Environmental factors influencing performance of West African Dwarf goats under semi-intensive management system

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ABSTRACT

The study used data on 562 kiddings from a flock of West African Dwarf goats maintained under semi-intensive management system at the National Goat Breeding Station, Kintampo, over 5 years (1997 to 2001). Records of performance were birth weight, sex of kid, type of birth, weaning weight at the age of 90 days, and pre-weaning growth and survival rates among the kids . The overall mean values for birth weight, weaning weight, and pre-weaning average daily gain were 1.17 kg, 4.05 kg and 32.0 g day^{-1}, respectively. Pre-weaning kid survival rate was 92.2 per cent, resulting in an overall pre-weaning kid mortality rate of 7.8 per cent. The proportions of singles, twins and triplets were 4.2, 50.2 and 1.6 per cent, respectively. Average litter sizes at birth and at weaning were 1.35 and 1.25, respectively. Statistical analyses of the data showed significant differences (P<0.05) in the sources of variation due to year and season of birth, type of birth and sex of kid, suggesting an influence of these factors on the growth and survival of kids up to weaning age.

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RÉSUMÉ

BAFFOUR-AWUAH, O., ANTIRI, Y. K. & DONKOR, J.: *Facteurs environnementaux influençant la performance des chèvres naines d'Afrique Occidentale sous le système de gestion demi-intensif*. Des données sur 562 chevreaux d'une bande de chèvres naines d'Afrique occidentale maintenues sous le système de gestion demi-intensif au Centre d'Élevage National de Chèvre, Kintampo pendant de cinq ans (1997-2001) ont été employées pour l'étude. Les indices d'étude obtenus étaient le poids de naissance, sexe de l'enfant, type de naissance, le poids de sevrant à l'âge de 90 jours et des taux de croissance et de la survie de pré-sevrage parmi les chevreaux. Les valeurs moyennes globales pour le poids de naissance, le poids de sevrage et le gain moyenne quotidien de pré-sevrage étaient de 1.17 kg, 4.05 kg et 32.0 g/jour, respectivement. Le taux de survie de chevreau de pré-sevrage était 92.2% ayant pour résultat un taux de mortalité global de chevreau de pré-sevrage de 7.8%. Les proportions des isolées, des jumeaux et les triplets étaient 4.2, 50.2 et 1.6%, respectivement. Les tailles moyennes de portée à la naissance et au sevrage étaient 1.35 et 1.25, respectivement. Les analyses statistiques des données ont indiqué des différences significatif (P<0.05) dans les sources de variation dues à l'année et la saison de naissance, le type de naissance et le sexe du chevreau, suggérant une influence de ces facteurs sur la croissance et la survie des chevreaux jusqu'à l'âge de sevrage.

Introduction

Under Ghana's World Bank-sponsored National Livestock Services Project, the Animal Production Department of the Ministry of Food and Agriculture in 1996 established a nucleus breeding station for the West African Dwarf goat at Kintampo in the Brong Ahafo Region as an *ex-situ* conservation strategy of this indigenous breed of goat. The National Goat Breeding Station, so established, was designed to undertake a genetic improvement programme of the West African Dwarf goat through selection, using village flocks as the main selection base. The foundation stock was West African Dwarf goat and their crosses of varying ages secured from mainly the open livestock markets countrywide.

Its purpose was to supply good breeding animals to farmers while conserving the genetic resource of the indigenous goat. It was envisaged that with the availability of the improved animals for breeding, the economic traits of the West African Dwarf goat as a meat producer would be enhanced.

Published reports from the tropics indicate that the major limiting factor in meat production from goats is their inherently low growth rate (Devendra & Burns, 1983). However, some evidence suggests that much genetic variability exists within many tropical breeds of goats; and progress through selective breeding in improving growth and overall performance in goats seems possible (Naude & Hofmeyer, 1981; Pattie, 1984). Nevertheless, the effective use of genetic variation in animal breeding requires reliable information regarding environmental and genetic effects on economic traits. Analysis of the non-genetic effects of production traits leads to a greater understanding of factors that underlie differences in animal performance, and which obscure genetic variation (Lewer, Rae & Wickham, 1983). It is, therefore, desirable to correct for such environmental effects, and so improve the accuracy with which genetic parameters are estimated.

The West African Dwarf goat is the most dominant goat breed in Ghana (Buadu, 1972; Tuah *et al.*, 1992). There have been reports on such non-genetic factors as year and season of birth, type of birth and sex of kid, and their effects on the birth weight and subsequent growth rates of some tropical breeds of goats (Mavrogenis, Constantinou & Louca, 1986). The need is to find out whether those factors have any effects on growth traits of the West African Dwarf goat, and the extent to which they cause variations in animal performance under Ghanaian conditions.

A study was undertaken to examine some major environmental factors influencing live weights at birth and weaning, and growth rate of kids before weaning in flock of West African Dwarf goats. The study provided some baseline information on pre-weaning performance of the indigenous West African Dwarf goats raised under semi-intensive management system in Ghana.

Materials and methods

Description of the study area

The study area, Kintampo, lies on latitude 8º 03'N and longitude 1º 43'E and is in the transitional agro-ecological zone of the Brong Ahafo Region. The average annual rainfall is 1300 mm. The two rainy seasons are the major (from August to November) and minor (from April to July) with a dry period (from December to March). The vegetation in this area comprises short branching trees that do not form close canopy, but are scattered. The ground layer consists of annual grasses, mainly *Panicum* and *Cynodon* spp.

Flock management

The animals were maintained under a semi-intensive system in which they were kept in pens during the night, and grazed on open pastures of *Cynodon plectostachyus* and *Stylosanthes hamata* and *Centrosema pubescens* in the day between 9.00 a.m. and 3.00 p.m. Supplementary feeding was practised, especially during the dry season when forage was scarce. Cassava peels, groundnut haulms and cowpea vines, corn chaff and dried brewer's spent grain were used. Clean water was provided twice daily, and mineral lick was also provided *ad libitum*. Routine medication included deworming of adults and weaners with *Abendazole*. The animals were vaccinated yearly against the *Peste de Petits Ruminants* (PPR) disease and regularly sprayed to control ticks and other ecto-parasites. Controlled mating was practised with matings in March/April, November/December, and July/August. These resulted in expected kiddings in August/September (in the major rains), April/May (in the minor rains), and December/January (in the dry season). Kids were tagged and classified according to type of birth and sex at birth. All kids were weighed within 2 h after birth and, thereafter, monthly. Kids were weaned in batches at the age of 90 days.

Source of data, data collection and analyses

The study used data on the kids born at the National Goat Breeding Station, Kintampo, in the Brong Ahafo Region of Ghana between 1997 and 2001. Records on each kid included kid identification number, year of birth, season of birth, type of birth and sex of kid, birth weight, and weaning weight. Pre-weaning growth rate of each kid, with complete data up to weaning, was calculated. From the number of kids born and those weaned, the proportion of kids dying before weaning was calculated to represent the pre-weaning mortality. The data were analysed statistically to determine the effects due to year and season of birth and sex of kids, using the Generalized Linear Model Procedure of the Minitab Statistical Package (Minitab, 1996).

Results and discussion

Pre-weaning growth traits

Kids born in 2000 were heavier at birth (1.25 kg)(Table 1) and at weaning (4.60 kg)(Table 2), and had the highest pre-weaning growth rate of 37.2 g day^{-1} (Table 3). In contrast, kids born in 2001 recorded the lowest birth weight (1.11 kg), weaning weight (3.76 kg), and pre-weaning growth rate (27.4 g day^{-1}). These differences could be attributed to the variations in the climatic and environmental conditions during the study, which might cause variation in feed availability; and also to changes in the management practices on the farm within the period (Moulick & Syrstad, 1970; Mavrogenis *et al.*, 1984; Adu, Odeniyi & Taiwo,1988; Benji *et al.*,1995).

Kids born during the minor rainy and dry seasons were heavier at birth (Table 1) and at weaning (Table 2) than those born during the major rainy season. The trend was translated into pre-weaning growth rate that was highest for kids born in the minor rainy season (36.2 g day^{-1}) as compared to kids born during the major rainy season (31.1 g day^{-1})(Table 3). This could be due to the availability of forage materials and, therefore, the relatively high plane of nutrition during the period of mating, which improved the reproductive performance of the does (Sachdeva, Singh & Lindahl, 1973; Amoah & Bryant, 1983; Payne, 1990). Kids born in the dry season recorded a significantly higher ($P < 0.05$) weaning weight (Table 3) because of the supplementary feed that was given to all nursing does only during the dry season when forage materials were scarce.

Male kids were significantly ($P<0.05$) heavier at birth and at weaning, and also grew faster during the suckling period. Others have reported on the effect of sex on growth traits in sheep and goats (Devendra & Burns, 1983; Malik, Kanujia & Pander, 1986; Mavrogenis *et al.*, 1986). This sexual dimorphism has been observed at all phases of growth from birth to maturity in small ruminants

TABLE 1

Least Square Means of Birth Weight (kg) of Kids

Factor	*n*	*Mean kg^{-1}*	*se*
Year of birth			
1997	147	1.19b	0.014
1998	98	1.19b	0.012
1999	82	1.16b	0.013
2000	61	1.2b	0.018
2001	172	1.11c	0.014
*Season of birth**			
Minor rains	107	1.7a	0.013
Major rains	329	1.15b	0.010
Dry	126	1.19a	0.010
Sex			
Male	287	1.22a	0.010
Female	275	1.14b	0.009
Type of birth			
Singles	271	1.23a	0.009
Twins	282	1.11b	0.009
Triplets	9	1.00c	0.017
Overall	562	1.17	0.007

Means with different letters for each sub-class are significantly different ($P<0.05$)

*Season of birth: Minor rains: April-July
Major rains: August-November
Dry: December-March

TABLE 2

Least Square Means of Weaning Weight (kg) of Kids

Factor	*n*	*Mean kg^{-1}*	*se*
Year of birth			
1997	125	3.89b	0.049
1998	95	4.08b	0.051
1999	73	4.53a	0.090
2000	58	4.60b	0.102
2001	167	3.76c	0.059
*Season of birth**			
Minor rains	90	4.45a	0.068
Major rains	310	3.95c	0.042
Dry	118	4.01b	0.054
Sex			
Male	261	4.20a	0.047
Female	257	3.91b	0.043
Type of birth			
Singles	258	4.20a	0.046
Twins	252	3.90b	0.045
Triplets	8	4.26a	0.219
Overall	518	4.05	0.038

Means with different letters for each sub-class are significantly different (P<0.05)

*Season of birth: Minor rains: April-July
Major rains: August-November
Dry: December-March

TABLE 3

Least Square Means of Pre-weaning Growth Rate of Kids (g day^{-1})

Factor	*n*	*Mean kg^{-1}*	*se*
Year of birth			
1997	125	29.8c	0.49
1998	95	29.8c	0.54
1999	73	32.2b	0.99
2000	58	37.2a	1.03
2001	167	27.4d	1.22
*Season of birth**			
Minor rains	90	36.2a	0.61
Major rains	310	31.1b	0.44
Dry	118	31.2b	0.56
Sex			
Male	261	33.3a	0.50
Female	253	30.9b	0.46
Type of birth			
Singles	258	32.9b	0.48
Twins	252	30.6c	0.49
Triplets	8	36.3a	0.36
Overall	518	32.0	0.34

Means with different letters for each sub-class are significantly different (P<0.05)

*Season of birth: Minor rains: April-July
Major rains: August-November
Dry: December-March

(Moulick & Syrstad, 1970; McGregor, 1984). The sexual difference in growth, according to Inyangala, Reye & Italya (1992), is attributable to hormonal differences between the sexes and their effects on growth.

Kids born as singles were heavier at birth and at weaning than twins and triplets (Tables 1 and 2), because single foetuses are better nourished *in utero* during the gestation period (Adu & Ngere, 1979). However, triplets grew faster than single and twin-born kids (Table 3), in spite of their low birth weights. Nevertheless, this was associated with the special attention and care given to the triplets during the suckling period. The proportions of singles, twins and triplets in this study were 48.8, 50.2 and 1.6 per cent, respectively. The figures differed remarkably from those reported by Buadu (1972) as 35 per cent singles, 55 per cent twins, 8.1 per cent triplets, and 1.9 per cent quadruplets for West African Dwarf kids born in the humid forest zone of Ghana.

The values recorded for the growth traits in this study for the West African Dwarf goat at the Kintampo Goat Breeding Station are lower when compared to those reported by Vohradsky & Sada (1973) and Devendra & Burns (1983) for West African goats in Ghana. Probably, not much selection for growth traits had been carried out in the flock at Kintampo.

TABLE 4

Pre-weaning Mortalities of West African Dwarf Kids

Factor	*n*	*Mean kg*$^{-1}$	*se*
Year of birth			
1997	149	24	16.1
1998	98	3	3.1
1999	82	9	11.0
2000	61	3	4.9
2001	172	5	2.9
*Season of birth**			
Minor rains	107	17	15.9
Major rains	329	19	5.8
Dry	126	8	8.5
Sex			
Male	287	26	9.1
Female	275	18	6.5
Type of birth			
Singles	271	13	4.8
Twins	282	30	10.6
Triplet	9	1	11.1
Overall	562	44	7.8

*Season of birth: Minor rains: April-July
Major rains: August-November
Dry: December-March

Pre-weaning kid mortality

The highest kid mortality of 16 per cent was recorded in 1997 at the beginning of the project. But as the years progressed and the management practices improved and the animals became acclimatized to the conditions on the farm, fewer kid deaths were recorded, with the lowest kid mortality of 2.3 per cent in 2001 (Table 4). The season of birth seemed critical to pre-weaning kid survival, with kids born in the two rainy seasons combined having higher mortality rates than those born in the dry season. The rainy season was usually the peak of worm infestation, which could be detrimental to the health of the kids, especially before they were weaned (Osuagwuh & Akpokodje, 1981; Turkson, Antiri & Baffour-Awuah, 2004).

Male kids had a higher mortality rate than female kids (Table 4), although they were slightly heavier at birth (Table 1). According to Devendra & Burns (1983), Awumbila & Sumani (1992), and Armbruster & Peters (1993), kids with low birth weights often die within a short period after birth. With low weights, kids are not in a better condition to withstand any environmental stress; and so they could be killed by the slightest unfavourable conditions. However, Osuagwuh & Akpokodje (1981) reported a higher mortality among female West African Dwarf kids and argued that could be the result of their low birth weights. In this study, although female kids had lower birth weights, the male kids were more at risk and had a higher mortality rate. Similar results were reported by Hight & Jury (1970). Factors other than birth weight may have affected pre-weaning mortalities of kids (Turkson *et al.*, 2004).

At the pre-weaning stage, a higher proportion of the dead kids were twins. Similar observations were recorded in northern Ghana by Awumbila & Sumani (1982) who found that kids from multiple births died more than single-born kids. Johnson *et al.* (1982) noted that pre-weaning mortality normally increased with litter size owing to a decline in birth weight as litter size increases. However, Osuagwuh & Akpokodje (1981) reported that the type of kidding or litter size did not influence the pre-weaning mortality pattern of West African Dwarf goats kept on an institutional farm in Nigeria.

The overall pre-weaning mortality of about 8 per cent in this study was lower than the 39 per cent reported for West African Dwarf goats kept under improved management in Nigeria (Osuagwuh &Akpokodje, 1981). Vohradsky & Sada (1973) had a mortality rate of about 21 per cent for kids up to 3 months of age under village conditions in Ghana, which was higher than that recorded in this study for kids of the same age. Improved management in institutional farms was found to reduce early and high mortality losses in West African Dwarf goats in Nigeria and Cote d'Ivoire (Osuagwuh & Akpokodje, 1981;

Armbruster & Peters, 1993).

Conclusion

Under semi-intensive management system for the West African Dwarf goat in Ghana, year and season of birth, type of birth, and sex of kid had some effect on birth weight, weaning weight, pre-weaning weight and pre-weaning growth rate and survival of kids. The pre-weaning kid mortality was lower than figures reported for West African Dwarf goats kept under village conditions (Vohradsky & Sada ,1973). The level of growth performance of the West African Dwarf goat under a semi-intensive system of management was found to be lower than what has been reported for the breed in Ghana and the sub-region (Oppong & Yebuah, 1981; Devendra & Burns, 1983; Adu *et al*., 1988). However, more fruitful avenue for the overall improvement in the level of performance in the flock of West African Dwarf goats at Kintampo likely lies in selective breeding to express the full genetic potential of the goat for growth (Pattie, 1984; Odubote & Akinokun, 1992). The kidding records should be analysed further, considering the effects of age and parity of doe at kidding and kidding intervals for a more comprehensive understanding of animal performance productivity.

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