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Influence of Breed, Season, Age and Body Condition Score (Bcs) on Litter Size of Goats Reared in Mubi, the Guinea Savanah Zone of Nigeria

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ABSTRACT

A two year study was conducted to investigate the effects of breed, year, season, age and body condition score on litter sizes of goats reared in Mubi, guinea savannah zone of Nigeria. Data was collected on fetuses recovered, and the grafian follicles as well as the presence of corpus luteum, which are direct measures of litter size from female Sahel and Sokoto Red goats of different age groups and body condition scores across four seasons for two years. It was discovered that, there were significant ($P<0.001$) effects of breed, season, age, year and body condition score variations on the litter sizes. The Sahel has higher number of litters than the Sokoto Red does. Season has highly significant ($P < 0.001$) effect on the litter sizes where early dry and late wet seasons ranked highest. Measurement of the litter size based on the number of matured follicles and the presence of corpora lutea shows similar trend. There are differences in the number of litter size in the does based on the year, as year 2016 recorded the highest number of matured follicles and corpora lutea. The highest number of ovarian parameters for both the right and the left were recorded among does aged ≥ 3 years with body condition score (BCS5). The combined effects of breed x season on litter sizes was significantly (($P < 0.01$) higher during the early dry and late wet seasons in both breeds, but was better in the Sahel in both seasons. Since breed, season, age and BCS has significant influence on the litter sizes as measured using fetal recovery and ovulation rate in does of both breeds, and with the ovaries being active all year round, selection and breeding exercise should be carefully carried out based on the records obtained. This indicates that breed or individual animals that have the best parameter values should be selected for breeding using the available measured index. **Keywords:** Influence, Breed, Year, Season, Age and BCS, Litter Sizes Goats, Nigeria

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INTRODUCTION

Nigeria has over 72.5 million goats out of the 861.9 million goats in the world, representing almost 8.41% of world population of goats (Premium times, 2017). More than 60% of the goats in Nigeria are found in the Sudan Savannah Zone of Northern Nigeria (Adalemo and Baba, 1993). The importance of goat as a provider of essential food in terms of meat and dairy products (protein) has been discussed and documented in many studies (Gruner and Charbert, 2000; Boyazoglu and Morand-Fer, 2001; Haenlein and Fahmy, 1999; Haenlein, 2001, 2004). Despite the tremendous contributions that the goat is making to the domestic economy, the livestock industry has neglected the goats and their potentials remained untapped.

The low level of animal protein in-take among Nigerians is partly due to low productivity level of the animals resulting from neglect of the livestock industry (Ozo, 2004). Therefore, increasing the population and productivity of small ruminants especially; goats could go a long way in meeting the citizens' demand for animal products. This could be achieved if better understanding of the productivity potentials of the indigenous breeds of goats is accessed through Oogenesis and ovarian development in the females. This may be hard to achieve as information on the reproduction efficiency of indigenous goats is rare (Bitto and Egbuinike, 2006).

Body condition score is a function of the nutritional status of an animal and the absence of diseases. And the overall performance of any class of animal is directly linked to body condition score at mating (Taiwo; Buvendran, and Adu., 2005). Seasonal variations coupled with environmental and genetic factors are some of the major hindrances that influence the production performance of different breeds of goats in the tropics (Devendra, 1962; Sacker and Trail, 1966). Similarly, reproductive efficiency in any given species of animal depends on several other factors such as; age, estrus cycle, litter size, gestation length, and length of breeding season, suckling period and duration of reproduction period, (Hafez, 1982).

Litter size is the number of kids born per doe, per 100 does per year or per litter, but these values are not very good indication of fertility since estrus and number of birth is a function of both breed and various environmental factors (Devendra and McLeroy, 1982). The mean number of kids born alive per kidding is an important factor that determines the level of production as it contributes to the total number weaned than the growth rate of the kids (Bradford, 1985). Based on the relationship that exists between litter size and ovulation rate and embryonic survival, improvement in embryonic survival can lead to tremendous improvement in uniformity of litter size at birth (Bradford, 1985).

Under controlled conditions and particularly for tropical breeds of goats that display estrus all year round, litter size is a useful method for fertility determination (Devendra and McLeroy, 1982). There exists a high degree of relationship between colour variation and litter size in goats, as pigmentation intensity is believed to have effect on reproduction in WAD goats (Ebozoje and Ikeobi, 1998). These authors reported that black pigmentation favour good litter size with white pigmentation having the least litter size.

The objective of this study was to investigate the effects of breed, season, age and body condition score on litter size of goats reared in Mubi guinea savannah zone of Nigeria.

MATERIALS AND METHODS

The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lays between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian (Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate

boundaries with Borno to the North, Gombe to the North-West and Taraba to the South-West (Adebayo, 1999; ASMLS, 2010a), as shown in Figure Ia.

Figure Ia: Map of Nigeria Showing Adamawa State

According to Adebayo and Tukur (1997), Adamawa State covers an area of land mass of about 38,741km². The state is divided into three Senatorial Zones (Northern, Central and Southern) which translates to three agricultural zones as defined by INEC (1996), which are further divided into 21 Local Government Areas (LGAs) for administrative convenience.

The State has a population of 2,102,053 persons (NPC, 1990). The main ethnic groups in the state are the Kilba, Higgi, Quadoquado, Lala, Yungur, Bwatiye, Chamba, Mbula, Margi, Ga'anda, Longuda, Kanakuru, Bille, Bura, Yandang, Fali, Gude, Verre, Fulani and Libo (Adebayo & Tukur, 1997; Adebayo, 1999; ASMLS, 2010b). The dominant religions are Christianity and Islam, although some of its inhabitants still practice African traditional religions. The major occupation of Adamawa people is farming. The soil type is ferruginous tropical soils of Nigeria based on genetic classification of soils by the Food and Agricultural Organization of the United Nations (FAO, 1996).

The soils are a function of the underlying rocks, the seasonality of rainfall and the nature of the wood-land vegetation of the zone. The soils are derived from the basement complex, granite and gnesis that form the ranges of mountains. The mineral resources found in the state include iron, lead, zinc and limestone (Adebayo & Tukur, 1997).

The common relief features in the state are the Rivers Benue, Gongola, Yadzaram and Kiri Dam, Adamawa and Mandara mountains and Koma hills. The state has minimum and maximum rainfall of 750 and 1050 mm per annum and an average minimum and maximum temperature of 15^0C and 32^0C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September), according to Adebayo (1999). The vegetation type is best referred to as guinea savannah (Areola, 1983; Adebayo & Tukur, 1997). The vegetation is made up of mainly grasses, aquatic weeds along river valleys and dry land weeds inter-spersed with shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to

about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugarcane, cowpea, benniseed, bambara nuts and tiger nuts, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, few camels, horses and poultry for subsistence (Adebayo & Tukur, 1997; Adebayo, 1999).

The Study Site

Mubi-North LGA is located at the northern part of old Sardauna Province, which now forms Adamawa North Senatorial District as defined by INEC (1996). The region lies between latitude 9^0 30´´ and 11^0 North of the equator and longitude 13^0 and 13^0 45´´ East of Greenwitch Meridian. It has an altitude of 696 meters above sea level with an annual mean rainfall of 1,220mm and a mean temperature of 15.2^0C during hamattan periods from November to February and 39.7^0C in April (ADADP, 1986). The LGA has essentially a mountainous landscape tranversed by river Yedzaram and many tributaries, Mandara and Adamawa mountains form part of this undulating landscape (Mansir, 2006). The Gude, Fali, Fulani and other tribes dominate the area which has a lot of pasture land. Mubi region is bordered in the North by Michika LGA, in the West by Hong LGA and in the South by Mubi South LGA, Maiha LGA in the South-East and the Republic of Cameroon in the East as seen in Figure IIb. It has a land area of about 4,728.77 km² and human population of about 759,045 going by NPC, (1991) census projected figures (Adebayo & Tukur, 1991). It has an international cattle market linking neighboring countries such as Cameroon, Chad, Central Africa, Niger, Mali and Senegal to Southern Nigeria where cattle are consumed as shown in Figure Ib.

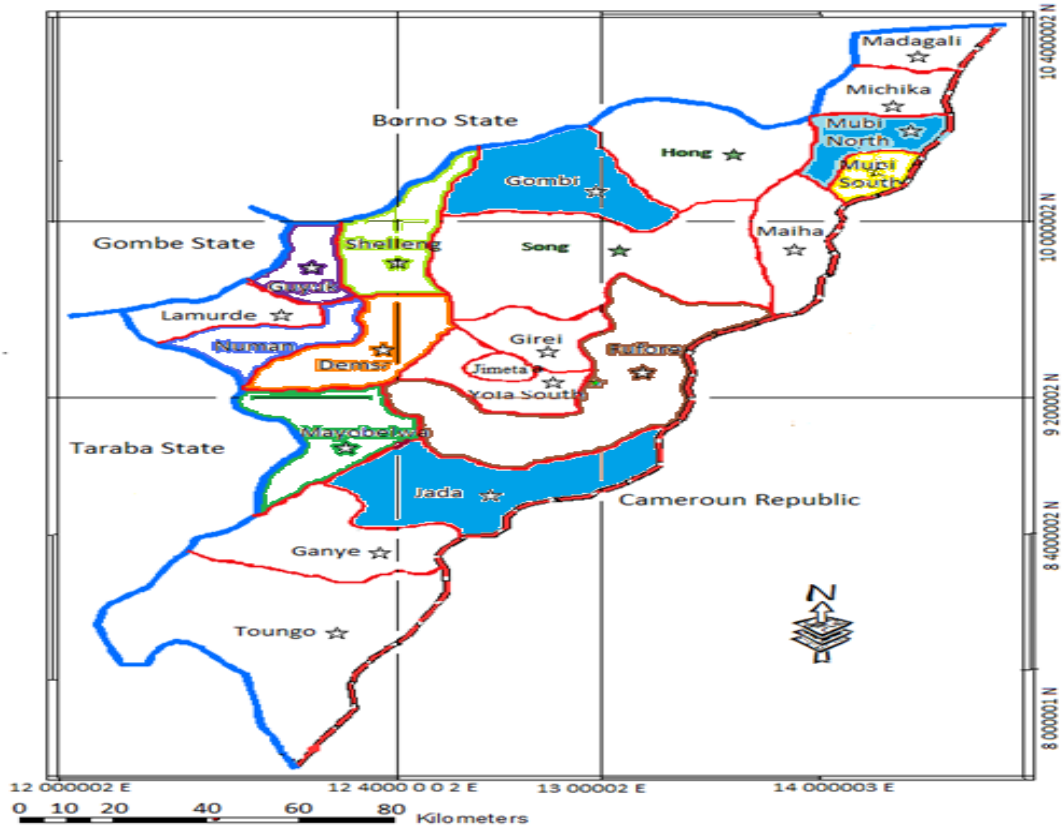

Figure Ib: Map of Adamawa State Showing the Study Area in Blue Colour

Data Collection

Data of two breeds of goats (Sokoto Red and Borno White) slaughtered were obtained from the Mubi abattoir records between January, 2015 and December, 2016. The study covered the period of four seasons viz: Early dry (ED) October to December, Late dry (LD) January to March, Early wet (EW) April to June and late wet (LW) July to September. The ages of the animals were determined using the method described by Abegaz and Awgichew, (2009). Year and seasonal events during the slaughter of the animals were studied with emphasis given to the number of pregnant animals slaughtered and the ovarian physiological status of all the female animals. The reproductive organs of the does were obtained complete postmortem. The tracts on removal were put in a cellophane bag to prevent weight loss and are carried to the laboratory for analyses. Both right and left ovaries were identified by putting the genital opening towards the stand of the examiner with the smooth surface upward and the numbers of ovaries and corpora lutea recorded.

Data Analysis

Data obtained were analyzed using the GLM procedure as contained in Statistix 9.1 (2012) USA, with, season, breed, age and body condition score as factors. Analyses of Variance, Means and standard error as well as Interaction effects between breed and season were calculated; Significant means were separated using LSD procedure as contained in Statistix 9.1 of (2012).

RESULTS AND DISCUSSION

The results of the effects of breed, season and year on the number of fetuses recovered from slaughtered does are shown in table 1. The Sahel does have the highest number of fetuses recovered. Differences in this variation could be due to inherent breed variability, preference by marketers and consumers. The results show significantly ($P < 0.001$) difference on the number of fetuses recovered between seasons with early dry season having the highest number. The results obtained from this study are lower than the average of 1.70 kids recorded in Sokoto Red does by Awemu *et al.* (1999). The highly significant ($P < 0.001$) seasonal influence on litter size, which is lower during late dry and early wet seasons, could be attributed to inadequate nutrition and climatic conditions which could affect reproductive activity of the does. Ovarian activity in the Sokoto Red does last throughout the year, being highest during the rainy seasons (June – September) and dry season (January – March). This could also be due to availability of pasture and ability of the animals to utilize browses and other forages for useful purposes during these seasons (Hambolu and Ojo, 1985). Devendra (1970) again, stated that dry season had less effect on kidding rates which occurs 2 to 3 times in 2 years in Sokoto Red goats.

Research has shown that, season of birth has influence on litter size as kidding during the early rainy season had largest litter at birth (Awemu *et al.,* 1999). This is in conformity with Wilson and Light (1986) and Silva *et al*. (1998) who reported similar findings. Difference in feed availability and temperature variation between seasons is also responsible for differences in litter size. These variations in addition to management systems between years also contribute to influence of year of birth on litter size (Awemu *et al.,* 1999). Several studies by Wilson (1989) have also shown that, African does have average of 1.38 kids at parturition with a range of 1.08 to 1.74. Devendra and Burns (1983) reported that, the average for Black Bengal goats, Malabari, Sirohi and Misra goats respectively falls within this range, but lower values were also reported by other authors. An average of 1.7 kids was reported for Sokoto Red (Awemu *et al*., 1999), while Thiruvenkadan *et al*. (2000a) reported an average of 1.93 kids for Kari Adu goats in India. For West Africa Dwarf goats in Nigeria, the average is 1.79 and 1.82 respectively (Odubote, 1996; Ebozoje and Ikeobi, 1998). While Amege (1988) reported an average of 1.84 as being litter size from a

Table 1: means ± SE by breed, season, and year on litter size of does

Variables	number of fetuses recovered
Breed	***
Sahel	1.08 ± 0.04[a]
Sokoto Red	0.90 ± 0.04[b]
Season	***
Early dry	1.88 ± 0.05[a]
Late dry	0.76 ± 0.05[c]
Early wet	0.69 ± 0.05[b]
Late wet	0.82 ± 0.05[c]
Year	**NS**
2015	0.95 ± 0.03[a]
2016	0.94 ± 0.03[a]

Key: *** = P < 0.001, NS = Non-significant. SE = Standard error,
Notes: Means for groups in homogeneous subsets and same superscript(s) are statistically similar.

population of West Africa Dwarf goats with 33% single births, 54% twins and 13.% tri-plets in Togo.

The effects of breed, season, year, age and body condition score (BCS) on both right and left number of matured follicles and corpora luteum are presented in Table 2. There was significantly high (P< 0.001) breed variation in number of matured follicles and developed corpora lutea which follow a similar trend with the number of fetuses recovered as the Sahel does has the highest values of number of matured follicles and developed corpora lutea for the right and left ovaries. Seasonal variation effects were also observed on the ovarian parameters of the does. There was depression in oviduct and ovarian activity during the early and late wet seasons as compared to the early and late dry seasons. This could be associated with the restriction of movement imposed on the animals by tethering and zero grazing them during the farming periods. Goats cherish so much freedom and loved to select their feeds carefully from crop residues to kitchen waste and browses to satisfy the taste and preference. They also hate rain with passion which could be because of their susceptibility to cold and septicemic conditions. The stress goats go through during this part of the year must have drastically affected their nutrient intake coupled with high incidence of disease and parasitic load during the wet seasons, thus, the low productivity. These observations are in agreement with Butswat (1994); Butswat and Zaharadeen (1998) who reported similar findings.

Prolificacy has positive relationship with advancement in age (Epistein and Herz, 1964) with maximum number of kids between 5 and 7years (Shelton, 1961). So also parity has significant effect on litter size. Large litter size was realized at the fifth parity in Sokoto Red goat breed in Nigeria (Awemu *et al.*, 1999). Mbap and Ngere (1989) and Odubote (1996) recorded the highest litter size at 6th and 7th parity respectively in WAD goats. Low prolificacy is persistent among primiparous does since their reproductive features have not reached advanced stage of physiological development and maturity compared to the multiparous (Levasseur and Thibault, 1980; Awemu *et al.*, 1999).

However, contrary to the results, Thiruvenkadan *et al*. (2000a) reported higher litter size during the wet season in Kanni Adu does which was attributed to low temperature and good herbage growth. Result obtained from this study is in conformity with the findings of Wilson and Light

(1986) and that of Silva *et al*. (1998) who reported that differences in feed availability and temperature variation between seasons could lead to differences in litter size in farm animals.

Table 2: Means ± SE by breed, season, year, body condition score, and age on ovarian parameters

Variables	rnomafl	rnocoplu	rnomafl	rnocoplu
Breed	***	***	***	***
Sahel	1.38 ±0.06[a]	1.07 ± 0.03[a]	0.29 ± 0.03[a]	0.83 ± 0.02[a]
Sokoto Red	0.83 ± 0.06[b]	0.69 ± 0.02[b]	0.28 ± 0.03[a]	0.57 ± 0.02[b]
Season	***	***	***	***
Early dry	1.34 ± 0.06[a]	0.79 ± 0.04[c]	0.44 ± 0.04[a]	0.92 ± 0.04[a]
Late dry	0.96 ± 0.06[bc]	0.85 ± 0.04[bc]	0.10 ± 0.02[b]	0.66 ± 0.03[bc]
Early wet	0.85 ± 0.05[c]	0.87 ± 0.03[b]	0.15 ± 0.02[b]	0.69 ± 0.02[b]
Late wet	1.20 ± 0.05[a]	1.05 ± 0.04[a]	0.39 ± 0.03[a]	0.58 ± 0.02[c]
Year	***	*	NS	NS
2015	0.88 ± 0.05[b]	0.91 ± 0.03[a]	0.30 ± 0.03[a]	0.83 ± 0.03[a]
2016	1.15 ± 0.05[a]	0.81 ± 0.03[b]	0.28 ± 0.02[a]	0.79 ± 0.03[a]
Age	***	*** ***	***	
≤ 1 year	0.92 ± 0.05[c]	0.50 ± 0.04[b]	0.44 ± 0.03[c]	0.37 ± 0.03[c]
≤ 2 years	1.20 ± 0.05[b]	0.94 ± 0.04[a]	0.31 ± 0.03[b]	0.84 ± 0.03[b]
≥ 3years	2.00 ± 0.03[a]	0.98 ± 0.04[a]	1.19 ± 0.02[a]	1.81 ± 0.03[a]
BCS	**	*** ***	***	
1	0.68 ± 0.02[c]	0.55 ± 0.05[c]	0.16 ± 0.04[d]	0.46 ± 0.04[c]
2	1.06 ± 0.05[b]	0.83 ± 0.05[ab]	0.23 ± 0.02[c]	0.66 ± 0.03[b]
3	1.22 ± 0.07[ab]	0.86 ± 0.05[ab]	0.35 ± 0.05[bc]	0.74 ± 0.05[ab]
4	1.10 ± 0.04[b]	0.78 ± 0.03[b]	0.46 ± 0.04[b]	0.70 ± 0.04[ab]
5	1.30 ± 0.07[a]	0.98 ± 0.05[a]	0.61 ± 0.04[a]	0.80 ± 0.04[a]

Key: ** = P < 0.01, *** = P < 0.001, RNMAFL = Right number of matured follicles, **LNMAFL** = Left number of matured follicles, RNCOPLU = Right number of Corpus luteum, LNCOPLU = Left number of Corpus luteum. Notes: Means for groups in homogeneous subsets and same superscript(s) are statistically similar.

The results also show that, does aged ≥ 3years recorded the highest number of matured follicles and corpora lutea for the right and left ovaries as shown in table 2. These ovarian profiles are the direct measure of litter size in does as the matured ovum on ovulation fertilizes forming the actual number of fetuses. The highly significant age variability effects observed in this study agrees with the findings of Epistein and Herz (1964) who reported that prolificacy has positive relationship with advancement in age, with maximum number of kids recorded at the 5th and 7th years of reproductive life. Parity has a direct link with age of the animal. It was observed that, large litter size was recorded at the 5th parity in Sokoto Red goat breed in Nigeria (Awemu *et al.,* 1999; Mbap and Ngere, 1989). Also, Odubote (1996) reported higher litter sizes at 6th and 7th parities in WAD goats. Low prolificacy is persistent among primiparous does as their reproductive features have not reached advanced stage of physiological development and maturity compared to the multiparous (Levasseur and Thibault, 1980; Awemu *et al*., 1999a).

The variation in litter size (ovarian activity) observed in this study between the two years could be attributed to change in environmental conditions, management systems and feed availability. This is in conformity with the findings of Awemu *et al,* (1999), who reported that, variations in feed availability in addition to management systems between years also contribute to influence of year of birth on litter size.

High effects (P < 0.01) of body condition score (BCS) on ovarian activity was observed in this study, where does with BCS_5 has the highest number of matured follicles and highly formed corpus luteum for both right and left ovaries respectively. This results agree with the findings of Gunn and Doney (1975) who reported that, BCS is the most vital factor influencing ovulation rate, occurrence of estrus, and response of does to buck stimuli (Mellado *et al.,*1996) and consequently, litter size (newton *et al.,* 1980) as well as embryo survival (West *et al*., 1991). Body condition score is perhaps the most vital factor influencing ovulation rate (Gunn and Doney, 1975), occurrence of estrus and response of does to buck stimulus (Mellado *et al*., 1996) and consequently, litter size (Newton *et al*., 1980) and embryo survival (Kelly *et al*., 1989; West *et al*., 1991).

The results of the interaction effects of breed x season on litter size in does are presented in Table 3. It was discovered that, in all the seasons, the Sahel does exhibited superiority over the Sokoto Red does. The highest litter size was recorded during the early dry and late wet seasons in both breeds. The reason behind the increase in number of matured follicles and the ovulation surge is availability of feed between the months of October to March and the freedom obtained by the animals to roam freely in search of feeds and browse plants. This again corroborated the findings of Awemu *et al*. (1999) that, season of birth have direct influence in litter size, and that, differences in feed availability alongside temperature variations between seasons could lead to differences in litter size across seasons (Wilson and Light, 1986; Silva *et al.,* 1998).

Table 3: Means ± SE by breed x season on litter size of does

Variables	Number of fetuses recovered
Breed x season	****
Sahel x early dry	1.89 ± 0.08[a]
Sahel x late Dry	0.50 ± 0.08[c]
Sahel x early wet	0.15 ± 0.08[e]
Sahel x late wet	1.83 ± 0.08[a]
Sokoto red x early dry	0.81 ± 0.08[b]
Sokoto red x late dry	0.20 ± 0.08[d]
Sokoto red x early wet	0.09 ± 0.08[e]
Sokoto red x late wet	0.88 ± 0.08[b]

Key: ** = P < 0.01, Notes: Means for groups in homogeneous subsets and same superscript(s) are statistically similar.

CONCLUTION AND RECOMMENDATIONS

It is therefore concluded that, breed, season, age and body condition score have significant influence on the litter size as measured using fetal recovery and ovulation rate in does of both breeds. The ovaries being active all year round, selection and breeding exercise should be carefully carried out based on the records obtained. This indicates that, breed or individual animal that has the best parameter values should be selected for breeding using the available index measured. This when strictly

adhered to, couple with good management, the goat can be used to produce meat that can supply the animal protein needs of the teeming human population in Nigeria

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