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Classification of slaughtered animals and estimation of body condition scores during rainy season in Sokoto abattoir

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Abstract

The animals slaughtered at the Sokoto City Abattoir in Northwestern Nigeria from 5th June to 6th August 2010 were classified based on body condition scores (BCS) and other variables. A total of 6215 animals (cattle, sheep, goats and camels) were slaughtered with wide disparities in body conditions. Cattle remain the predominant animal slaughtered (67.74%) with the least predominant animal being camel (5.41%). The majority (80.80%) of the large ruminant slaughtered were in borderline to optimum (3-4) body condition while the majority of small ruminant (81.73%) primarily fell into the optimum (2-3) body conditions at slaughter. Multivariable ordered logistic regression analysis revealed that BCS as an estimated outcome is based principally on seasons with the beginning of rains (June) being the most critical. Since the study was undertaken at the beginning to middle of rainy season, it is expected that the animals are just recovering from the stress of previous dry season and scarcity of feed resources, this support the result from the analysis. Additional factors may contribute to differences in BCS of slaughtered animals are not evaluated in this study due to limitation of data collection, and future useful data may be generated by implementing a more comprehensive data recording system for slaughter statistics and research at the Nigerian abattoirs.

Keywords: Abattoir, Body condition score, Nigeria, Ordinal model, Rainy season, Slaughtered animals
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Introduction

In order to evaluate improvement in a group of livestock, and eliminate economic and health hindrances associated with animals that are not in optimum conditions, one of the well accepted scoring criteria remains the body condition scores (BCS). It is a criterion for categorising animals based on the degree of body energy reserves, response to improvement in animal nutrition, and grouping of farm animals for strategic farm management practices amongst others. BCS is often stated as a numerical guideline, which differs based on animal groupings (e.g 1-9 in beef herds, 1-5 in dairy herds, 1-5 in pigs, and 1-4.5 in sheep and goats), and they can influence the reproductive performance and efficiency of farm animals (Eversole *et al.*, 2009; Apple *et al.,* 2010). BCS uses the degree of physical weakness, muscle atrophy, visibility of spines, ribs, lumbar processes, chest and such other indications in the scoring (Neary & Yager, 2002).

In some instances when referred data and empirical evaluations of the animals presented for slaughter in the Nigerian abattoirs are available, inconsistency and missing data on breeds, health status, weight and BCS of the slaughter animals are evident. However, information on breed, BCS, health status, weight and major biometrical data are essential in

records and information needed in modern abattoirs or slaughter houses. The objective of this study is to identify and classify the animal species, breeds, sexes slaughtered at the Sokoto abattoir and relate this information to their BCS.

Materials and methods

Area of study

Sokoto State is situated in the northwestern part of Nigeria and shares boundary with Niger Republic to the north, Benin Republic to the west, Kebbi State to the southwest and Zamfara State to the southeast (Sokoto, 2001). The State is situated on latitude 12^0 15N and 05^0E, and is 308m above the sea level. Sokoto States account for an estimated 1992 cattle population of 1.18 million (Mamman, 2005). The abattoir chosen for this study is the only major one that supplies meat to inhabitants of Sokoto City and satellite towns. The abattoir with its associated meat shops is located approximately 1km southward and 3km westward from two of the main roads leading into the State.

Data collection and statistical analysis

All animals presented for slaughter at the abattoir between 6.00am and 9.00am on 5th June until 6th August 2010 were conveniently sampled and included in the survey based on the assumption that similar pattern of slaughter will prevail except during the festive seasons. Animals were identified by species and breeds on arrival at the abattoir lairage. The age, BCS, health status, breed, sex and other biometric data were obtained from each animal as it was presented for slaughter. Species and breeds identifications were done based on phenotypic/external characteristics (Blench, 1999). Body conditions were scored before slaughter based on the examination of certain body parts including the ribs, shoulder, spinous and transverse processes of the vertebrae, hip, stifle, tail head, and pin bones as described by Neary & Yager (2002). This involves visual observation and/or palpation of specific areas of fat deposition especially over the back, ribs, and over the horizontal processes of the backbone or edge of loin. The BCS of individual breed was compared and scored on a nine point (1 – 9) scale for camels and cattle according to acceptable protocol (Faye *et al*., 2001; de Souza *et al*., 2008; Eversole *et al*., 2009), and on an eight point (1 – 4.5) scale for sheep and goats (see Tables 2 and 3). Animals with lowest BCS score were taken to be extremely thin while those with the highest BCS as very obese and scores used were as follows: 1-2: thin; 3-4: borderline; 5-7 optimum; 8-9: fat/obese. Specifically, the individual scores were:

1. Physically weak, muscle atrophy, visible spines, hip bones, pin bones and rib outlines with no fat in briskets and flanks. (1.0 for sheep and goat).
2. Muscle atrophy, visible spines, hip bones, pin bones and rib outlines with no fat in briskets and flanks. (1.0 for sheep and goat).
3. Slight muscle atrophy, visible spines, hip bones, pin bones and rib outlines with no fat in briskets and flanks. (1.5 for sheep and goat).
4. No muscle atrophy, slightly visible spines, hip bones, pin bones and 3-5 rib outlines with no fat in briskets and flanks. (2.0 for sheep and goat).
5. No muscle atrophy, no visible spines, hip bones, pin bones and 1-2 rib outlines with no fat in briskets and flanks. (2.5 for sheep and goat).
6. No muscle atrophy, no visible spines and rib outlines, visible hip bone and pin bone with some fat in briskets and flanks. (3.0 for sheep and goat).
7. No muscle atrophy, no visible spines and rib outlines, slightly visible hip bone and pin bone with full fat in briskets and flanks and slight patchy fat around the tail head. (3.5 for sheep and goat).
8. No muscle atrophy, no visible spines and rib outlines, slightly visible hip bone and pin bone with full fat in briskets and flanks and more patchy fat around the tail head. (4.0 for sheep and goat).
9. No muscle atrophy, no visible spines and rib outlines, slightly visible hip bone and pin bone with extreme fat in briskets and flanks and extreme patchy fat around the tail head. (4.5 for sheep and goat).

All data were taken for each animal on an individual data collection sheet between 6.00am and 9.00am in a space of two months (5th June – 6th August, 2010). A total of 6,215 animals were involved during the study period.

The whole dataset was entered into the Microsoft® Office Excel for Windows 2007 spreadsheet, filtered and all errors and missing values were identified and corrected. Data subsets were formatted and transferred for further analyses into the StataIC 10® format (StataCorp, Lakeway Drive, College Station, Texas, USA). Descriptive statistics and necessary cross-tabulations were conducted to test the significance of the associations between month, breed, sex, and animal condition on the BCS of slaughtered animal species. Since the larger majority 4210/6215 (67.74%) of slaughtered animals were

bovines, this species with variables that have unconditional associations with the outcome that are significant at very liberal probability value ($P \leq 0.2$) in the univariable analysis were selected and included for further analysis in a multivariable ordered logistic regression base model (Dohoo *et al.,* 2009). Four models with BCS (response variable) were fitted to this data.

The Likelihood ratio test (LRT) was used to evaluate the difference between nested models, using a stepwise backward removal of variables. All statistically significant variables were kept in the model based on the LRT. Graphing of data was employed in displaying the trend of daily animal throughput across the study period.

Results

The total number of animals slaughtered including the trends during the period of this study was 6,215 heads (Table 1, Figure 1). Cattle accounted for 4210 (67.74%), followed by goats 1002 (16.12%), sheep 667 (10.73%), and camels 336 (5.41%). In the univariable analysis, all covariates associated with the bovine species were identified as potential predictors for BCS ($P \leq 0.20$, Table 2) except the variable "sex" for the caprine species. Among slaughtered cattle, Red Bororo breed produced the highest number 2059(45.29%) followed by Sokoto Gudali, Adamawa Gudali and White Fulani breeds with 688 (15.13%), 563 (12.38%), and 462 (10.16%) animals, respectively. Other breeds slaughtered in the minority are Azawak, Muturu, N'dama, Wadara and the unclassified/mixed breeds. None of the cattle included in this study was above 6.0 and only two of the small ruminants reached a maximum score of 4.5.The slaughtered cattle were in different body conditions with the majority (65.07%) in BCS of 3 (Table 3). Camel accounted for 7.39% of the total large ruminants slaughtered and none of the studied cattle or camel attained the BCS of 7-9 (very fat/obese).

For small ruminants (sheep and goats), the distribution of BCS revealed that majority of the animals are slaughtered in BCS of 2 (48.11%) with a total of 70.64% having a BCS of ≤2.5. (Table 4, Figure 2). Goats are more slaughtered than sheep and accounted for 1002 (60.04%) of the total small ruminant slaughtered (Table 4, and Figure 1). Among the sheep breed, 276 (16.54%) heads of Uda was slaughtered while only 1 (0.06%) head of Buzaye was slaughtered (Table 4). Among the goat breeds, Sokoto Red goat was more slaughtered 529 (31.70%) than Sahel goat 98 (5.87%). The individual group and category BCS are shown in Table 4.

Among the large ruminants (camels and cattle), the animals with poor body conditions are 3665 with the female having 67.86% (2,487/3665) of the total animals with poor BCS of ≤3. Contrastingly, the males have better BCS of 5 and 6 with a total of 113/166 (68.07%) (Table 3).Among sheep and goats, male animals have the highest number in all the BCS categories except in score 3.5 where females predominated by 51 (50.50%) (Table 4).

Predictors for BCS in the final multivariable ordered logistic regression model (Table 5) included month of slaughter, breed and sex of cattle, and animal condition. Subjective assessment of animal condition (thin, borderline and optimum) was a very strong significant predictor ($P< 0.001$) with BCS in bovine species. There was a strong negative association between the BCS of Sokoto Gudali and most of the other cattle breeds. The ordered log-odds (logit) regression coefficients for females being in a higher BCS category is -0.46 compared to males when the other variables in the model are held constant, this relationship was highly significant ($P = 0.001$).

Table 1: Total number of all animals slaughtered at the Sokoto City Abattoir from June to August, 2010

Species	Breed	Number slaughtered in heads (% of total)
Bovine	Adamawa Gudali	563 (9.06)
	Azawak	33 (0.53)
	Mixed/unclasified	260 (4.18)
	Muturu	20 (0.32)
	N'dama	7 (0.11)
	Red Bororo	2059 (33.13)
	Sokoto Gudali	688 (11.07)
	Wadara	118 (1.90)
	White Fulani	462 (7.43)
Sub-total (%)		4210 (67.74)
Camelid	Camel (local)	336 (5.41)
Caprine	Mixed/unclassified	375 (6.03)
	Sokoto Red goat	529 (8.51)
	Sahel goat	98 (1.58)
Sub-total (%)		1002 (16.12)
Ovine	Balami	229 (3.68)
	Buzaye	1 (0.02)
	Mixed/unclassified	5 (0.08)
	Uda	276 (4.44)
	Sudanese	2 (0.03)
	Yankasa	154 (2.48)
Sub-total (%)		667 (10.73)
Gross total (%)		6215 (100)

Table2: Variables tested, in each species category, in the univariable analysis to identify variables that might be of value for further investigation

Species	Variable	X^2	*P* – value
Bovine	*Month	394.24	< 0.001
	*Breed	127.35	< 0.001
	*Sex	192.37	< 0.001
	*Animal condition	7.91	< 0.001
Camelid	*Month	51.29	< 0.001
	*Sex	33.63	< 0.001
	*Animal condition	648.60	< 0.001
Caprine	*Month	155.74	< 0.001
	*Breed	15.80	0.201
	Sex	7.61	0.268
	*Animal condition	1.90	< 0.001
Ovine	*Month	72.79	< 0.001
	*Breed	130.44	< 0.001
	*Sex	15.70	0.028
	*Animal condition	1.32	< 0.001

*Variables identified significant on univariable analysis and included into the multivariable model (only for bovine specie)

Table 3: BCS of camels and cattle breeds slaughtered at the Sokoto City Abattoir from June to August, 2010

Breed	BCS and number of heads of animals (%)									Total (%)
	1	2	*1&2 (%)*	3	4	*3&4 (%)*	5	6	*5&6 (%)*	
Adamawa Gudali (bovine)	12 (14.46)	62 (9.94)	*74/563 (13.14)*	378 (12.78)	90 (12.59)	*468/563 (83.13)*	20 (12.42)	1 (20.00)	*21/563 (3.73)*	563 (12.38)
Azawak (bovine)	1 (1.20)	6 (0.96)	*7/33 (21.21)*	22 (0.74)	3 (0.42)	*25/33 (75.76)*	1 (0.62)	0 (0.00)	*1/33 (3.03)*	33 (0.73)
Mixed/unclassified (bovine)	4 (4.82)	22 (3.53)	*26/260 (10.00)*	175 (5.92)	45 (6.29)	*220/260 (84.62)*	11 (6.83)	0 (0.00)	*11/260 (4.23)*	260 (5.72)
Muturu (bovine)	0 (0.00)	8 (1.28)	*8/20 (40.00)*	8 (0.27)	3 (0.42)	*11/20 (55.00)*	1 (0.62)	0 (0.00)	*1/20 (5.00)*	20 (0.44)
N'dama (bovine)	0 (0.00)	2 (0.32)	*2/7 (28.57)*	4 (0.14)	1 (0.14)	*5/7 (71.43)*	0 (0.00)	0 (0.00)	*0/7 (0.00)*	7 (0.15)
Red Bororo (bovine)	36 (43.37)	297 (47.60)	*333/2059 (16.17)*	1330 (44.96)	318 (44.48)	*1648/2059 (80.04)*	77 (47.83)	1 (20.00)	*78/2059 (3.79)*	2059 (45.29)
Sokoto Gudali (bovine)	12 (14.46)	72 (11.54)	*84/688 (12.21)*	418 (14.13)	143 (20.00)	*561/688 (81.54)*	41 (25.47)	2 (40.00)	*43/688 (6.25)*	688 (15.13)
Wadara (bovine)	3 (3.61)	17 (2.72)	*20/118 (16.95)*	81 (2.74)	15 (2.10)	*96/118 (81.36)*	2 (1.24)	0 (0.00)	*2/118 (16.95)*	118 (2.60)
White Fulani (bovine)	10 (12.05)	74 (11.86)	*84/462 (18.18)*	304 (10.28)	69 (9.65)	*373/462 (80.74)*	5 (3.11)	0 (0.00)	*5/462 (10.82)*	462 (10.16)
Local camel (camelid)	5 (6.02)	61 (9.78)	*66/336 (19.64)*	238 (8.05)	28 (3.92)	*266/336 (79.17)*	3 (1.86)	1 (20.00)	*4/336 (11.90)*	336 (7.39)
Total (%)	83 (1.83)	624 (13.73)	*707 (15.56)*	2,958 (65.07)	715 (15.73)	*3673 (80.80)*	161 (3.54)	5 (0.10)	*166 (3.64)*	4,546 (100)

Grand totals of 1&2; 3&4; and 5&6 were indicated in italics in the Table

Table4: BCS of sheep and goats breeds slaughtered at the Sokoto City Abattoir from June to August, 2010

Breed	BCS and number of heads of animals (%)										Total (%)
	1	1.5	2	2.5	*Total 1-2.5 (%)*	3	3.5	4	4.5	*Total 3-4.5 (%)*	
Balami (ovine)	2 (5.00)	5 (8.62)	77 (9.59)	43 (15.47)	*127/229 (55.46)*	54 (19.08)	15 (14.85)	33 (31.73)	0 (0.00)	*102/229 (44.54)*	229 (13.72)
Buzaye (ovine)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	*0 (0.00)*	1 (0.35)	0 (0.00)	0 (0.00)	0 (0.00)	*1/1 (100.00)*	1 (0.06)
Mixed/unclassified (sheep)	1 (2.50)	0(0.00)	0(0.00)	1 (0.36)	*2/5 (40.00)*	1 (0.35)	0(0.00)	1 (0.96)	1 (50.00)	*3/5 (60.00)*	5 (0.30)
Uda (ovine)	3 (7.50)	2 (3.45)	92 (11.46)	48 (17.27)	*145/276 (52.54)*	71 (25.09)	29 (28.71)	31 (29.81)	0 (0.00)	*131/276 (47.46)*	276 (16.54)
Sudanese (ovine)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	*0 (0.00)*	0 (0.00)	0 (0.00)	2 (1.92)	0 (0.00)	*2/2 (100.00)*	2 (0.12)
Yankasa (ovine)	6 (15.00)	1 (1.72)	51 (6.35)	34 (12.23)	*92/154 (59.74)*	32 (11.31)	22 (21.78)	7 (6.73)	1 (50.00)	*62/154 (40.26)*	154 (9.23)
Subtotal (ovine)	12	8	220	126	*366*	159	66	74	2	*301*	667
Sokoto Red goat	12 (30.00)	29 (50.00)	296 (36.86)	88 (31.65)	*425/529 (80.34)*	65 (22.97)	21 (20.79)	18 (17.31)	0 (0.00)	*104/529 (19.66)*	529 (31.70)
Sahel goat	2 (5.00)	8 (13.79)	56 (6.97)	12 (4.32)	*78/98 (79.59)*	12 (4.24)	2 (1.98)	6 (5.77)	0 (0.00)	*20/98 (20.41)*	98 (5.87)
Mixed/unclassified (goat)	14 (35.00)	13 (22.41)	231 (28.76)	52 (18.72)	*310 (82.67)*	47 (16.61)	12 (11.88)	6 (5.77)	0 (0.00)	*65 (17.33)*	375 (22.47)
Subtotal (caprine)	14	37	352	100	*503*	79	23	24	0	*124*	1002
Total (%)	40 (2.40)	58 (3.48)	803 (48.11)	278 (16.66)	*1179 (70.64)*	283 (16.96)	101 (6.05)	104 (6.23)	2 (0.01)	*490 (29.36)*	1,669 (100)

Table5: Final multivariable ordered logistic regression model for the BCS outcome measure and its relationship with the explanatory variables for bovine species as detected by inspection of slaughtered animals at the Sokoto City Abattoir from June to August, 2010

Variable	Level (number)	Coefficient	SE	z	*P* – value	95%CI
Month	July	-	-	-	-	-
	August	0.28	0.33	0.84	0.402	-0.37; 0.93
	June	1.68	0.16	10.65	< 0.001	1.37; 1.99
Breed	Sokoto Gudali (688)	-	-	-	-	-
	Adamawa Gudali (563)	-0.68	0.24	-2.67	0.008	-1.11; -0.17
	Azawak (33)	-0.53	0.81	-0.64	0.521	-2.11; 1.07
	Mixed/unclassified (260)	0.79	0.35	2.01	0.044	0.02; 1.37
	Muturu ((20)	-0.67	0.69	-0.95	0.343	-2.02; 0.70
	N'dama (7)	-0.79	1.24	-0.61	0.543	-3.18; 1.68
	Red Bororo (2059)	-0.23	0.17	-1.10	0.273	-0.53; 0.15
	Wadara (118)	-0.20	0.43	-2.29	0.022	-1.83; -0.14
	White Fulani (462)	-0.65	0.26	-2.44	0.015	-1.13; -0.12
Sex	Male	-	-	-	-	-
	Female	-0.46	0.14	-3.25	0.001	-0.73; -0.18
Animal condition	Optimum/good	-	-	-	-	-
	Borderline/moderate	-9.48	0.60	-15.9	< 0.001	-10.65; -8.32
	Thin	-20.95	0.97	-21.59	< 0.001	-22.85; -19.05

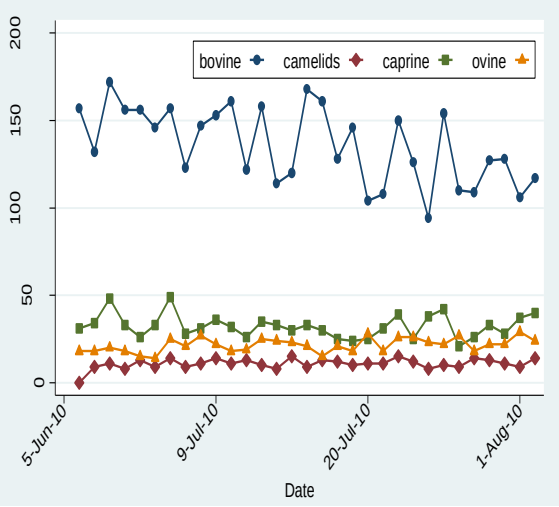

Figure 1: Number of animal species slaughtered daily at the Sokoto City Abattoir, June to August, 2010

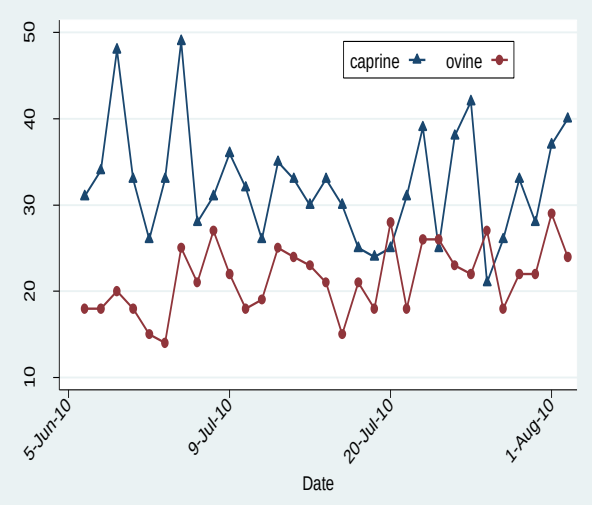

Figure 2: Number of caprine and ovine species slaughtered daily at the Sokoto City Abattoir, June to August, 2010

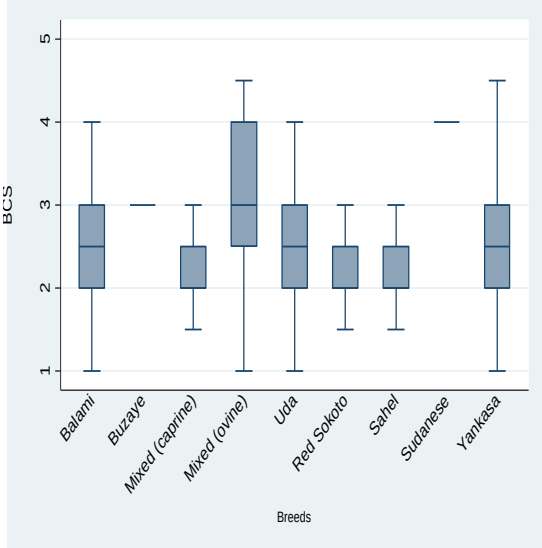

Figure 3: Distribution of BCS by breed of sheep and goats slaughtered at the Sokoto City Abattoir, June to August, 2010

Discussion

That more cattle are slaughtered than other animals may be a reflection of the large population of cattle in Sokoto, numerous markets for cattle, and the preference of the consumers to eat beef more than the meat of other species of food animals. Tewe (1997), had earlier reported that cattle are the most predominant and highly valued livestock in Nigeria and beef account for more than 50% of Nigeria's total meat supply (Haruna & Murtala, 2005). Previous study by Mohammed (2000) has also confirmed that over 80% of camels in the northwestern region of Nigeria are mainly used by the farmers for draught and transport purposes and only go for slaughter when they are incapacitated by old age or diseases. Similarly, camels are rated as the least preferred meat source by both the butchers and consumers and these explains its low frequency in the survey (Mohammed, 2000).

The wide disparities in the numbers of different breeds of cattle slaughtered in this study may be associated with the predominance of cattle breed in the study area. Although, the Sokoto Gudali and the White Fulani cattle breeds are the two predominant breeds in the state (Blench, 1999) and farmers prefer to rear them for breeding and dairying purposes, the Red Bororo breed are also readily available in the regional cattle markets due to unhindered trans-border cattle movement along the Niger Republic borders.

A significant variation also exists in the BCS among the cattle and sheep slaughtered (Tables 2-4), and most of the large ruminants (80.80%) were in moderate body conditions. It should be understood that the survey was conducted during the end of dry season into the beginning to middle of rainy season (June – August), a period when these animals that have lost significant body reserves and are just recovering and improving body conditions. Management practices for ruminants in Nigeria often involve the movement of these herds/stocks in search of feed resources. The gains in weights and BCS made when the feed resources are freely available towards the end of rainy seasons are often lost during the period of scarce feed resources and animal movements which are also associated with stress and diseases (Shittu *et al.,* 2008). It will be necessary to modify current management practices to optimise the gains in these animals; for example, feed resources may be harvested and processed during the period of abundance and use to supplement the animal feed in period of scarcity. In addition, the genetic potentials of the breeds of cattle (Sokoto Gudali and Red Bororo) and sheep (Balami and Uda) that appeared to adapt better to the Nigerian tropical environment should be further explored to maximise them for increased production. Payne (1990), Tawah & Rege, (1999) and Taiwo *et al.* (2010) had previously reported on the

advantages of Sokoto Gudali over certain other breeds.

For the small ruminants (sheep and goats), the large majority (70.64%) were in body condition scores of ≤2.5 and a large proportion (60.04%) of these percentage were goats. Apart from the factors associated with low BCS stated above, some of these animals are brought for slaughter severely diseased or stressed (including the transport stress), or were rarely fattened before presentation at the abattoir. Lamy *et al*., (2012) had pointed out the demerits of such conditions and the associated loss of incomes in earlier report.

We observed a very low frequency in the highest BCS category (6 for cattle and camel and 4.5 for sheep and goats, Table 2 & 3). It should be noted that in Nigeria, farmers rarely sell their healthiest and best built animals, unless under severe circumstances and dire needs (Wosu & Dibua, 1992; Alabi, 1993; Addass *et al.,* 2010). The Sokoto Red goats, the most dominant breed in Sokoto area, were the most slaughtered of the small ruminant species and this agreed with the findings of Okoli *et al.* (2001). It is possible that the ready availability and affordability compared to sheep may be responsible for this observation. Previous study by Mohammed (2000) has also concluded that restaurants operators prefer to buy goat meat due to its preference by customers. It is however important to know that the pattern of slaughter may change during the festivities (especially the Muslim festivals) when rams are the preferred species for slaughter. These may also partially explain why the frequency of rams and sheep are low in this study.

A very significant variation in the BCS was observed among the different breeds of goats and sheep ($P<0.001$), with goats having the higher percentage of animals with poor BCS, 722/1002 (72.10%) than sheep, 186/667 (27.90%). This significant variation may not be unconnected with the fact that while goats are mostly managed extensively with minimal daily feed allowances and supplementation by scavenging for poor quality food, sheep are often raised semi-intensively or intensively fattened before selling usually during the Ramadan Muslim festival (Wosu & Dibua, 1992; Alabi, 1993; Addass*et al.,* 2010). In addition, due to the physiological body conformation, healthy goats are expected to be in a BCS range of 2 to 3.5 while sheep may fall within the higher scores (Detweiler *et al.*, 2008; Yami & Merkel, 2009).

Similarly, a significant variation exists in the BCS recorded between the sexes in camels and cattle ($P<0.001$) with females having a higher proportion of the animals in poor BCS, 569(80.48%), while males have the higher number with better BCS, 138 (19.52%). This variation may be due to the fact that male animals may have more body reserves since they may only be used for breeding and sometimes draught while the female animals are involved for pregnancy and milk production in addition to the other uses mentioned above. The female animals are also sold only when they become very old, less productive or incapacitated with diseases while the male are sold in their prime.

Our study has certain limitations; it focused on only one regional abattoir within the northwest region of Nigeria, a more spread national study may present a different view. In addition, the health status or presence of infection or abnormality among the slaughtered animals was not correlated with the BCS but we are aware that this may bias the BCS in the different animals. The duration of the study was small and does not cover the different periods of the year. It will be necessary to do an all-year round study to evaluate the patterns of slaughter and predict/plan for the future use of the abattoir. Finally, there were some resistance and lack of cooperation by the butchers and abattoir workers, and as such, it was difficult to have an accurate and detailed annual slaughter statistics from the Sokoto City Abattoir from which a good retrospective data may have been compared to the current study. However, findings from this pilot study may serve as a basis for a more comprehensive evaluation of the abattoir slaughters in Nigeria.

Finally, we recommend that certain fixed criteria should be set for the slaughter of animals within Sokoto Abattoir and by refection other Nigerian abattoir and more comprehensive data recording system for slaughter should be implemented to ensure that production animals are slaughtered at appropriate body condition for optimum productivity, while excellent slaughter statistics and research data are generated at the Nigerian abattoirs.

References

Addass PA, Midau A, Milka M & Tizhe MA (2010). Assessment of Abattoir Foetal Wastage of Cattle, Sheep and Goat in Mubi Main Abattoir Adamawa State, Nigeria. *World Journal of Agricultural Sci*ence, **6**(2):132-137.

Alabi A (1993). Ante-mortem and post-mortem Inspection of Food Animals. *Paper presented at a Workshop on Meat Inspection held at the College of Agriculture and Animal Science.* Mando Road, Kaduna, Nigeria, Pp 23-30.

Apple JK, Davis JC & Stephenson J (2010). Influence of Body Condition Score on By-Product Yield and Value from Cull Beef Cows. *Journal of Animal Science,* **77**(10):2670–2679.

Blench RM (1997). Neglected Species, Livelihoods and Biodiversity in Difficult Areas: How Should the Public Sector Respond? *Natural Resource Perspective Paper 23.* London: Overseas Development Institute.

Blench RM (1999). Traditional Livestock Breeds: Geographical Distribution and Dynamics in Relation to the Ecology of West Africa. *Working Paper 122.* London: Overseas Development Institute.

de Souza AG, de Souza JC, de Andrade IF, de Freitas RTF &Cirillo MA (2008). Characterisation of Cattle Slaughtered at the Public Abattoir in Lavras-MG. Ciênc. *Agrotec., Lavras*. **32**(1):251-257.

Detweiler G, Gipson T, Merkel RC, Goetsch A &Sahlu T (2008). Body Condition Scores in Goats. Goat Field Day, Langston University, Langston, Pp 127-133.

Dohoo IR, Martin SW & Stryhn H (2009). Veterinary Epidemiologic Research. VER Inc., Charlottetown, Prince Edward Island, Canada, Pp 136-150.

Eversole DE, Browne MF, Hall JB & Dietz RE (2009). Body condition scoring for beef cows. *Publication 400-791*, *Virginia Cooperative Extension, Virginia Polytechnic and State University.* http://pubs.ext.vt.edu/400/400-795/400-795.html, retrieved 2012-04-21.

Faye B, Bengoumi M, Cleradin A, Tabarani A & Chilliard Y (2001). Body Condition Score in Dromedary Camel: A Tool for Management of Reproduction. *Emirate Journal of Agricultural Science*, **13**:1-6.

Haruna U & Murtala N (2005). Commodity Chain Analysis of Cattle Marketing in Nigeria; A Case Study of K.R.I.P Area Kano State. *A Report Submitted to ADENI Project/NAERLS,* Zaria, Pp 13-14.

Lamy E, van Harten S, Sales-Baptista E, Mendes Guerra MM & de Almeida AM (2012). Factors Influencing Livestock Productivity. Ch 2, pp 19-51. *In: Environmental Stress and Amelioration in Livestock Production. Sejian V, Naqvi SMK, Ezeji T, Lakritz J & Lal R, editors),* http://www.springer.com/978-3-642-29204-0, retrieved 2014-04-19.

Mamman AB (2005). Transport aspects of livestock marketing at the Achida and Sokoto Kara markets. http://community.dur.ac.uk/nigerian.marketing/A.B.%20Mamman%20-%20Transport%20Aspects%20of%20Livestock%20Marketing%20at%20the%20Achida%20and%20Sokoto%20Kara%20Markets.pdf, retrieved 2014-04-19.

Mohammed I (2000). Study of the Dromedary in the Smallholder Crop-livestock Production Systems in Northwestern Nigeria. Cuvillier Verlag, Göttingen, Pp 228.

Neary M & Yager A (2002). Body Condition Scoring in Farm Animals. *Purdue Extension Service. Purdue University* AS-550-W. http://www.ces.purdue.edu/extmedia, retrieved 2013-11-07.

Payne WJA (1990). An Introduction to Animal Husbandry in the Tropics.(4th edition).*Tropical Agricultural Series. Longman Group Ltd, New York (USA).*Pp 881.

Shittu A, Junaidu AU, Chafe UM, Magaji AA, Faleke OO, Salihu MD, Jibril A & Mahmud MA (2008). A Survey on Current Milk Production and Pricing in Sokoto State, Nigeria. *Sokoto Journal of Veterinary Sciences,* **7**(1):53-58.

Sokoto BA (2001). The Study of Local Geography for Nigerian Secondary Schools (1st edition). *Ministry of Education, Sokoto*, Pp 104-110.

Taiwo BBA, Olaniran ODD & Aluko FA (2010). Breed and Environmental Factors Affecting Body Measurements of Beef Cattle in Yewa, Nigeria. *Agriculture Journal,* **5**(3):211-214.

Tawah CL & Rege JEO (1999).The State of African Cattle Genetic Resources II. *Geographical Distribution, Characteristics and Uses of Present-day Breeds and Strains. Animal Genetic Resources Information (FAO),* **26**:1-25.

Tewe OO (1997). Sustainability and Development: Paradigms from Nigeria's Livestock Industry. Inaugural Lecture Series. University of Ibadan Press, Ibadan, Pp 41.

Wosu LO &Dibua EC (1992). Lamb and Kid Wastage Through Slaughtering of Pregnant Ewes and Goats at Enugu and Nsukka Abattoir in Anambra State, Nigeria *In: Small Ruminant Research and Development in Africa: Proceedings of the First Biennial Conference of the African Small Ruminant Research Network (SHB Lebbie & I Ranolds, editors),* ILRAD Nairobi - Kenya. http://ilri.org/InfoServ/Webpub/fulldocs/AnGenResCD/docs/X5520B/X5520B00.HTM, retrieved 2014-04-19.

Yami A & Merkel RC (2009). ESGPIP *Sheep and Goat Production Handbook for Ethiopia.* USAID funded project in Ethiopia. http://www.esgpip.org/, retrieved 2014-04-19.