

ENVIRONMENTAL FACTORS AFFECTING BIRTH WEIGHT AND LITTER SIZE IN YANKASA SHEEP

R.O. BALOGUN, M.E. OLAYEMI AND O.A. OSINOWO.

National Animal Production Research Institute,
Federal Ministry of Science and Technology,
Ahmadu Bello University,
P. M. B. 1096, Shika, Zaria, Nigeria.

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ABSTRACT

Records on 1634 lambings of a Yankasa sheep flock collected from 1983 to 1990 were used to determine the effects of parity, litter size, sex, season and year of birth on birth weight, and that of parity, season and year of birth on litter size respectively.

Least squares means (\pm s.e.) for birth weight and litter size were 2.49 ± 0.013 kg and 1.22 ± 0.010 respectively. Birth weight was significantly ($P < 0.01$) affected by parity, sex, litter size and season of birth. Lambs born in the late wet season had higher birth weights than those born in other seasons. Also, male and single lambs were heavier at birth than female and twin lambs.

Litter size was significantly ($P < 0.01$) affected by parity, season and year of birth. Late wet season lambing had lower litter size than other seasons.

The repeatability estimates for birth weight and litter size were 0.19 ± 0.028 and 0.01 ± 0.032 respectively while phenotypic correlation between the two traits was -0.249 .

Key words: Environmental, litter size, birth weight, Yankasa sheep.

INTRODUCTION

Lamb weight at birth is one of the most important factors influencing their survival and growth, with heavier lambs surviving better than the lighter ones. A high birth weight confers an initial advantage which is maintained at least to weaning (Adu *et al.*,

1979).

Combellas *et al.* (1980) also reported that the relationships between birth weight and weaning weight, and between weaning weight and slaughter weight are economically very important in lamb production.

Litter size is one of other factors determining prolificacy in livestock and the ability to increase litter size will generally increase meat production in sheep. Accelerated lambing system (twice-yearly) has also been reported to achieve this goal (Osinowo *et al.*, 1985).

Considering the importance of higher birth weight and litter size, it is necessary to select for them in order to achieve increased production of sheep. Ainsworth and Shrestha (1987) have reported a progressive increase in overall fertility and fecundity as the type of birth of lambs increased from single to triplet.

The repeatability estimate of a trait is a parameter that measures the relationship between repeated measurements of such trait on the same individual. It sets an upper limit to heritability and could also be used to predict future performance from past record (Falconer, 1989).

Repeatability estimates of some traits such as litter size, birth weight, litter weight and weaning weight had been investigated (Bradford, 1972) and it has been noted that gain in accuracy expected from multiple measurements on this traits is dependent on repeatability (Falconer, 1989).

The objectives of this investigation were therefore, to study the effects of parity, litter size, sex, season and year of birth on birth weight, and that of parity, season and year of birth on litter size in Yankasa sheep. Also,

repeatability estimates of birth weight and litter size as well as the phenotypic correlation between these two traits were estimated.

MATERIALS AND METHOD

The data used for this study were 1634 and 1382 lambing records of a pure-bred Yankasa flock, collected over a period of 8 years (1983-1990) at the National Animal Production Research Institute, Shika, Nigeria. Shika lies within the Northern Guinea Savanna Zone of Nigeria and its local climatic conditions have earlier been described by Adu, *et al.* (1979).

All factors under study were considered at lambing and ewes within the first sixth parities were used. Litter size for the purpose of this study refers to the number of lambs born per ewe at each parturition. The seasons of birth were divided into late dry (January - March), early wet (April - June), late wet (July - September) and early dry (October - December) according to the rainfall pattern in the area of study. During the period from 1983 - 1990, sheep were kept under the semi-intensive system of management where they were being grazed on improved pastures of *Andropogon gayanus*, *Hyparrhenia rufa*, *Cyanadon spp*, *Chloris gayana* and *Stylosanthes spp*. Prior to grazing the animals were supplemented with concentrate ration consisting of about 15%CP at 300 - 500g per head. During the dry season the animals were offered the above forage hay at 1 - 2% body weight in addition to grazing and concentrate supplementation.

Statistical Analysis

The effects of the environmental factors under investigation were analysed using the least squares method and the differences between means were tested using the Probability Difference Comparison (SAS, 1987). The statistical model used for the analysis of birth weight was: (a) $Y_{ijklmn} = U + S_i + A_j + T_k + Z_l + B_m + E_{ijklmn}$, where, Y_{ijklmn} = measurement on the trait of interest, U = overall mean for birth weight,

S_i = the fixed effect of the i th parity of dam,
 A_j = the fixed effect of the j th sex of lamb,
 T_k = the fixed effect of the k th litter size of dam,

Z_l = the fixed effect of the l th season of birth,
 B_m = the fixed effect of the m th year of birth,
 E_{ijklmn} = uncontrolled random error.

A similar model that excluded sex of lamb and litter size of dam was used for the analysis of litter size.

Repeatability estimates for birth weight and litter size were calculated based on intra-class correlation using the variance component estimation procedure as described by Helwig and Council (1979). The phenotypic correlation between birth weight and litter size was computed using Pearson's correlation, and tested by Pearson's probability (Wilkinson, 1988).

RESULTS AND DISCUSSION

Results of the least squares analysis are shown in Table 1. All factors under study except for year of birth had significant ($P < 0.01$) influence on birth weight. Also parity and season of birth significantly ($P < 0.01$) affected litter size, as did year of birth ($P < 0.05$).

The overall least squares mean for birth weight in this study was lower than 2.8 kg and 2.9 kg reported by Buvanendran *et al.* (1981) and Osinowo (1990) for Yankasa sheep, but closer to 2.52 kg reported by Hassan (1987) for the same Yankasa sheep. It was however, lower than 3.59 and 3.39 kg reported for Balami and Sudanese Desert sheep respectively by Adu *et al.* (1985). Birth weight significantly increased from first to sixth parity ($P < 0.01$). The slight decline at the fifth parity was not, however, significant ($P > 0.05$). This agrees with Adu *et al.* (1985) who reported that birth weight was significantly affected by parity but that the effect decreased with age.

The significant effects of sex and litter size on birth weight agree with the findings of other workers (Adu and Ngere, 1979; Adu *et al.*, 1985). Male lambs had significantly

TABLE 1. LEAST SQUARE MEANS FOR BIRTH WEIGHT (BWT) AND LITTER SIZE (LS)

Main effects	Sub-class	No. of observations		Least square means	
		BWT	LS	BWT	LS
Overall means		1634	1382	2.49±0.013	1.22±0.010
Parity	1	534	473	2.25±0.026 ^a	1.12±0.019 ^a
	2	405	345	2.42±0.029 ^b	1.16±0.023 ^{ab}
	3	324	269	2.51±0.030 ^c	1.21±0.024 ^{bc}
	4	184	150	2.54±0.040 ^c	1.24±0.032 ^{cd}
	5	116	89	2.51±0.050 ^c	1.31±0.042 ^d
	6	71	56	2.68±0.064 ^d	1.30±0.053 ^{cd}
Sex	Male	808		2.68±0.022 ^a	-
	Female	826		2.30±0.022 ^b	-
L size	Single	1131		2.69±0.020 ^a	-
	Twin	503		2.28±0.025 ^b	-
Season	Late dry	418	350	2.33±0.033 ^a	1.25±0.027 ^a
	Early wet	450	367	2.45±0.032 ^b	1.26±0.026 ^a
	Late wet	342	298	2.67±0.033 ^c	1.18±0.025 ^b
	Early dry	424	367	2.49±0.033 ^b	1.20±0.026 ^{ab}
Year	1983	89	74	2.43±0.063	1.29±0.050 ^a
	1984	196	159	2.43±0.042	1.25±0.034 ^b
	1985	189	155	2.50±0.040	1.21±0.032 ^{ab}
	1986	114	97	2.52±0.050	1.21±0.040 ^{ab}
	1987	198	172	2.53±0.046	1.24±0.036 ^{ab}
	1988	450	372	2.51±0.034	1.26±0.028 ^a
	1989	255	227	2.45±0.036	1.16±0.029 ^b
	1990	143	126	2.51±0.050	1.14±0.039 ^b

Means within column within main effects with different superscripts are different at $P < 0.01$ except for the year of birth ($P < 0.05$).

($P > 0.01$) higher birth weights than female lambs. The same goes with lambs born single against those born twins. Lambs born during the late wet season had significantly ($P < 0.01$) higher birth weights than those born in other seasons with the least observed at late dry season.

Birth weight generally increased from late dry through early wet season and reached a peak during late wet season after which it declined. Birth weight of lambs born in early wet season was not, however, significantly ($P > 0.05$) different from those obtained during the early dry season. This agrees with the findings of Buvanendran *et al.* (1981) using Yankasa sheep. It however contradicts the results of Adu *et al.* (1985) who reported higher birth weights during the dry season period.

The highest birth weight during the late wet season could be due to the fact that the dams to those lambs born during this period must have conceived during the late dry period (February - April) thus making the gestation period, most especially the last trimester to fall within the period when forage was abundant (June - August). The dam thus had more feed for foetal development and hence higher birth weights. The reverse situation was the case for those lambs born at other seasons, when forage quality or quantity are usually low. The non-significant effect of year of birth on birth weight agrees with the findings of Adu *et al.* (1985).

The overall least squares mean for litter size obtained for this study is in close agreement with 1.17 reported for Balami sheep (Adu *et al.*, 1985) and 1.29 for Yankasa sheep by Osinowo (1990). It is however, lower than 2.34 reported for Finnish Landrace crossbred ewes (characterized by large body sizes) under an accelerated lambing programme involving lambings three times in two years (Notter and Copenhaver, 1980). Litter size significantly ($P < 0.01$) increased from first to the fifth parity and declined insignificantly ($P > 0.05$) at the sixth parity. Age of dam which is a factor

of parity has been reported to influence litter size (Adu *et al.*, 1979; Sumberg and Mack, 1985; Osinowo, 1990). Ewes that lambbed in the early wet season had significantly ($P < 0.01$) larger litter sized than those that lambbed in the late wet season but were not significantly ($P > 0.05$) different from those that lambbed in the early and late dry seasons. Also early dry season lambing was not significantly ($P > 0.05$) different in litter size from late wet season lambing.

Generally however, litter size increased from early dry season through late dry to early wet season after which it declined. This result agrees with that of Osinowo *et al.* (1989) who reported higher average litter sizes in their dry season classification (January-June) than in their wet season classification (July-December). Their dry season corresponds to the late dry and early wet seasons in this study which also had higher litter sizes. Adu *et al.* (1985) however reported no significant difference in litter size as a result of seasonal variations, although ewes that lambbed in the wet season had a slightly higher litter size than those that lambbed in other seasons.

The significantly higher litter sizes obtained for ewes giving birth in the late dry and early wet seasons could be explained by the fact that they were bred when forage was available in the fields (August to December). Flushing has been shown to increase ovulation rate and hence litter size in ewes (Smith *et al.*, 1981). The reverse situation goes with those ewes lambbed in the late wet and early dry seasons. The significant ($P < 0.05$) effect of year of birth on litter size did not follow any particular pattern. However, variations in climatic conditions between years, as well as the overall management could be the contributing factors.

The repeatability estimates for birth weight and litter size are shown in Table 2. The repeatability estimate for birth weight in this study is slightly higher than 0.14 reported for Yankasa sheep (Hassan, 1987) but is much closer to 0.17 and 0.18 reported for Targhee and Suffolk breeds of sheep respectively (Abd

TABLE 2. REPEATABILITY ESTIMATES AND PHENOTYPIC CORRELATION OF BIRTH WEIGHT (BWT) AND LITTER SIZE (LS)

Trait	N	Repeatability ± S. E	Phenotypic correlation
BWT	1634	0.19±0.028	-
LS	1382	0.10±0.032	-
BWT:LS	1382	-	- - 0.249*

*P<0.01

ulkhaliq *et al.* 1989). It is however, lower than 0.23 reported for Welsh Mountain ewes by Dalton (1962).

The repeatability estimate for litter size closely agrees with 0.12 and 0.09 reported for Targhee and Suffolk breeds respectively (Abdulkhaliq *et al.* 1989). It was however, lower than values of 0.17 reported for Columbia sheep by the same authors.

There was a negative and significant ($P<0.01$) phenotypic correlation (-0.249) between birth weight and litter size (Table 2).

It can be concluded from this study that birth weight and litter size were affected by the factors under study (except for year of birth which did not affect birth weight) and that these factors should be given proper consideration in planning any breeding programme for Yankasa sheep. Also, it was found that the repeatability estimates for birth weight and litter size in Yankasa sheep were low and therefore there will be gain in accuracy if multiple measurements are taken on these traits. And also, a negative and significant phenotypic correlation exists between birth weight and litter size.

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