; the fat recorded in the dry season was higher than the wet season and more in the younger does.

2.3 Ruminant feed resources and their management systems;

The reproductive patterns in goats indicate that mass losses

in non-pregnant adult goats were higher during the wet season (Ikwegbu and Ofodile, 1992). In contrast report on the reproductive pattern of cattle, is reported to be higher during the dry season (Steinbach and Bologun, 1972; Lamorde and Weinmann, 1992). Concentrates supplementation had a positive effect on the reproductive performance of goats (Awotwi and Fynn, 1992). Concentrates supplementation tended to significantly increase fertility (Guessous *et al.,* 1989).

Inadequate feeding is another major limiting factor to small ruminant production in tropical Africa. Fodder is of poor nutritional value for most of the year due to the rainfall pattern. In the arid and semi-arid zones, rainfall is less than 600 mm and between 600-1000 mm per year, respectively. The management systems are nomadic, transhumant pastoralism, agropastoral, village system, and cut and carry system. In some cases animals have to trek long distances in search of fodder and water. The quality of available forage is low and browse species, which can provide higher levels of proteins and carbohydrates, are sparsely dispersed. In the subhumid zones, up to six months of the year can be rainless, resulting in poor quality forages. The rapid buildup of cell-wall materials and decline in crude protein (CP) content with maturity reduces the nutritional value of the forages. This is particularly true of the arid, semi-arid and subhumid areas, where 75% of the sheep and 80% of the

goats of tropical Africa and where the rangeland is the most important source of food (Ademosun, 1988).

A variety of grasses and legumes have been used to improve pastures and high yields have been recorded. Under station conditions a yield of 20 tonnes of dry matter per hectare (DM/ha) has been obtained with *Pennisetum purpureum* in the humid zone of Nigeria (Sumberg, 1985). Under ranching conditions, with systematic clearing of woody vegetation, Jahnke, (1982) reported a yield of 6 tone DM/ha with *Cynodon dactylon.* Tropical grasses are generally low in Crude Protein content. As they grow, the lignin content and other cell-wall materials build up rapidly, adversely affecting digestibility. Studies have shown that the use of a grass such as *Panicum maximum* or *Cynodon nlemfuencis* alone is not adequate to allow optimum production in sheep and goats (Ademosun *et al.,* 1985). The use of browse and other feed sources have proved satisfactory. Browses such as *Gliricidia septum* and *Leucaena leucocephala* have been successfully used for small ruminant production systems in alley farms and intensive feed gardens (Ademosun, 1988).

Besides the use of browse, other strategies can be employed to improve the feeding of animals. During the dry season, the quality of available herbage is so low that, unless the animals have access to supplementary feeds, they lose weight and therefore low productivity.

These supplementary feeds can be obtained from agro-industrial by-products such as residues of oil extracted from oil-bearing seeds (groundnuts, coconut, palm kernels, cotton seed, soyabean etc), by-products of grain processing (maize, rice, wheat, sorghum, millet etc), peelings of crops (yams, cassava, potatoes, plantains etc) and industrial by-products (brewers' dried grains, fruit cannery by-products, molasses etc). The types and quantities available tend to be location and season specific.

The feeding quality of the rangelands in semi-arid and subhumid areas can be improved by oversowing the natural grassland with legumes. This has been successful in the subhumid zone of Nigeria (ILCA, 1984). The legume of choice has been *Stylosanthes.* The ILCA work was with cattle but could be useful for small ruminants. Crop residues also provide good alternative feeds in the dry season. Their feeding value and DM production can be improved if the crops are planted with forage legumes, with the selection of the appropriate legume.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Location of the Study

Mubi Area (Mubi North and Mubi Nouth Local Government Areas) lie within Northern Guinea Savannah zone of Nigeria and located at latitude10°00 north, longitude 13°30 east and about 305 meters above sea level, with an area of 961.39 km^2. The dry season in this area commences early October and last up to April. The wet season begins from May and attains its peak between July and August, and declines in September; the mean annual rainfall is 1050 mm. The relative humidity is extremely low 20-30%between January and March and start increasing as from April and reaches a peak of about 80% in August and September, the relative humidity starts to decline from October following the cessation of rains. The maximum temperature can reach 40°C particularly in April while minimum temperature is about 18°C between December and January. The varieties of livestock include cattle, sheep, goats and pigs. The dwarf goats are the most common breeds (Adebayo and Tukur, 1999).

Mubi area consisting of twenty-one political wards, eleven wards in Mubi North and ten wards in Mubi South, with a population of about151,072 in Mubi North and 128,937 in Mubi South local government areas (National Population Commission, 2006). Mubi is bounded to the South by Maiha local government area to the West by

Hong Local Government Area and to the North by Michika Local Government Area and to the East by Cameroun republic. The people are predominantly farmers. Most households keep various livestock species.

3.2 Sampling Techniques

Purposeful, multistage and random sampling techniques were used, to select 280 farmers in the selected wards, out of which 150 farmers were served with a structured questionnaire to determine the consumption and acceptability of goat milk. Forty lactating Red Sokoto does, 20 in the dry season (January-April, 2008) and 20 in the wet season (June – September, 2008), were selected within Mubi area to determine the milk yield and its composition.

3.3 Collection of Milk Samples and Analysis

Goat milk samples were collected from the two local government areas, in the dry and wet seasons, during the year 2008. During milk collection, the does were adapted to a regime of placing concentrate feed in their respective pens to lure them, the udder and teats of each doe were washed with lukewarm water and cleaned with cotton wool soaked in disinfectant and then they were hand-milked into previously sterilized containers and measured. Milk yield was measured for 12 weeks from each doe after kidding except for the first 3 days postpartum. The sample was stored in a deep freeze before analysis. The entire content was then evaluated for the following; total solid, solid non fat, fat, cholesterol,

calcium, phosphorus and magnesium levels, these were determined according to the standard procedures described by A.O.A.C **(**Association of Official Analytical Chemists, 1990). The minerals (Phosphorus, Calcium and Magnesium) were determined by Atomic Absorption Spectrophotometer (AAS**).**

3.4 Milk Analysis

3.5 Moisture content determination

The AOAC (1990) oven drying method was used. 5g of each sample was measured with Petri dishes of known weights in triplicates. The samples were placed in the oven at 103˚C for 3 hours after which they were removed, cooled, in a desiccator and reweighed. The samples were returned for another 30 minutes, cooled and reweighed again. The reheating, cooling and reweighing continually repeated until constant weight was obtained for each of the samples.

$$\% \text{ Moisture content} = \frac{\text{loss of weight on drying}}{\text{Initial weight of sample}} \times \frac{100.}{1}$$

3.6 Lipid content determination

The Wener schmid method as described in Pearson's chemical analyses of foods (Egan *et al.,* 1981) was used. 10g of milk weighed into a test tube and 10ml of concentrated hydrogen chloride (conc. HCL) added and immersed in boiling water until all the casine were dissolved. At this stage, the mixture was brown in colour and the fat were seen and

collected on the surface, the tube was cooled in running water. The fat were extracted by shaking with 30ml of diethyl ether and blow the extract, after allowing the layers to separate into weighed flask; separation was often aided by the addition of little alcohol. The extraction was repeated 3 times and distils off the solvent. Then the fat was dried at 100°C, the fat was dissolved in light petroleum (b. Pt. 40 - 60°C) and shaken vigorously for 30 seconds then separation was complete.

$$\% \text{ Fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times \frac{100}{1}$$

3.7 Total Solid (T.S.)

The gravimetric method as reported by Egan *et al.* (1981) was used. Ten (10g) of the sample was placed into a metal dish with a close fitted lid of known weight. The uncovered dish was placed on a boiling water bath for 30 minutes until most of the moisture was driven off. Then the bottom of the dish wiped and was transferred to a well-ventilated oven at 100°C. The lid was placed next to the dish in the oven. It was dried for two and half hours in the oven and then the dish was covered with the lid, was then cooled for 30 minutes in desiccators and weighed. The dish and lid was heated for repeated one-hour interval, cooling and reweighing until the loss in weight before successive weighing did not exceed 0.5mg.

$$\% \text{ Total solid} = \frac{\text{Final weight}}{\text{Original weight of sample}} \times \frac{100}{1}$$

3.8 Solid Non Fat (S.N.F).

This was determined by weight difference.

%SNF = %T.S - %Fat

3.9 Calcium, Phosphorus and Magnesium were determined by using Atomic Absorption Spectrophotometer (AAS).

AAS contains the following, the atomic absorption unit has four basic parts; interchangeable lamps that emit light with element specific wavelengths, a sample aspirator, a flame or furnace apparatus for volatizing the sample, and a photon detector.

The milk solution was digested with concentrated sulphuric acid, a specific lamp was chosen that produces a wavelength of light that is absorbed by the element, the sample solutions were then aspirated into the flame, and the ions of the given element in the flame absorbed the light produced by the lamp before they reached the detector. The amount of light absorbed depends on the amount of the element that were present in the sample. Absorbance values were then compared to the calibration curves prepared by running known samples.

3.1.0 Statistical Analysis

All data generated were subjected to analysis of variance using GenStat 7.2.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Milk yield

The milk yield obtained in Table 2.2 and 3.3, in the study was 3.38 and 2.08kg per week in wet and dry season respectively. It was observed that the milk yield is higher ($P<0.001$) in the wet season. This may be due to the availability of forages in the wet season, which was lower in the dry season, the effect of parity were not significant on milk yield in the wet season as shown in Table 2.2 and the same result obtained in dry season Table 3.3, as parity has no significant effect on the milk yield.

Table 2.2 Milk yield and composition (Red Sokoto goat milk) in the Wet season.

Contents %	Mean	Minimum	Maximum
Milk yield/kg/week	3.40	2.80	4.00
Fat	5.01	3.05	6.40
Total solid	16.58	11.00	21.10
Solid non fat	11.79	6.20	16.21
Cholesterol	0.18	0.13	0.27
Calcium	0.30	0.20	0.40
Magnesium	0.15	0.11	0.17
Phosphorus	0.14	0.11	0.16

n=20

This values are comparable to the previously reported values of 3.8 litres per week (Ehoche and Buvanendran, 1983), 3.3 litres per week (Adu *et al.,* 1979), 3.3 litres per week (Akinsoyinu *et al.,* 1981) and lower than 3.7 kg per week (Alawa and Oji, 2008), but higher than 1.6 kg per week

obtained by Sankey, (1991) from does of the same breed (Red Sokoto goats).

Table 3.3 Milk yield and composition (Red Sokoto goat milk) in the Dry season

Contents %	Mean	Minimum	Maximum
Milk yield/kg/week	2.08	1.26	2.85
Fat	4.84	3.01	6.20
Total solid	17.86	14.94	20.55
Solid non fat	13.42	11.01	16.76
Cholesterol	0.17	0.13	0.27
Calcium	0.22	0.11	0.30
Magnesium	0.14	0.10	0.16
Phosphorus	0.13	0.11	0.16

(n=20)

The milk yield is low compared to the values reported for European breeds of 1.9 kg per day (Morand-Fehr and Sauvant, 2006).

4.2 Milk fat

The milk fat obtained in this study were 5.01 and 4.84% in wet and dry season respectively, the difference was not significant. Fat showed significant difference ($P< 0.001$) with parity effect as shown in Table 4.4. The values obtained were similar to the values of 5.04 and 4.94 reported by Zarhraddeen *et al.* (2007).

Table 4.4 Effect of Parity on milk yield and Composition

Wet season									
Parity	Milk yield	Water	TS	Fat	SNF	Choles	Cal.	Mag	Phos
1	3.30	86.10	13.90	3.63	10.27	0.20	0.28	0.14	0.14
2	3.53	84.76	15.24	4.69	10.55	0.18	0.30	0.16	0.14
3	3.38.	82.07	17.93	5.13	12.81	0.17	0.31	0.14	0.13
4	3.30	80.77	19.23	5.59	13.54	0.17	0.27	0.15	0.13
Dry season									
Parity	Milk yield	Water	TS	Fat	SNF	Chol	Cal.	Mag	Phos
1	1.84	82.67	17.34	3.68	13.65	0.17	0.23	0.15	0.12
2	1.96	83.70	16.30	4.45	11.86	0.16	0.21	0.14	0.14
3	2.34	81.68	18.41	5.16	13.05	0.18	0.19	0.12	0.14
4	2.19	80.62	19.38	6.08	14.50	0.17	0.21	0.14	0.14

n=40

TS=Total Solid, SNF=Solid Non Fat Chol=cholesterol, Cal=Calcium, Mag=Magnesium, Phos=Phosphorus

This study have shown that, the mean value of fat was lower in the dry season and higher in the wet season, this might be in relation with lower temperature during the raining season, it also shows that fat content tends to increases as parity increases Table 4.4, this might be due to increase in age and body weight which favors fat deposition.

4.3 Total solid and solid non fat (SNF)

The values of solids-non-fat and total solids in this study, were 11.79 and 16.58%, wet season, 13.42 and 17.86% dry season respectively, the effect of season is significant ($P<0.05$) and significant ($P<0.01$) with effect of parity in the dry season, these values are similar to the values obtained, 11.4 and 17.1%, respectively (Alawa and Oji, 2008), but also higher than the previously reported lower values of 10.53 and 15.83% by Mba *et al.* (1975), 13.63 and 0.73% by Sankey (1991). The values were higher in the dry season, the effect of parity was significant on total solid ($P<0.001$).

4.4 The mineral content

There were no significant differences in the values of the minerals obtained in this study with parity. The values of calcium found in this study was 0.22 and 0.29% in dry and raining season respectively, the significant difference in calcium ($P<0.001$) caused by seasonal effects might not be unrelated to the nutritional level in the raining season. These values are comparable to the value 0.20%, obtained by Alawa and Oji (2008). Magnesium values were 0.14 and 0.15% in dry and wet season respectively, which are also comparable to 0.14% (Alawa and Oji, 2008).

The values obtained for phosphorus were 0.13 and 0.14% in the dry and wet season, the influence of season and parity was not significant, 0.13%, (Alawa and Oji, 2008), obtained for same breed in the dry season

(Red Sokoto goat) was in agreement with the value obtained in this study in the dry season.

4.5 Cholesterol level

Cholesterol values obtained in this study were 0.17 and 0.18% in the dry and wet season respectively; research on Red sokoto goat milk cholesterol level seems unavailable, an average of 0.14% for European goats breed. But in comparison with cow milk the cholesterol level in Red Sokoto goat milk obtained in this study was slightly higher than the average value 0.15%, for European breeds of cattle (Chicama, 2009). An average cholesterol level in human milk 0.20% is higher than the values for both goat and cow milk. "Low-cholesterol" means the food contains 20 mg cholesterol or less per 100g. American Heart Association (2009) recommends that, average daily cholesterol intake of less than 300mg, if you have heart disease, up to 400mg for healthy persons.

4.6 Goat milk consumption

Results from Table 5.5 shows the reasons for keeping goats, about 86.8% of the farmers produce for income, 12.5% for household meat supply, and 0.69% for ceremonial reasons.

Table 6.6 shows the result of those who milk their goats for different purposes viz; for consumption 4.2%, those for sale 1.39% while 4.9% use it for medicinal and other purposes, a total of 10.4% uses the milk, and 86.9% do not milk or use the milk. The result of Table 6.6 also revealed

that 70.8% do not consume goat milk at all, 23.6% do not consume because of the little quantity of the milk obtained from the goats which is not enough to be consumed, therefore is an indication that such group of people would likely consume the milk if the quantity of the milk might have been increased; Based on odor about 1.39% do not take goat milk. The low yielding potentials of our local goats might be one of the barriers for increased interest in goat milk consumption in addition to odor in Mubi area.

During the dry season, pastoralist group from the republic of Niger, such as the Buzaye, Nadaranko'en, Zomanko'en, Uda'en and Kekkatanko'en bring large herds of goats into Northern Nigeria. Milk and nono from their goats are regularly offered for sale in nearby markets. Goat milk is preferred to cows' milk and therefore commands a much higher price (Nigerian Livestock Research, 1992). This contrasts with other parts of Nigeria, where goats' milk is regarded as undrinkable. Comparison between the milk prices of cow and goat was recorded in Sokoto state in mid 1990. This shows that a measure of large cup cow milk cost N2.50 while goat milk was N5.00 a calabash of cow milk was sold at N3.00 while goat milk was sold at N5.00. (Northern Sokoto State, 1990)

It was deduced from this investigation that, the preference for cow milk is high at about 96.5%, this result is in line with the statement of Oyeyemi and Akusu, (2002), who showed that cattle have been the

Table 5.5 Farmers reasons for keeping goats.

Variables	No. of farmers	% of farmers
For income	125	86.8
For meat	18	12.5
For ceremonial purposes	1	0.69
Total		**100**

Table 6.6 Number of respondents that milk their goats and those that don't milk their goats

	Variables	No. of farmers	% of farmers
	Utility		
i.	Those milking for consumption	6	4.2
ii.	Those milking for sale	2	1.39
iii.	Those milking for medicine	7	4.9
iv.	Those that don't milk their goats	129	89.6
	Total		**100**
	Reasons for non-consumption		
vi.	Those that responded not drinkable	102	70.8
vii.	Those, because is of little quantity	34	23.6
viii.	Odor	2	1.39
	Total		**100**

primary source of milk supply in the country, while preference for goat milk obtained in this study was at 3.5%.

Low yield was one of the reasons for non consumption of goat milk in this locality; milk odor also plays a role as indicated by about

1.39 % of the respondents based on the odor as a deter, a result of which none of the respondents kept goat for milk production.

CHAPTER FIVE

5.0 SUMMARY

The result of the study shows that 10.4% of the respondents use goat milk and 89.6% do not use goat for any purpose. Reasons for non-consumption were based on milk odor, small quantity and not drinkable. The mean values obtained for composition were 4.84, 17.86, 13.42, 0.17, 0.22, 0.14, 0.13 % and 2.08kg/week for fat, total solid, solid non fat, cholesterol, calcium, magnesium, phosphorus and milk yield in the dry season respectively. The mean values of 3.38kg/week for milk yield and 5.01, 16.58, 11.79, 0.18, 0.29, 0.15 and 0.14% for fat, total solid, solid non fat, cholesterol, calcium, magnesium, phosphorus obtained in the wet season respectively. The results showed that, milk yield was significantly ($P<0.001$) affected by season. Fat, total solid, solid non fat were significantly ($P<0.001$) affected by parity. There was seasonal variation ($P<0.001$) on calcium. TS and SNF was significant ($P<0.05$) as affected by season. Parity and season has no effect on cholesterol, magnesium and phosphorus.

5.1 CONCLUSION

It was concluded, from the results that, goat milk consumption in this area was low (4.2%). Preference for cow milk was higher (96.5%). The values obtained for milk yield and composition in this study is similar to the reported values obtained from same breeds in other parts of the countries.

There was seasonal variation ($P<0.001$) on calcium. TS and SNF was significant ($P<0.05$) as affected by season. Parity and season has no effect on cholesterol, magnesium and phosphorus.

5.2 RECOMMENDATION

It is recommended that milk production potentials of the local breeds of goats should be improved through breeding, nutrition, improved management systems as well as creating awareness on nutritional value of goat milk and milk processing to reduce or eliminate the buck odor. These might increase goat milk consumption, income generated from sales of milk and a better health status of the rural families.

REFERENCES

Adebayo A. A. and Tukur A. L. 1999. *Adamawa State in maps.*1st edition, published by Paraclete Yola Nigeria Ltd.

Ademosun, A A, Jansen, H. J. and van Houtert, V. 1985. Goat management research at the University of Ife. In: Sumberg J.E. and Cassaday K. editions, *Sheep and goats in humid West Africa.* Proceedings of the Workshop on Small Ruminant Production Systems in the Humid Zone of West Africa held in Ibadan, Nigeria, 23-26 January 1984. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. Pp. 34-37.

Ademosun, A A. 1988. Trends in small ruminant production for the last two decades and its future in West and Central Africa. Keynote address. In: Adeniji K.O. edition, *Improvement of small ruminants.* OAU (Organization of African Unity), Nairobi, Kenya.

Adu, I.F., Buvanendran, V. and Lakpini, C.A.M. 1979. The reproductive performance of Red Sokoto goat *in Nigeria Journal Agric Sci. Camb 93: 563:- 566.*

Akinsoyinu, A.O., Tewe, O.O., Ngere, L.O. and Mba, A.U. 1982. Milk composition and yield of the Red Sokoto (Maradi) goats. *Dairy Science.*

Alawa. J.P. and Oji, U.I. 2008. Effect of Pendulous Udder Enlargement on Yield and Proximate Composition of Milk from Red Sokoto Goats. *Journal of Animal and Veterinary Advances* 7 (7): 870-872, Medwell Journals.

American Heart Association (AHA). 2009. Recommended cholesterol intake guide for heart disease. *American Journal of Life Science Medicine*, July 1, 2009. *circ.**aha**journals.org/cgi/content/full/.*

Anon, 1990. The history of dairy development in Nigeria. National Seminar on Dairy production, Hill station, Jos, 9-19th August (1990).Pp: 1-11.

AOAC, 1990. *Official Methods of Analysis*. Association of Official Analytical Chemists. 15th Ed. Washington, DC, pp: 1085.

Awotwi, E. K. and Fynn, K. E. 1992. African Livestock Research (Ethiopia) 1:46-69.

Banerjee, G.C. 1998. *A text book of Animal husbandry*, eighth edition, Oxford and IBH Publishing Co. PVT. LTD. New Delhi. Pp. 932.

Barnet, H. Jr. and Fredrick, S. 2000. *Dairy goats production guide*. Institute of Food and Agricultural Science (UF/IFAS), University of Florida, U.S.A. Pp: 102-121.

Belanger, J. 1975. *Raising milk goats in a modern way*. Garden way publishing company Vermont, U.S.A.

Chicama R. 2009. *Raising local natural meat, vegetation and free range eggs*. Purcellville V.A.

Davendra, C. and McLeroy, G. B. 1988. *Sheep and Goat production in the tropics*. ELBS Longman Ltd, Singapore, Pp 271.

Economist Intelligence Unit. 2005. November Country Report (Nigeria).

Egan, H., Kirk, S.R. and Sawyer, R. 1981. *Pearson's chemical analysis of food*. Churchill Livingstone.

Egbowon, B. F., Osinowo, O. A. and Dipeolu, M. A. 2005. Factors affecting colostrums and milk of West African Dwarf and Red Sokoto goats.

Ehoche, O.W. and Buvanendran, V. 1983. The yield and composition of milk, pre weaning growth rate of Sokoto Red goats in Nigeria. World Review Animal Production. 19(2):19-24.

FAO, 1980. *Food and Agricultural Organization year book.* Food and Agriculture Organization, Rome, Italy.

French, M. H. 1970. Observation on goat. F. A. O. studies No. 80 of F.A.O., Rome Pp 129-294.

GenStat Release 7.2. (2007). Lawes Agricultural Trust (Rothamsted Experimental Station), USA.

Guessous, F., Boujenane, I., Bourfia, M. and Narjise, H. 1989. Sheep in Morocco, In: *Small ruminant in the Near East*. Vol. III, North Africa Animal Production and health Paper 74,FAO, Rome. 1195.

Haenlein, G. F. W. 1992. Role of goat meat and milk in human nutrition. *Proceedings Vth international conference on Goats*, New Delhi, India,II (2): 575-580.

Haumesser, J.B. 1975. Some aspects of reproduction in the Red Sokoto goat. Comparison with other tropical and subtropical breeds. *REMVT* 28: 225–233.

Ibeawuchi, J. A. and Dalyop, D.M. 1995. Composition and quality of fresh cow milk offered for sale in parts of plateau state of Nigeria. *Nigerian Journal of Animal Production 22(1): 81-84.*

Ikwegbu, O. A. and Ofodile, S. 1992. Wet season supplimentation of West African dwarf goats raised under traditional management in the sub humid zone of Nigeria. In: *Goat production system in the humid tropics*. Proc. Inter. Workshop Obafemi Awolowo University. Ile-Ife, Nieria, July 6-9, Pp. 195-201.

ILCA, 1984. International Livestock Centre for Africa. *Humid zone programme. Annual Report 1984.* ILCA, Addis Ababa, Ethiopia. Pp 21.

Jahnke, H E. 1982. *Livestock production systems and livestock development in tropical Africa.* Kieler Wissenschaftsverlag Vauk, Kiel, Germany. Pp253.

Jenness, R. 1980. Composition and characteristics of goat milk: Review 1968-1979. *Journal of Dairy Science. 63: 1605-1630.*

Lamorde, A. G. and Weinmann, D. E. 1992. A comparison of reproductive performance of northern Nigeria cattle with those in government farms., *Journal of Nigerian Veterinary Medical Association. 1: 19-22.*

Malau-Aduli, B. S., Eduvie, I. O., Lakpini, C. A. M. and Malau-Aduli, A. E. O. 2001. Effect of supplementation on the milk yield of Red Sokoto does. *Proceedings of the 26th annual Conference of Nigerian Society of Animal Production*, March 2001 ABU, Zaria, Nigeria, Pp 353-355.

Mason, I. L. 1988. (3rd ed). *A world dictionary of livestock breeds, types and varieties*. CAB International, Wallingford, UK.

Mba. A.U, Bayo B.S. and Oyenuga, V.A. 1975. Studies on milk composition of West African Dwarf, Red Sokoto and Saanen goats at different stages of lactation. 1. Total solids, butter fat, solids-not-fat, protein, lactose and energy contents of milk. *Journal of Dairy Resource.*42: 217-226.

McDonald, I. and Low, J. 1985. *Livestock rearing in the tropics*. Macmillan, London. Pp: 12-32.

Morand-Fehr P. and Sauvant D. 2006. Composition and yield of goat milk as affected by nutritional manipulation. Department of Animal Science, Institute NationalAgronomique, Paris, France 75231

National Livestock Development Centre. 1984. Report National Livestock Development Centre. Lagos, Nigeria.

National Population Commission. 2006. Nigeria, National Population Census. National Population Commission, Abuja.

Ndamukong K.J.N., Sewell M.M.H. and Asanji M.F. 1989. Disease and mortality in small Ruminants in the North West Province of Cameroon. *Tropical Animal Health and Production.* 21, 191-196. www.springerlink.com/index/P9351660517JU260.pdf.

Ngere, L.O., Adu, I.F. and Okubanjo, I.O. 1984. The indigenous goats of Nigeria. *Animal Genetic Resources Information* 3: 1–9.

Nigerian Livestock Resource. 1992. National Synthesis Vol. II Resource Inventory and Management Ltd.

NLPD (National Livestock Production Division).1992. National Dairy Survey, NLPD, Kaduna, Nigeria.
No. 42, pp: 217-226.

Northern Sokoto State. 1990. Prices of cow and goat milk. In *Nigerian Livestock Resource*. 1992. National Synthesis Vol. II Resource Inventory and Management Ltd.

Okello, K. L. and Obwolo, M. J. 1985. Review of the potentialities of goat production. *World Animal Production* 53: 27-31.

Osuhor, C. U. Alawa, J. P. and Lufadeju, E. A. 1998.Overnight manure production from Red Sokoto goats in Zaria, Nigeria. *Proceedings of the Silver Anniversary Conferencce of NSAP and Inaugural Conference of WASAP*, Abeokuta, Nigeria. Paper No. 434.

Oyeyemi, M. O. and Akusu, M. O. 2002. Response of multiparous and primiparous West African Dwarf goats (*Capra hircus*, L.) to concentrates supplementation. *Veterinary Archive* 72, 29-38, 2002.

Parkash, S. and Jenness, R. 1968. The composition and characteristics of goat milk, a review *Dairy Science Abstracts*, 30: 67-87.

Perkin-Elmer, 1976. *Analytical methods for atomic absorption spectrophotometry.* Perkin-Elmer Corp. Norwalk, Conn., USA.

Payne, W. T. A. 1990. *An introduction to Animal Husbandry in the tropics*. Longman Group UK. Pp 480.

Sankey, L.B. 1991. Milking potential of Red Sokoto does at first parity. B.Sc. Thesis, Ahmadu Bello University, Zaria, Nigeria.

Steinbach, J.A. and Balogun A. 1972. Seasonal variation in the conception rate of beef cattle. The seasonal equational climate of Southern Nigeria. *International Journal of Biometeorology.* (Netherlands) 16: 131-144.

Sumberg, J.E. 1985. Small ruminant feed production in a farming systems context. In: Sumberg J E and Cassaday K editions, *Sheep and goats in humid West Africa.* Proceedings of the Workshop on Small Ruminant Production Systems in the Humid Zone of West Africa held in Ibadan, Nigeria, 23-26 January 1984. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. Pp. 34-37.

Uche N. 2006. Nigeria product, brief Nigeria's dairy Market. Gain report, Global Agriculture Information Network. 5/4/2006.

Upton, M. 1985. Returns from small ruminant production in South West Nigeria. *Agric. Syst*. 17: 65-84.

Webster, C. C. 1989. *Agricultural production in the tropics*. Longman Inc. New York, Pp 357-370.

Williamson, G. and Payne, W. J. A. 1984. *An Introduction to Animal Husbandry in the tropics*. 3rd edition. ELBS, London.

Zahraddeen, D., Butswat, I.S.R. and Mbap, S.T. 2007. Evaluation of some factors affecting milk composition of indigenous goats in Nigeria. *Livestock Research for Rural Development* 19 (11). Published 1 November 2007. http://www.lrrd.org/

Zeuner, F. E. 1963. *A History of Domesticated Animals*. London: Hutchinson.

QUESTIONNAIRE ON THE LEVEL OF CONSUMPTION AND ACCEPTABILITY OF GOAT MILK IN MUBI AREA.

Dear Sir/Madam

Kindly assist the researcher who is undertaking research on the above topic to answer the questions below by ticking or writing where applicable.

Thank you

PERSONAL DATA

1. The name of your town/village is ……..……
2. Your age is.....years.
3. Sex. Male ☐ Female ☐
4. Marital Status (a).Single ☐ (b).Married ☐ (c). Widow ☐
   (d). Divorcee ☐
5. Family size…….
6. Educational status (a). Informal education (b). Primary education (c). Secondary education (d). Tertiary education
7. Occupation (a). Farmer (b). Civil servant (c).Business
   (d). Teacher. (e). others specify……
8. Do you rear animals? (a). Yes (b).No
9. If yes which type? a. Goats (b). Sheep (c). Chickens (d). Cattle
10. If you rear goats which breed(s)? (a). Sokoto red (Maradi)
    (b). Borno white (Sahel goat). (c).West African Dwarf goats
    (d). Others specify……

11. Do you have improved breed of goats (a). Yes (b). No

12. What is the purpose of keeping the goats (a). For milk (b). For income (c).Meat (d). For religious/traditional purpose (e).Others specify……

13. Do you milk the goats? (a).Yes (b).No. If yes

14. What do you use it for (a). Consumption (b). Sell (c). Others please specify…….

15. How much do you obtain milk from one female each day?...litre(s)

16. How much do you sale per litre? ……

17. If you are not milking them, why? (a). Not consumable (b). Little quantity (c). Any religion or traditional taboo (d). Others specify

18. Apart from goats which animals do you milk? (a). Cow (b). Sheep (c). others specify……

19. Which milk do you prefer most (a). Goats (b). Sheep (c).Cattle (d). others specify……

20. How many goats do you raise in a year?.....

21. How often do they give birth in a year?.....

22. How many females (does) do you have in your herd?…….

23. How often do you sale the goats? (a). yearly basis (b). 2 times a year (c).whenever there is financial problem (d) Festive periods.

24. How many goats did you sell this year?.....…and what was the average price per goat?…….

25. How much did you realize from the sales of the goats?.....
26. Do you have security for the animals? (a). Yes (b). No
27. If yes which type? (a). Guard (b). herdsman (c). insurance
28. How much do you spend on wages per month?.....
29. How much do you spent on torch batteries per month?.....
30. Do you have extension worker in your place? (a). Yes (b). No
31. If yes how was his schedule of meeting with the farmer's? (a). Daily (b). Once in a week (c). Twice a week (d). Every two weeks (e). Once a month (f). Others specify……
32. What has he/she been teaching you? (a). How to manage our animals properly (b). Fertilizer trial on farms (c). Variety trials on farm (d). Spacing trials on farms (e). Others specify……..
33. Do you have access to credit facilities (a). Yes (b). No
34. If yes which source (a) N.A.R.D.B (b). Commercial banks (c). Cooperatives (d). Fadama II (e). Others specify…….
35. Which type of management practice do you employ (a). Intensive (b). Extensive (c). Semi-intensive
36. If not intensive do you provide house or shelter for the animals (a). Yes (b).No
37. How many feeders do you have?.....
38. How much did you purchase 1 trough?.....
39. How much did it cost you to erect the pen?.....

40. Do you provide supplementary feed for the animals

(a). Yes (b). No

41. If yes which type of feed (a). Groundnuts cake/haulms

(b).Cotton seed cake/husk (c). Corn offal (d). Silage/hay

(e). Others specify……..

42. Do you vaccinate the animals (a). Yes (a). No

43. How much does it cost you to vaccinate a goat?.....

44. How much does it cost you to feed a goat per week?.....

45. How long did it take for a goat to reach market weight?.....

46. How much do you pay as tax on each goat?.....

47. Some Problems of goat's production. Tick 1 if the problem is very severe, tick 2 if it is severe and tick 3 if it is mild

S/No	TYPE OF PROBLEM	VERY SEVERE (1)	SEVERE (2)	MILD (3)
1.	Out-break of diseases			
2.	High cost of feeds			
3.	Theft			
4.	Inadequate credit facilities			
5.	Religious believes			
6.	Inadequate extension services			
7.	Low market price of the animals			
8.	Low out-put potentials of the breeds			
9.	Other problems not mentioned……..			

48. Can you suggest solution(s) to these problems mentioned above?…….....