

Traditional cattle breeding and management systems of smallholder farmers in Yobe state, Nigeria

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Target audience: *Animal breeder, animal scientists, researchers, ruminant expert, household farmer.*

Abstract

This research investigated the traditional cattle breeding and management practices of smallholder farmers in Yobe state, Nigeria. Information was collected on herds' size and structure, effective population size, breeding and management systems, using structured questionnaire. Data obtained were analyzed using Descriptive statistics of SPSS V. 20.0. Chi square (χ^2) statistics were used to compare variables between agro-ecological zones. The rate of inbreeding (ΔF) among cattle populations was estimated. Eastern zone had larger mean herd size (11.4 ± 0.30) composed mainly Red Bororo (6.9 ± 0.24). Higher (1.3 ± 0.09 , 2.2 ± 0.13) male and female calves were observed for Northern and Eastern zone, respectively. Majority (41.2%) of the farmers had between 6-10 cattle per herd while 6.0% had more than 20. Effective population size was higher (1466.0) in Eastern zone. Inbreeding rate estimate was low (0.03). Most (97.9%) farmers culled their cattle by selling. Majority (81.0%) of farmers selected their animals based on individual performance. Most (81%) farmers had no knowledge of inbreeding. Only 25.0% farmers in each of Northern and Eastern zones practiced intensive management. A few (17%) farmers kept record on their animals with majority (33.5%) in the north while 95.0% did not in the southern zone. Cross breeding increased 29.5%, 36.0% to 50.0% in Northern, Eastern and Southern zones, respectively but line breeding decreased from 70.5, 64.5 to 50.0% in Northern, Eastern and Southern zones. Control mating is recognized (43.3%). There were significant ($P < 0.001$) differences across zones on the practice of control mating with higher (68.5%) number in the south.

Keywords: Red Bororo; population size; inbreeding; cross breeding; breeding

Description of Problem

The rate at which human population increases currently in the Tropics is a matter of concerns (1). In Nigeria particularly, the sharp slump in oil prices poses a negative toll on the nation's economy. The consequent effect of which generated urgent need to address under nutrition, enhancing food security, combating rural poverty and achieving rates and pattern of agricultural growth that would contribute to overall economic development and environmental protection (2). Animal agriculture in the tropics is done for multiple purposes staked by different breeding objectives (3). Any breeding programme is totally dependent on environmental condition, the production system, the culture of the people for whom the animals are bred and marketed, and to which the products are sold (4). Indigenous knowledge of animal breeding is made up of various concepts and practices used by livestock breeders to influence the genetic composition of their herd (5). Tropical regions are endowed with wide variety of strains and breeds of livestock that have evolved to adapt to the prevailing harsh environmental conditions and traditional husbandry systems (6). The animals have high degree of heat tolerance and are partly resistant to many prevailing animal diseases in the tropics and with ability to survive long periods of feeds and water shortages. However, it is quite obvious that the potential for milk and meat is poorly developed in most of the indigenous breeds of the tropics (7).

Cattle command a prominent position in Nigerian livestock industry. Beef is estimated to supply about 45 percent of total meat consumed in Nigeria (7). National herd contains an estimated population of 9.2 million herds of cattle in

1981 with an estimated annual growth rate of 1.5 percent. Recent report (2022) has it that Nigeria's cattle population is estimated at 20.9 million heads (8). Over 90 percent of these are in the hands of traditional producers in the Northern parts of the country. Experience from advanced livestock genetic improvement programmes, particularly in developed countries has shown that long-term evolving strategies involving the public and private sectors can be highly successful (9). One of such approaches that has recently stimulated global interest is a community-based breeding strategy (10).

Designing effective genetic improvement strategy for the smallholder stipulates prior knowledge of traditional systems and institutions pertaining to livestock breeding (11). Smallholder farmers have very valuable knowledge about animal management and desirable traits but less knowledge on how genes are transmitted to the next generation and how to use information from relatives for genetic improvement (12). In the past, most breeding programmes were designed by scientists and implemented by development agents without taking into consideration all of the needs of the farmers and the long-term impacts of their actions (13). Consequently, most of the breeding programmes failed (14). Indigenous knowledge can be a source of information about scientifically undocumented breeds and traits (5, 15). According to (16), biological characterization may not, on its own, be adequate for decisions on conservation because diversity is being lost due to human activities and preferences, and human beings also adopt and adapt breeds to their needs. Ultimately, both the rate of

interbreeding and the success of improvement strategy, depend upon the actions of the farmers who own and utilize those animals. Therefore, people's knowledge and preferences should be an integral part of characterization. The intent of this study was therefore to examine the traditional cattle breeding and management systems of smallholder farmers in Yobe state, Nigeria

Materials and Methods

Description of the Study Area

Yobe state is situated at the North eastern region of Nigeria. It has a total land area of 45,502 square kilometers. This state lies between coordinates of latitude 11° N and longitude 13.5° E. The State's vegetation is predominantly of the Sudan savanna type, with scattered desert trees such as *acacia* species. There is also an area of Sahel savanna, consisting of sandy soils and thorn scrubs, which is located in the far north. The state has local boundaries with Bauchi, Borno, Gombe and Jigawa and borders to the north of Diffa and Zinder regions of Niger Republic.

The state falls within the Sahel savannah ecological zone with annual rainfall of between 1000 and 1100 mm per annum. Effective rainy season starts from mid-May or early-June. Mean monthly minimum and maximum temperatures were 24.13°C and 33°C, respectively with an average of 29.3°C. The month of March is the hottest in the year while December is the coldest. Relative humidity of Yobe state ranges from about 12% in February to about 68% in August (17).

This research was carried out from July 2019 to January 2020 in some selected Local Government Areas of Yobe State. The selected local government areas covered all the three (3) Agro-ecological

zones of the state as described by Yobe state Agricultural Development Programme (YOSADP). The zones are Northern zone which comprises of seven local government areas: Bade, Jakusko, Karasuwa, Machina, Yunusari, Yusufari and Nguru local government areas. Eastern zone covered six local government areas: Damaturu, Geidam, Bursari, Gujba, Gulani and Tarmuwa local government areas. Southern zone consists of four local government areas: Potiskum, Nangere, Fika and Fune local government areas.

Out of the seventeen (18) local government areas of the state, twelve (12) were randomly selected (four local government areas from each agricultural zone). Five (5) villages/ communities were then purposively selected in each of the randomly selected local government areas based on accessibility and livestock population. Ten (10) cattle farmers/households were purposively chosen in each of the selected village/community based on their years of experience with the aid of extension agents and ward heads. This amounted to a total sample of 600. The farmers were individually interviewed using structured questionnaires earlier pretested for suitability. The questionnaires covered information on herd sizes and population structure, selection practices, traditional breeding and management practices.

Data Analysis

Data obtained were first sorted and checked for errors to improve precision and then analyzed using SPSS Statistical Package version 20.0 (18). Descriptive statistics using frequency counts and standard errors were performed. Cross tabulations and Chi square (χ^2) statistics were used to compare categorical

variables between agro-ecological zones. One-way analysis of variance was used to compare herd size between the agroecological zones and where significant differences were detected, means were separated using Fisher's Least Significance difference (LSD) test.

The rate of inbreeding (ΔF) among cattle populations was estimated according to the formula by (19).

The effective population size (N_e) for a randomly mated population was calculated using the formula:

$$\Delta F = \frac{1}{2N_e}$$

Where:

ΔF = rate of inbreeding

N_e = Effective population size

$$N_e = \frac{4NmNf}{Nm + Nf}$$

Where:

N_e = Effective population size

N_m = Number of breeding males

N_f = Number of breeding female

Results and Discussion

Table 1 shows the overall mean size and structure of farmers' herds as observed in this study. There were significant ($P < 0.01$) differences among the zones in overall mean herd sizes as well as in herd composition based on breed, calves of both sexes and breeding males. However, no significant difference was observed between the zones in number of breeding females per herd. The largest mean herd size (11.4 ± 0.30) was in the Eastern zone followed by 9.9 ± 0.40 and 9.8 ± 0.48 in the Southern and Northern zone, respectively. Breeds composition of the herds were

mainly Red Bororo (6.9 ± 0.24), followed by White Fulani (2.4 ± 0.09) and the least (1.8 ± 0.15) being Sokoto Gudali across all the locations. The mean number of Red Bororo cattle per herd was 9.0 ± 0.46 , 7.6 ± 0.39 and 4.2 ± 0.31 in the Northern, Eastern and Southern zones, respectively. The means for White Fulani on the other hand was 3.1 ± 0.34 in the Southern zone, followed by (1.8 ± 0.26) in the Eastern zone and (0.45 ± 0.10) was in the Northern zone. For Sokoto Gudali, the highest mean (2.0 ± 0.21) was observed in the Eastern zone followed by 1.7 ± 0.17 and 0.39 ± 0.07 in the Southern and Northern zones, in that order.

The result of this study that revealed Red Bororo as being the most common breed reared in all the locations agrees with earlier reports (20, 21, 22, 23) who found that Red Bororo was the most preferred breed in most Northern Nigerian states. This could be due to its adaptation potentials in terms of disease resistance and tolerance to drought (23).

The highest herd size observed in the Eastern agro-ecological zone as reported in the current study (11.4 ± 0.30) could be attributed to the enthusiasm of middle-aged men towards cattle rearing for financial gains, as attested to by their high number across the zones. This category of people has affinity towards cattle business which could be linked with the close proximity of the study area to some major livestock markets in Jigawa, Gombe and Bauchi states, Nigeria. This is in line with the definition of livestock marketing system by (24) as the functionally interdependent institution of human beings and physical facilities that directs the flow of livestock from areas of production to appropriate points for slaughter and subsequent consumption as meat.

For male calves, the averages were (1.3 ± 0.09), (1.0 ± 0.07) and (0.8 ± 0.08) for

Table 1: Means and standard errors of herd's composition

Variables	North	East	South	N	LOS
Herd size	9.8±0.48 ^b	11.4±0.30 ^a	9.9±0.40 ^b	10.4±0.23	*
Herd composition					
Breeding bulls	1.9±0.08 ^b	2.8±0.10 ^a	2.6±0.10 ^a	2.4±0.06	***
Breeding cows	4.8±0.30	5.0±0.10	4.9±0.26	4.9±0.14	NS
Male calves	1.3±0.09 ^a	1.0±0.07 ^a	0.8±0.08 ^b	1.3±0.11	***
Female calves	1.9±0.18 ^a	2.2±0.13 ^a	1.3±0.11 ^b	1.8±0.07	***
Herd composition (Breeds)					
Red Bororo	9.0±0.46 ^a	7.6±0.39 ^b	4.2±0.31 ^c	6.9±0.24	***
White Fulani	0.4±0.10 ^e	1.8±0.26 ^b	3.1±0.34 ^a	1.8±0.15	***
Sokoto Gudali	0.39±0.74 ^b	2.0±0.2 ^a	1.7±0.17 ^a	2.4±0.09	***

^{abc} Means within row with different superscript significantly differ, *(P<0.05), ***(P<0.001), NS: Not significant, N: Overall mean

Northern, Eastern and Southern zones, respectively. On the other hand, the highest mean (2.2±0.13) for female calves was observed in the Eastern zone, followed by 1.9±0.18 in the Northern zone and the least (1.3±0.11) was in the Southern zone. The findings that most of the herds were mainly composed of breeding cows agrees with the reports of (22), (25), (26), (27) and (28) in different cattle herds in some African countries including Nigeria. It could be attributed to the need to multiply herds rapidly with more breeding cows, necessitates the avoidance of keeping large number of bulls. The annual removal of breeding bulls for *Eid el-kabir* rites by the Muslims could also in part explain the dominance of breeding cows in most herds in this research. This was also observed by

(29) and (30).

Table 2 presents the herd size distribution. Majority (41.2%) of the respondents had between 6-10 cattle per herd, this is followed by 25.5% of those of between 11-15 cattle per herd, while 19.2% of the respondents had between 1-5 cattle per herd, and a few cattle farmers (8.2%) and (6.0%) had between 16-20 and more than 20 cattle per herd, respectively.

Effective population size and estimated inbreeding rates are presented in Tables 3 and 4. The overall effective population size was 3954.4. Across the zones, effective population size was 1466.0, 1396.5 and 1091.9 for Eastern, Southern and Northern zones. The overall male to female ratio was 1:2. The ratios were 1:3 for Northern zone and 1:2 for each of the Eastern and

Table 2: Respondents herd size distribution

Variable	North	East	South	N	χ^2	LOS
Herd Class						
Up to 5	55(47.8)	6(5.2)	54(47.0)	115(19.2)		
6-10	75(30.4)	104(42.1)	68(27.5)	247(41.2)	55.535	***
11-15	47(30.7)	59(38.6)	47(30.7)	153(25.5)		
16-20	10(1.7)	20(3.3)	19(3.2)	49(8.2)		
> 20	13(36.1)	11(30.6)	12(33.3)	36 (6.0)		

χ^2 : Chi-square, LOS: Level of Significance, Figures in parenthesis are in percentages, *** (P<0.001): Statistically significant at 99.9%, N: Overall mean

Table 3: Effective population size

Variables	North	East	South	Total (N)
N_m	381	573	537	1491
N_f	963	1017	998	2978
N_e	1092	1466	1396	3954

N: total, N_f : Number of females, N_m : Number of males, N_e : Effective population, $\%F$ = Inbreeding rates

Table 4: Estimated inbreeding rates

Rate of inbreeding ($\%F$)	Percentage (%)
North	0.04
East	0.03
South	0.03

Southern zones. The estimated average inbreeding rate (ΔF) in percentage was 0.03. Meanwhile, the estimated inbreeding rate across the zones, was 0.04 for the Northern zone and 0.03 for each of the Eastern and Southern zones.

The low inbreeding rate estimates being observed in this study indicates that the practice of allowing herds to mix and graze with other herds in most of the villages could be one of the factors limiting inbreeding. This consequently makes village herds into more or less a large single herd. This observation is in agreement with the findings earlier reported by (31). It was observed by (32) that population size has a major impact on the dynamics of a population as the smaller the population, the higher the tendency to be depressed in its reproductive potential due to inbreeding. (30) similarly observed that inbreeding is unlikely to be an issue in open herds. This observation agrees with the findings of (21) and (33).

Table 5 shows the respondents selection and culling practices. It revealed that 71.7% of the farmers practiced selection of animals that will be parents of subsequent generations. Out of this, 97.9% culled their animals by selling, while only 2.1% culled by slaughtering. The zones significantly ($P < 0.001$) differed in stages and methods of selection, but no significant differences

were observed between them in terms of culling practices. Majority (62.8%) selected animals only when they were matured, 16.7% did selection when the animals were young while 20.5% selected the animals at both stages (multi-stage). The table also revealed that 81.0% of the farmers selected their animals based on individual performance while a few (9.5%) did so based on pedigree records and progeny performance in each case.

The proportions of respondents that used individual performance as method of selection by zone were 86.0, 85.4 and 71.3% in the Southern, Northern and Eastern-zones, respectively. On the other hand, those that used progeny performance were in the order 11.9%, 9.7% and 7.0% for Eastern, Northern and Southern zones. Selection using pedigree information was practiced by 16.8%, 7.0% and 4.9% in the Eastern, Southern and Northern zones, respectively.

The results of awareness of inbreeding (Table 6) revealed that 81% of the cattle farmers had no knowledge of inbreeding and its consequences regardless of zone. This result was buttressed by the larger proportion of the farmers (68.7%) who had no knowledge of correlation between traits (Table 6). There were no significant associations between zones and respondent's awareness of inbreeding and

its consequences.

Majority (69.2%) of the respondents had elites in their herds as shown in Table 6; larger percentage (66.5) were willing to accept elites from other herds while a smaller portion (33.5%) of the respondents were not willing to do so. In line with this, 52.0% against 48.0% of the respondents were not willing to borrow out their elites. Across the zones, Southern zone had significantly ($P<0.001$) higher number of respondents that had elite animals and also willing to borrow these animals to other farmers compared to other zones. However, there were no significant differences between the zones on their willingness to accept elite animals from other herds. Majority (51.8%) of the respondents allowed their animals to graze with other herds while 48.2% of them restricted them, especially during the rainy season.

Farmers in the zones significantly ($P<0.001$) differed in their management systems and breeding methods (Table 7). The farmers that practiced intensive management system were meager (25.0%) in Northern and Eastern zones while higher proportion (39.0%) were into intensive system in the Southern zone. Interestingly, farmers that practiced semi-intensive system accounted for larger proportion (75.0, 69.5 and 52.5%) in the Northern, Eastern and Southern zones. For the extensive system of management, there were 8.4% (Southern), 5.5% (Eastern) and 0.0% (Northern) farmers. This suggests that shifting of local cattle farmers from old management practice (extensive) to semi-intensive and intensive systems; would be an indicative of improvement in local animal agriculture.

The result of record keeping by cattle farmers as revealed in Table 7 indicated that on average, only 17% of the farmers kept record on their animals while larger proportion (82.7%) did not keep record.

There was significant ($P<0.001$) difference between record keeping and non in the three zones. Specifically, the northern zone was higher (33.5%) in record keeping while respondents who did not keep record were higher (95.0%) in the southern zone. This finding is an indication that smallholder cattle agriculture has not received improvement in the area of record keeping which is crucial to livestock breeding and management for effective productivity.

The proportion of farmers that practiced cross breeding across the zones were 29.5%, 36.0% and 50.0% for Northern, Eastern and Southern zones, respectively, while those that practiced line breeding were in the order 70.5, 64.5 and 50.0% in the Northern, Eastern and Southern zones.

The result of this study showed that 43.3% of the cattle farmers practiced control mating while larger portion (56.7%) did not care to practice control mating. There were significant ($P<0.001$) differences across the zones on the practice of control mating. It is revealed that significant (68.5%) number of respondents were practicing control mating in the southern zone while a lower (25.5%) did practice in the north. By implication, majority (74.5%) of the cattle farmers in the northern zone did not practice control mating with a lower (31.5%) in the southern agro-ecological zone. These findings could not be unconnected with high level of western education observed for the higher majority of cattle farmers in the southern zone and low in the north. Education is believed to open knowledge and wisdom of practicing thing in a better way.

Conclusions and Application

1. Eastern zone had larger mean herd size and most the breeds' herds were composed mainly of Red Bororo.

Table 5: Selection and culling practices of cattle farmers

Variables	North	East	South	N	χ^2	LOS
Selection practice						
Yes	144(72.0)	143(71.5)	143(71.5)	430(71.7)	24.373	**
No	56(28.0)	57(28.5)	57(28.5)	170(28.3)		
Stage of selection						
Young	21(14.6)	41(28.8)	10(7.0)	72(16.7)	125.549	***
Matured	67(46.5)	76(53.1)	127(88.8)	270(62.8)		
Multi Stage	56(38.9)	26(18.1)	6(4.2)	88(20.5)		
Selection method						
Individual	123(85.4)	102(71.3)	123(87.8)	348(81.0)	54.872	***
Pedigree	7(4.9)	24(16.8)	10(7.0)	41(9.5)		
Progeny	14(9.7)	17(11.9)	10(7.0)	40(9.5)		
Culling method						
Slaughtering	4(2.0)	6(3.0)	2(1.0)	12(2.1)	5.495	NS
Selling	196(98.0)	194(97.0)	198(99.0)	588(97.9)		

LOS: Level of Significance, χ^2 : Chi-square value, **: (P<0.01), ***: (P<0.001), NS: Not significant difference, N: Total

Figures in parenthesis represent percentages

Table 6: Farmers Awareness of Inbreeding and Correlation between Traits and Sharing of

Breeding Stocks						
Variables	North	East	South	Total	χ^2	LOS
Awareness of inbreeding depression						
Yes	47(23.5)	37(18.5)	30(15.0)	114(19.0)	4.743	NS
No	153(76.5)	163(81.5)	170(85.0)	486(81.0)		
Awareness of correlation between traits						
Yes	76(38.0)	53(26.5)	59(29.5)	188(31.3)	6.615	NS
No	124(62.0)	147(73.5)	141(70.5)	412(68.7)		
Presence of elites						
Yes	126(63.0)	114(57.0)	175(87.5)	415(69.2)	162.826	***
No	74(37.0)	86(43.0)	25(12.5)	185(30.8)		
Borrowing out elites						
Yes	88(44.0)	79(39.5)	121(60.5)	288(48.0)	19.591	***
No	112(56.0)	121(60.5)	79(39.5)	312(52.0)		
Willingness to accept elites						
Yes	141(70.5)	120(60.0)	138(69.0)	399(66.5)	5.027	NS
No	59(29.5)	80(40.0)	62(31.0)	201(33.5)		
Herd graze with others						
Yes	115(57.5)	131(65.5)	65(32.5)	311(51.8)	47.477	***
No	85(42.5)	69(34.5)	135(67.5)	289(48.2)		

LOS: Level of Significance, χ^2 : Chi-Square, ***: (P<0.001): Statistically significant at 99.9%. NS: Not significant, Figures in parenthesis are in percentages

Table 7: Management practices and breeding methods

Variable	North	East	South	N	χ^2	LOS
Management System						
Intensive	50(25.0)	50(25.0)	78(39.0)	178(29.7)	33.118	***
Semi-Intensive	150(75.0)	139(69.5)	105(52.5)	394(65.7)		
Extensive	0(0.0)	11(5.5)	17(8.5)	28(4.7)		
Presence of records						
Yes	67(33.5)	27(13.5)	10(5.0)	104(17.3)	59.763	***
No	133(66.5)	173(86.5)	190(95.0)	496(82.7)		
Breeding Methods						
Cross	59(29.5)	72(36.0)	100(50.0)	231(38.5)	26.730	***
Line	141(70.5)	128(64.0)	100(50.0)	369(61.5)		
Control mating practice						
Yes	51(25.5)	72(36.0)	137(68.5)	260(43.3)	81.869	***
No	149(74.5)	128(64.0)	63(31.5)	340(56.7)		

N = Total, χ^2 = Chi -square, LOS: Level of Significance, ***: (P<0.001), Figures in parenthesis are in percentages

2. Male and female calves were abundant in the Northern and Eastern zone.
3. Most farmers kept 6-10 cattle per herd while a few kept larger numbers.
4. Individual performance was used as selection criteria and Inbreeding rate estimate was low.
5. Semi-intensive management system was predominantly practiced with selling being the primary culling method.
6. Cross breeding practice increased north- east ward with reverse pattern for line breeding. Thus, farmers should be encouraged to practice cross breeding for better productivity.

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