

Goat Reproductive Performance as Affected by Stocking Rate on Caatinga Vegetation in the Semiarid Northeast Brazil

Clovis Guimarães Filho and José Givaldo Góes Soares
Centro de Pesquisa Agropecuária do Trópico Semi-Árido (CPATSA)
Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)
Petrolina, Brazil

ABSTRACT

This study was aimed at determining the influence of native goats grazing caatinga under different stocking rates on production either per animal or per unit area. In April 1981, 90 goats were allocated by stratified randomization, on the basis of liveweight, into three treatments with two replications of each. Stocking rates applied were 3.0 (low), 2.0 (moderate) and 1.0 per hectare (high) per doe. Kids were removed from the plots at weaning (112 days). Does were continuously exposed for mating throughout the 3-year experimental period. Results show no evidence of any effect of stocking rate on either fertility or fecundity ($P > 0.05$). Mean values for kids weaned per kid born were also similar for all treatment groups ($P > 0.05$). Number of kids weaned per doe exposed increased with decrease in stocking rates ($P < 0.05$). At the low stocking rate, 77 percent more kids were weaned than at the high one. When performance was expressed per unit area of land, 70 percent more kids were weaned at the high stocking group than at the low one ($P < 0.05$). Such stocking rates are likely to increase the goat raisers' ability to withstand drought without adversely affecting profits, since most of them continue to stock caatinga at rates heavier than those.

INTRODUCTION

The caatinga vegetation constitutes the basic source of feed for livestock under current production systems in the semiarid Northeast Brazil. In extensive systems of goat production the caatinga's contribution to the nutrition of the herd ranges from 60 to 100 percent.

It is believed that, as a result of improper management, the caatinga has been submitted to a deterioration process, affecting both botanical composition and potential for forage supply.

Poor goat performance, as shown by some studies (1, 2), is the consequence of such mismanagement, although, under the prevailing extensive system, it does not necessarily mean unprofitability.

Overstocking has been a common practice in caatinga (3). This condition has been aggravated lately by the occurrence of consecutive drought-affected years. Establishment of dryland pastures and provision of supplementary feeding are probably the most effective ways of achieving higher sustainable goat production and of reducing the stocking load on the caatinga. Limitations of capital investment have been the main contributing factor toward the lack of adoption of such practices.

Since stocking rate is considered to be the most important single management factor affecting grazing animals, the problem is, thus, to define an optimum stocking rate for caatinga conditions.

This investigation was therefore aimed at determining the influence of native goats grazing caatinga under different stocking rates on production either per animal or per hectare. Evaluation of reproductive traits is reported in the present paper.

METHODS

The study was conducted at the Caatinga Management Experimental Station, located 42 kilometers north of Petrolina, State of Pernambuco, at an altitude of 379 meters. Average annual rainfall is 401 millimeters, of which about 80 percent falls between December and April. Mean maximum air temperature is highest in October (31.4°C) and minimum air temperature is least in July (20.6°C).

The native caatinga in the experimental area is very dense with a predominant shrub-tree layer where the four most common species are "moleque-duro" (*Cordia leucocephala* Moric), "quebra-faca" (*Croton* spp.), "mororó" (*Bauhinia cheilanta* Steud) and "carqueja" (*Calliandra depauperata* Benth) with, respectively, 1.843, 1.657, 1.240 and 1.161 individuals per hectare.

In April 1981, 90 native-type does were allocated by stratified randomization, on the basis of liveweight, into three treatments with two replications of each. Treatments consisted of caatinga pastures grazed at three stocking rates: one doe per 1.0 (high), per 2.0 (moderate) and per 3.0 hectares (low). Measurements were performed over three periods of observation: 1980-1981 (I), 1981-1982 (II) and 1982-1983 (III). Animals were fed no dry season supplement. In each of the treatments, they were continuously supplied with a mineral lick.

Does and kids were weighed at 28-day intervals. Kids were removed from the plots at weaning (112 days). Does were continuously exposed for breeding throughout the 3-year experimental period. Bucks were rotated weekly among treatments. Does and their kids were dosed every 4 months with anthelmintics to control internal parasites.

The following parameters were considered to assess reproductive performance:

fertility of the does (A) defined as does kidding per doe exposed,
fecundity of the does (B) defined as kids born per doe exposed,
survival of the kids (C) defined as kids weaned per kid born, and
overall reproductive performance of the does (D) defined as kids weaned per doe exposed.

Thus,

$$D = A \times B \times C.$$

Data were statistically analyzed by means of a two-way analysis of variance, with stocking rate and period of observation as fixed effects.

DISCUSSION

Fertility

Number of does kidding per doe present at mating was not affected by stocking treatment ($P > 0.05$), as shown in Table 1.

Table 1. Number of does kidding per doe exposed as affected by stocking rate and period of observation.

Stocking rate	Period of observation			Mean
	I	II	III	
Low	1.28	0.60	1.10	0.99 ^a
Moderate	1.17	0.78	0.82	0.92 ^a
High	0.99	0.74	0.67	0.80 ^a
Mean	1.15 ^a	0.71 ^b	0.86 ^{ab}	0.91

Note. Column or row means with different superscripts differ ($P < 0.05$).

Overall mean (0.91) was consistent with those recorded earlier for caatinga conditions. Guimarães Filho et al. (4) found 1.01 does kidding per doe exposed in a herd grazing at a stocking rate of 3.0 hectares per doe. A similar finding was observed by Simplicio et al. (5) stocking caatinga at a rate of 1.5 hectares per doe. This fertility level was lately confirmed in a study (6) where an average of 0.90 does kidding per doe exposed at a comparable stocking rate was reported.

Values observed indicate a poor performance for all treatment groups. Kidding less than once a year means kidding intervals longer than 360 days. This condition is usually associated with delayed return to normal estrous cycles postpartum as a result of nursing and undernutrition.

Under northeast semiarid conditions, nursing and undernutrition affect in a combined way, since most kiddings occur at either the end of the rainy season or the beginning of the dry season. Lactating does are thus subjected to a 3- to 5-month underfeeding period which results in extended intervals to reconception.

Period of observation significantly influenced fertility values ($P < 0.05$). Much of this variation can be related to the high coefficient of variation for annual rainfall in the semiarid Northeast.

The effect of rainfall, however, can be complicated by its irregular distribution and the effects of the rainfall of past seasons. Coincidentally, the period of observation of highest rainfall (770 millimeters) showed the maximum fertility rate (1.15), whereas the minimum observed fertility rate (0.71) was achieved in that period of lowest rainfall (315 millimeters). The period of intermediate rainfall rate (499 millimeters) corresponded also to an intermediate performance (0.86).

Fecundity

Mean values are summarized in Table 2. Number of kids born per doe exposed did not differ ($P > 0.05$) among treatments.

Table 2. Number of kids born per doe exposed as affected by stocking rate and period of observation.

Stocking rate	Period of observation			Mean
	I	II	III	
Low	1.63	0.78	1.81	1.41 ^a
Moderate	1.35	0.89	1.21	1.15 ^a
High	1.14	0.89	0.89	0.97 ^a
Mean	1.37 ^a	0.85 ^b	1.30 ^{ab}	1.17

Note. Column or row means with different superscripts differ ($P < 0.05$).

Although not significantly different, a trend for does grazing at decreasing stocking rates to show a correspondent increase in fecundity was detected.

Overall mean value observed for fecundity in this study (1.17) is not much different from those reported in other studies (4, 5, 6), where number of kids born per doe exposed ranged from 1.18 to 1.37.

It is suggested that, as in sheep, failure to attain a high reproductive performance in goats could be also related to severe nutritional stress in early life. This is presumably due to a reduced

ovulation rate in adult does. Background of experimental animals does show they were imposed such stress. This theory however could not be confirmed in the present study since inadequate nutrition was also provided in later life.

Number of kids born per doe exposed varied between periods of observation ($P < 0.05$), the mean difference between periods I and II being more than 0.5 kid born per doe exposed (Table 2).

Increased feed availability has been shown to improve reproductive performance through an increased incidence of multiple births (4, 7, 8). In the present study the variation observed in fecundity between periods I and II cannot be explained by decreased multiple birthrate as a result of lower feed availability. Indeed, percentage of multiple birth averaged 19.6 and 20.0 for periods I and II, respectively. The difference in fecundity values should be attributed rather to an increased fertility for all treatment groups in the periods of higher feed availability.

Kid Survival

Mean values are presented in Table 3. There were no significant differences between stocking treatments as far as number of kids weaned per kid born ($P > 0.05$).

Table 3. Number of kids weaned per kid born as affected by stocking rate and period of observation.

Stocking rate	Period of observation			Mean
	I	II	III	
Low	0.76	0.73	0.70	0.73 ^a
Moderate	0.62	0.66	0.71	0.66 ^a
High	0.49	0.74	0.58	0.60 ^a
Mean	0.62 ^a	0.71 ^a	0.66 ^a	0.66

Note. Column or row means with different superscripts differ ($P < 0.05$).

Overall observed mean for kid survival (0.67) was consistent with results reported earlier (4, 6, 8, 9), where survivability from birth to weaning, under similar conditions, ranged from 0.67 to 0.85.

The high kid mortality rates reported for current goat production systems in the Northeast are mainly associated with the ultraextensive management conditions imposed on the herds. Also, mortality rates from birth to weaning were reported to be higher in kids born during the dry season than in the rainy season and higher in those born as twins than as singles (1, 9, 10, 11).

In the present study, percentages of dry-season-born kids and twinning rates did not show substantial differences between treatments to induce a better survival performance in any of them. Overall means for these parameters averaged 55.7 and 29.5 percent, respectively.

Table 3 also shows that, as occurred in stocking treatments, period of observation did not affect kid survival ($P > 0.05$). It means that this similarity, contrarily to what was observed for fertility and fecundity, should be attributed to factors other than variation in feed availability between periods.

Overall Reproductive Performance

Table 4 presents mean values for number of kids weaned per doe exposed. Results show that weaning rate was markedly affected by stocking rate ($P < 0.05$). When data were combined over all periods, approximately 77 percent more kids were weaned per doe available for service at the low stocking rate than at the high one.

Table 4. Number of kids weaned per doe exposed as affected by stocking rate and period of observation.

Stocking rate	Period of observation			Mean
	I	II	III	
Low	1.24	0.56	1.28	1.03 ^a
Moderate	0.85	0.57	0.85	0.76 ^b
High	0.57	0.64	0.53	0.58 ^b
Mean	0.89 ^a	0.59 ^a	0.88 ^a	0.79

Note. Column or row means with different superscripts differ ($P < 0.05$).

The main determinant of this effect was the significant difference ($P < 0.05$) registered within period of observation III, when number of kids weaned per doe exposed, at the low stocking rate, was 140 percent higher than at the high one.

Overall reproductive performance did not vary over periods of observation ($P > 0.05$). It could be expected that as a result of variable rainfall, the effects on performance were far greater at the heavy than at the low stocking rate, but such did not occur. Number of kids weaned per doe exposed at the high stocking rate was similar over all periods of observation.

Number of kids weaned per doe present at mating observed for the low stocking rate (1.03) was comparable to the 1.12 formerly registered when a less dense caatinga was stocked at a similar rate (4). Other studies in the region (1, 5, 6, 8) reported poorer reproductive performances, ranging from 0.37 to 0.85 kids weaned per doe, at heavier stocking rates.

Although not different from the other groups in fertility, fecundity and kid survival, the low stocking rate group achieved a higher number of kids weaned per doe exposed. This confirms that maximum overall reproductive performance is thus not necessarily dependent on maximum fertility, fecundity or survival rates, but rather on an optimum compromise between one another.

When performance was expressed per unit area of land (Table 5), however, 70 percent more kids were weaned at the high stocking rate ($P < 0.05$) than at the low one.

CONCLUSIONS

Stocking caatinga at rates ranging from 1 to 3 hectares per doe did not show marked differences in fertility, fecundity or kid survival. Overall reproductive performance was highest at the low stocking rate. When the results are considered on a per-hectare basis, the best performance was observed at the high stocking rate.

Table 5. Number of kids weaned per hectare as affected by stocking rate and period of observation.

Stocking rate	Period of observation			Mean
	I	II	III	
Low	0.41	0.18	0.42	0.34 ^a
Moderate	0.42	0.28	0.42	0.37 ^a
High	0.57	0.64	0.53	0.58 ^b
Mean	0.47 ^a	0.36 ^a	0.46 ^a	0.43

Note. Column or row means with different superscripts differ ($P < 0.05$).

Most goat raisers continue to stock caatinga at rates heavier than those applied in the present study. This heavy stock is likely to cause further caatinga deterioration. The range of stocking rates applied did not permit estimation of the optimum for caatinga conditions in terms of either production per head or per unit area. Such stocking rates, however, if adopted, would probably increase the goat raisers' ability to withstand drought without adversely affecting profitability.

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