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PRODUCTIVITY INDICES OF THE RED SOKOTO GOAT REARED UNDER SEMI-INTENSIVE MANAGEMENT IN THE NORTHERN GUINEA SAVANNA ZONE OF NIGERIA

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Target Audience: Researchers, breeders and geneticists, and goat producers.

ABSTRACT

The study conducted on the Red Sokoto goat (RSG) flock at the National Animal Production Research Institute, Shika, Zaria, assessed the productivity of the goats based on some indices of overall flock performance. The effects of environmental variables on productivity were also examined. Least-squares means were 24.97 kg for weight of kids produced per doe per year (Index I), 943.75 g for weight of kids per kg liveweight of doe per year (Index II), 2.13 kg for weight of kids per kg metabolic weight of doe per year (index III), 28.48 kg for total litter weight at 90 days per doe during lifetime (Index IV) and 12.60 kg for kid mass per parturition (Index V). The values of Indices I, II and III were within the upper limits reported for most African goat breeds. All environmental variables studied significantly ($P<0.05$) influenced the indices except season which was not important for Index III. Type of birth, parity and parturition interval had the most important influence on productivity. Correlations among Indices I, II, and III were high, positive and significant ($P<0.01$) and between kidding interval and Indices I, II and III were all negative. The productivity of the RSG could therefore be improved by greater attention to management to increase litter size and litter weight at birth and weaning, and to reduce kidding intervals. Combined with selection for these traits, better productivity should be achieved.

Key words: Productivity indices, Red Sokoto goat.

DESCRIPTION OF PROBLEMS

Goats form about 61.4% of the small ruminant population in Nigeria (11), with the Red Sokoto goat (RSG) as one of the major types. The contributions of the RSG to the national economy have been quite enormous providing meat, milk, skin, manure, fibre and cash. The skin which is one of the world's most valuable (6), formed a major export product for Nigeria in the colonial

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and immediate post colonial era. In order to meet up with the increasing demand for food and cash, the productivity of the RSG must be increased through improved husbandry and breeding applications.

The productivity of goats has been quantified by different measures (22, 25, 15, 20, 12, 13, 5) as appropriate for different situations or purposes and as determined by available data. Also, the productivity of the RSG has been evaluated by several workers (2, 7, 1, 19, 9). These authors focussed mainly on individual characteristics (e.g. growth rate, weights at different ages, mortality, parturition interval, etc.) as measures of productivity. Since meat production is a function of doe fertility, prolificacy and mothering ability, kid mortality and kid weight, single figures (indices) that combine these components that influence total animal productivity have been developed (25, 20, 13, 5). Such indices could be used to make meaningful comparisons within and between different breeds and production systems.

Wilson (23, 24) in an analysis of the productivity of sheep and goats based on the output of meat per kg liveweight of breeding female, showed that goats were better producers of meat than sheep, their productivity indices being 0.37 and 0.25, respectively. Using indices I, II, and III it was shown that sex and parity have the most consistent influence on goat productivity (25, 27). These investigators also demonstrated that type of birth has a significant effect on productivity of goats, lending support to selection for multiple births.

The objective of this study was to evaluate the productivity of the RSG using a number of indices of overall flock performance and to assess the effects of environmental variables on flock productivity.

MATERIALS AND METHODS

The study was conducted at the National Animal Production Research Institute, Shika, Zaria located in the subhumid zone of Nigeria. Shika is characterized by wide variations in seasonal distribution of rainfall (varying from 0.1% falling in the late dry season to 69.6% in the late wet season) and temperature (from 4°C in the late dry season to 37°C in the late wet season). Forage availability follows the pattern of rainfall.

Animals were managed semi-intensively and fed with a supplementary concentrate ration of 250 - 500 g/head/day, depending on physiological status, before grazing. They were routinely treated against internal and external parasites and provided with suitable shelter at night.

Production, breeding and reproduction records were kept on all animals. Data recorded on 401 kiddings with information on litter size, weaning weight, viability, postpartum doe body weight and parturition interval were used in constructing three productivity indices for each doe, as follows:

$$\text{Index I: Weight of kids produced per doe per year (kg)} = \frac{\text{Litter weight at weaning}}{\text{parturition interval}} \times 365$$

$$\text{Index II: Weight of kids produced per kg liveweight of doe per year (g)} = \frac{\text{Index I}}{\text{Doe postpartum weight}} \times 1000$$

$$\text{Index III: Weight of kids produced per kg metabolic weight of doe per year (kg)} = \frac{\text{Index I}}{\text{Doe postpartum weight}^{0.75}}$$

Does that did not wean their kids were assigned zero values for productivity indices. Similarly, for dams in their first parity, subsequent parturition interval was used in the construction of Index I.

Index IV and Index V (kid mass index) were also constructed for each doe to evaluate additional apparent biological productivity of does. Thus,

$$\text{Index IV} = \text{Total litter weight at 90 days per doe during lifetime}$$

$$\text{Index V (kid mass)} = \frac{\text{Index IV}}{\text{Average number of parturitions per flock}}$$

The environmental sources of variation considered in data analysis for Indices I, II and III were parity (1, ..., 6), type of birth (singles, twins, triplets, quadruplets), season of birth (late dry - January to March, early wet - April to June, late wet - July to September and early dry - October to December) and year of birth (1988, 1989, 1990). For Indices IV and V the factors included were lifetime birth type (1 - singles all through, 2 - multiple birth at least once, 3 - multiple birth more than once) and total number of parturitions during lifetime (1, ..., 7). Data analysis was by the General Linear Model procedure of SAS (21) software package. Means with significant differences were separated by the Duncan's New Multiple Range test (8) programme available in the software. Correlations among the indices and components of flock productivity were also evaluated.

RESULTS AND DISCUSSION

Productivity indices I, II, and III

Least squares means of productivity indices I, II and III are given in Table 1. All variables except season significantly ($P<0.05$) influenced the three indices; the effect of season on Index III was not pronounced. Index values of 24.97 ± 0.38 kg (Index I), 943.75 ± 16.61 g (Index II) and 2.13 ± 0.04 kg (Index III) are within the upper limits reported for most African goat breeds (see Table 2) and indicate a high productivity for the RSG. Indices I and III values are very

Table 1. Least squares means (± SE) for productivity Indices I, II and III

Variable	N	Index I (Kg)		Index II (g)		Index III (Kg)	
		LSM	±SE	LSM	±SE	LSM	±SE
Overall	401	24.97	0.38	943.75	16.61	2.13	0.04
Parity							
1	125	20.97^{d}	1.10	868.87^{c}	48.39	1.92^{c}	0.11
2	114	21.37^{cd}	1.05	864.85^{c}	46.00	1.93^{c}	0.10
3	90	22.53^{cd}	1.13	860.04^{c}	49.76	1.93^{c}	0.11
4	49	23.63^{c}	1.31	844.67^{c}	57.46	1.91^{c}	0.13
5	18	27.94^{b}	1.94	984.08^{b}	85.27	2.25^{b}	0.11
6	5	33.43^{a}	3.64	1240.01^{a}	160.19	2.84^{a}	0.35
Type of birth							
single	136	12.29^{d}	0.92	454.91^{c}	40.53	1.03^{c}	0.09
twin	202	18.17^{c}	0.82	651.25^{bc}	36.03	1.48^{b}	0.08
triplet	56	24.34^{b}	1.24	823.44^{b}	54.51	1.88^{b}	0.12
quadruplet	7	45.09^{a}	3.02	1845.41^{a}	132.63	4.13^{a}	0.29
Season							
late dry	86	26.52^{a}	1.29	1008.49^{a}	56.75	2.28	0.13
early wet	105	23.73^{bc}	1.13	909.73^{b}	49.65	2.02	0.11
late wet	85	24.86^{b}	1.35	910.58^{b}	59.49	2.06	0.13
early dry	125	24.80^{b}	1.17	946.20^{b}	51.52	2.14	0.11
Year							
1988	155	24.54^{b}	1.31	923.48^{b}	57.76	2.09^{b}	0.13
1989	140	24.15^{c}	1.25	963.55^{a}	54.85	2.16^{a}	0.12
1990	106	26.24^{a}	1.07	944.24^{a}	47.10	2.14^{b}	0.10

^{abcd} Means in the same column within variables with different superscripts are significantly different ($P<0.05$).

Index I = Weight of kid weaned per doe per year.

Index II = Weight of kid weaned per ky live weight of doe per year.

Index III = Weight of kid weaned per ky metaboloc weight of doe per year

similar to the respective values of 25.42 kg and 2.04 kg reported for the Sudan Desert goat (25). The high productivity may be credited to the higher litter sizes at birth and weaning, lower doe postpartum weight and shorter parturition interval of these goats compared to other African breeds (Table 2).

Productivity generally increased with parity, being highest at the sixth parity. This trend might be attributed to larger litter sizes, heavier weights of kids at birth and weaning and better mothering ability of older dams. This finding is supported by the works of Wilson (25) and Wilson et al. (27). Wilson (25) attributed lower productivity of primiparous dams to higher mortality rate of their kids. In addition, the ongoing physiological development of younger does could impair their productivity.

Table 2. Means of components of flock productivity of the Red Sokoto goat compared with some African goat breeds

Trait	Breed	Mean	Location	Authors
Litter size at birth	Adal	1.07	Ethiopia	Awgichew et al. (4)
	Saanen x Adal	1.16	Ethiopia	Awgichew et al. (4)
	Swazi goats	1.85	Swaziland	Lebbie and Manzini (16)
	WAD goat	1.79	Nigeria	Odubote (18)
	Red Sokoto	1.82	Nigeria	Present study
Litter size at weaning	Adal	0.95	Ethiopia	Awgichew et al. (4)
	Saanen x Adal	0.95	Ethiopia	Awgichew et al. (4)
	Red Sokoto	1.74	Nigeria	Present study
Individual weaning weight (kg)	WAD	4.87	Nigeria	Ebozoje et al. (10)
	WAD x Red Sokoto	6.06	Nigeria	Ebozoje et al. (10)
	Red Sokoto	6.58	Nigeria	Present study
Litter weaning weight (kg)	Red Sokoto	6.77	Nigeria	Present study
Parturition interval (days)	Landim	391	Mozambique	Mckinnon and Rocha (17)
	Long legged West African			
	Sahel goat	311	Sudan	Wilson and Light (26)
	WAD goat	275.5	Nigeria	Odubote (18)
	Red Sokoto	215.26	Nigeria	
Postpartum body weight (kg)	Adal	33	Ethiopia	Awgichew et al. (4)
	Saanen x Adal	32.9	Ethiopia	Awgichew et al. (4)
	Long legged West African			Wilson and Light (26)
	Sahel goat	29.0	Sudan	Karua (14)
	Small East African	32.27	Malawi	Present study
	Red Sokoto	24.91	Nigeria	

Type of birth was one of the most important factors found to influence the productivity of the RSG. Quadruplet births yielded productivity index values of 32.8 kg for Index I, 1390.5 g for Index II and 3.1 kg for Index III in excess of those of single births. Multiple births therefore contributed more to the productivity of does than singles. Although larger litter sizes have been associated with higher mortality rates of kids (3), adequate management practices could be used effectively to reduce mortality rates. It is in recognition of the inherent advantages that Wilson et al. (27) recommended selection for multiple births as a means of improving goat productivity.

The season and year in which the does kidded also had serious implications on their productivity. Highest productivity was recorded for parturitions occurring in the late dry season (January - March) which is a period that has been shown to record the highest kid viability (3). The low mortality rate of kids at this period of the year coupled with abundant forage that comes with the onset of

the rains could have enhanced the productivity of the does. Significant ($P<0.05$) year effect may be related to seasonal effects on forage availability and general management practices.

Significantly ($P<0.01$) very high and positive correlations (Table 3) among the indices implies that improving Index I would also result in the improvement of Indices II and III. Negative but significantly low correlations were however recorded between the three indices and parturition interval implying that prolonged intervals would lower productivity. Wilson and Light (26) also reached the same conclusion. Short parturition interval is therefore desirable for enhanced productivity. Correlations between dam's postpartum weight and all three indices were significantly ($P<0.01$) fairly high and positive, surprisingly

Table 3. Correlations among productivity indices and their components

	Index I	Index II	Index III	Parturition interval	Postpartum dam weight
Index I					
Index II	0.89**				
Index III	0.92**	0.99**			
Parturition interval	-0.17**	-0.16**	-0.17**		
Postpartum dam weight	0.37**	0.39**	0.42**	0.03	
Litter weaning weight	0.47**	0.43**	0.45**	0.07	0.40**

** $P<0.01$, d.f. = 399.

so with Indices II and III for which negative relationships were expected. This may be explained by the relatively heavier weaning weights of litters from older dams which might have overwhelmed the effect of their higher postpartum weights compared with younger dams. Positive correlations between litter weaning weight and all three indices were expected though they were not as high as would be for part-whole relationships which they are.

Productivity Indices IV and V

Lifetime number of kiddings and lifetime birth type had significant ($P<0.001$) influences on additional apparent biological productivity of the RSG (Table 4). Indices IV (total litter weight at 90 days per doe during lifetime) and V (kid mass) consistently increased with number of kiddings. This was expected since the more the number of parturitions by a dam, the greater its productivity, all other things being equal. Does that had multiple births two or more times during their lifetime were the highest producers. This again emphasizes the

importance of multiple births in the productivity of goats. Selection for litter size will therefore enhance biological productivity of goats.

Table 4. Least squares means (± SE) for Indices IV and V by variables affecting them

Variable	N	Index IV [1] (kg)		Index V [2] (kg)	
		LSM	±SE	LSM	±SE
Overall	177	28.48	0.49	12.60	0.22
Life time parturitions					
1	63	6.87^{e}	0.96	3.04^{e}	0.42
2	58	12.22^{de}	.093	5.41^{de}	0.41
3	25	19.21^{d}	1.36	8.49^{d}	0.60
4	18	27.87^{c}	1.62	12.33^{c}	0.72
5	8	34.86^{bc}	2.35	15.42^{bc}	1.04
6	1	37.19^{b}	6.54	16.46^{b}	2.89
7	4	61.15^{a}	3.42	27.06^{a}	1.51
Life time birth type					
1	38	28.17^{b}	1.71	12.46^{b}	0.76
2	102	29.19^{a}	1.28	12.91^{b}	0.57
3	37	29.88^{a}	1.46	13.43^{a}	0.65

^{abcdefg} Means in the same column within variables with different superscripts are significantly different ($P<0.05$).

[1]Index IV = Total litter weaning weight at 90 days per doe during lifetime.

[2]Index V = Index IV averaged over the number of parturitions per flock.

CONCLUSIONS AND APPLICATIONS

It can be concluded from this study that the Red Sokoto goat is characterized by high productivity, comparable to those of the best African breeds of goats. All the environmental factors examined exerted significant influences on the productivity of the goats, except season that had no effect on Index III. The major contributors to the high productivity were litter size, litter weaning weight and kidding interval. The importance of multiple births in enhancing the productivity of the goat is also underscored by this study. However, as shown in a previous study, multiple births are also prone to heavier mortality losses. These findings call for greater attention to management to increase litter size and litter weight at birth and at weaning, and to shorten the intervals between kiddings, in order to fully exploit the productivity potential of the goat.

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