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Effects of stocking rate on the performance of *Digitaria setivalva* Stent and goat production

(Kesan kadar muatan ternakan terhadap *Digitaria setivalv*a Stent dan pengeluaran kambing)

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Key words: goat grazing, stocking rate, *Digitaria setivalva*

Abstrak

Satu percubaan ragutan secara berterusan dengan kadar muatan kambing Katjang sebanyak 20, 40, 60 dan 80 ekor/ha telah dijalankan terhadap rumput MARDI Digit yang dibaja dengan nitrogen. Tujuannya adalah untuk menilai kecekapan pastura dan pengeluaran ternakan. Kenaikan berat badan yang baik sebanyak 22.3-49.7 g/ekor sehari (109.5-496.5 kg/ha setahun) telah didapati. Kadar muatan ternakan yang paling sesuai dengan pengeluaran pastura yang stabil ialah 20-40 ekor/ha. Kadar muatan yang tinggi, iaitu 60 dan 80 ekor/ha telah mengakibatkan kekurangan makanan. Kadar muatan 20 ekor/ha adalah rendah dan menyebabkan hasil bahan kering rumput setinggi 3 500 kg/ha pada akhir percubaan dengan komposisi botani terdiri daripada 57% rumput MARDI Digit, 1.5% tanah tanpa rumput dan 32.4% rumpai berbanding dengan komposisi botani 36, 3.4 dan 46.1% dengan hasil bahan keringnya 1 444 kg/ha pada kadar 40 ekor/ha.

Pengeluaran pastura yang baik dapat dikesan dengan nisbah daun dan batang sebanyak 0.79:1 hingga 0.98:1, memberikan nilai kebolehcernaan bahan kering sebanyak 58.1% untuk daun dan 47.5% untuk batang. Kebolehcernaan bahan kering sebanyak 59.4-67.1% telah dicatat pada kadar muatan kambing yang rendah (20 ekor/ha). Wujud perkaitan yang kuat di antara sejatan hujan, kadar muatan ternakan, pengeluaran pastura dan komponen- komponen tumbuhan seperti dedaun, batang dan bahan-bahan reput.

Abstract

A continuous grazing experiment with set stocking rates of 20, 40, 60 and 80 heads/ha using Katjang goats was carried out on nitrogen-fertilized *Digitaria setivalva* Stent to assess the effects on pasture performance and animal production. Good liveweight gains of 22.3-49.7 g/head per day (109.5-496.5 kg/ha per year) were obtained from grazing goats. The optimal stocking rate with stable pasture production was 20-40 goats/ha. High stocking rates of 60 and 80 heads/ha have resulted in an inadequate supply of feed. Stocking rate of 20 goats/ha was understocked, resulting in dry matter (DM) on offer at the end of the trial as high as 3 500 kg/ha with good botanical composition of 57% Digit grass, 1.5% bare-ground and 32.4% weeds, in comparison to the DM on offer of 1 444 kg/ha and with respective botanical composition of 36, 3.4 and 46.1% at

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the stocking rate of 40 goats/ha. Good pasture production was detected with leaf to stem ratios of 0.79:1 to 0.98:1, giving mean DM digestibility of 58.1% for leaves and 47.5% for stems. The DM digestibility of 59.4-67.1% was recorded with grazing goats at the low stocking rate (20 goats/ha). There were strong relationships between rainfall, stocking rate, pasture yield and sward components such as leaf, stem and dead materials.

Introduction

The development of small ruminants and definition of production systems, have been well documented (Devendra 1976, 1981 and 1986). The production systems are mainly the village system, extensive system, combining arable cropping system and systems integrated with tree cropping. Of the systems indicated, intensive grazing of cultivated forage by goats is one which has not been investigated, partly for reasons of land limitation, and partly because of the general neglect of goat production. The productive capacities of goats are intimately associated with their inherent features such as small size, inquisitive feeding habits, high digestive efficiency for cellulose, efficiency of food utilization, high fertility, and short generation interval (Devendra and Burns 1983). The last four characteristics are especially important attributes to the economic viability of goat production. Commercialized large scale operations, based on tropical pastures to intensify land use in the system, may probably be able to exploit fully those economic traits of goats. Yet, the potential carrying capacity of monocultured tropical pasture under such ranching operation has to be assessed.

Goats are selective in their feeding habits, being dependent on the availability and the growth of forages. Research on grazing selectivity on types of forages reveal that 83% (of the 1 728 bites) were on browse plant and 17% on grasses. Further information cited by Kearl (1982) on Van Dyne's comprehensive review indicated that goats selected 60% shrubs, 30% grasses and 10% forbes. Based on their natural browsing habits, it is therefore, generally believed that goats do not thrive well when kept solely on one feed for any given length of time (Anon. 1982). By designing such monocultured tropical forages, it may provide great opportunity to observe their performance and production as well as the pattern of utilizing tropical grass. Although a few large governmental goat farms are in operation in Malaysia, the adoption of intensive production system on improved pasture is still at its infancy stage. To be in line with the trend towards commercialized production system, it is appropriate to assess the potential carrying capacity of grazing goats on N-fertilized tropical grass, *Digitaria setivalva* Stent (MARDI Digit).

This paper presents the results of the study, the patterns of utilizing the grass by grazing and the potential production of Katjang goats under such intensively managed pasture.

Materials and methods

Pasture establishment and sampling

A randomized block design was adopted to evaluate the four grazing pressures of goats on an improved MARDI Digit grass in three replications *(Table 1)*. The pasture was hand planted with rooted materials at Serdang. During establishment, hand weeding was carried out frequently to ensure pure sward. Once the pasture was established, a chain-link fence was put up to partition the paddocks into various sizes. Standard fertilizers at the rate of 150 kg N, and 40 kg P and K per hectare per year were split into three equal applications annually. Sampling of pasture for dry matter (DM) estimation was initially carried out at bimonthly intervals, then monthly, when grazing effects were evident. Four samples (1 m x 1 m quadrat) were cut from each experimental

Table 1. Details of stocking rate treatments on MARDI Digit pasture

Stocking rate (goats/ha)	Code	No. goats/ paddock	Paddock size (m^2)
20	SR20	5	2 500
40	SR40	5	1 250
60	SR60	5	833
80	SR80	5	625

paddock but only one sample was taken and hand-sorted for plant part components of sward i.e. green leaves (inclusive of leaf sheath), stems and dead materials. Chemical and botanical composition analyses of the pasture were done every monthly. The botanical composition was recorded using the "Point Quadrat" method with a 2.5 cm point spacing to hit the base of the plants (Heslehurst 1971). A total of 50-100 quadrats were taken to examine the grazing effects. Samples for mineral and digestibility analyses were taken by hand from the top strata of forage swards to simulate grazing.

Grazing management

Sixty heads of Katjang goats selected from farmers around Nibong Tebal, Province Wellesley were purchased. Their initial liveweights of 7-12 kg were systematically randomized to keep the total liveweights of animals within each paddock approximately uniform. The allocation was in fixed numbers of 5 goats/paddock, but paddock size varied to accommodate the respective stocking rates *(Table 1)*.

Standard health care was carried out monthly to control the infestation of worms and ticks. The adoption of a continuous grazing system in which animals graze and stay in the paddock from 0900 h to 1900 h was ensured by building sheds within the premises of respective paddocks. Sufficient water and mineral licks were offered in the shed for grazing animals. A bi- weekly weighing schedule was fixed to record the performance of the goats.

Results and discussion

Pasture yield and sward component

Stocking rates have a very strong relationship (p <0.01) with the production of MARDI Digit grass (r = 0.73). The forage DM yield decreased drastically when the stocking rate was increased (DM: $y = 5\ 115.5 - 52.9x$; where x = stocking rate; y = DM yield in kg/ha per year). The impact was so great that a few animals died from the high stocking rate treatments of SR60 and SR80 having to be subsequently withdrawn prematurely. The changes in mean monthly DM yield and its sward components i.e. leaf, stem and dead material in response to grazing pressures are shown in *Figure 1*, *Table 2* and *Table 3*. The forage available to goats in SR60 and SR80 paddocks during the time of withdrawal were virtually nil, whereas the forage on offer from lower stocking rates of SR20 and SR40 was satisfactory. The forages recorded for SR20 was higher than that of SR40. At the end of the experiment, there were about 3 500 and 1 500 kg DM/ha available in SR20 and SR40 paddocks respectively *(Table 2)*. This indicated that the SR20 paddock was understocked, while the pasture in SR40 paddock was evidently adequate and well grazed by the animals. However, the pasture in SR40 paddock was not that stable in terms of botanical composition as the percentage of main pasture, MARDI Digit, was fast declining *(Table 4)*.

The sward composition, in terms of plant part components also declined steadily when the stocking rates increased from SR20 to SR80. Highly significant (p <0.01) relationships were recorded between stocking rates (x) and the plant part

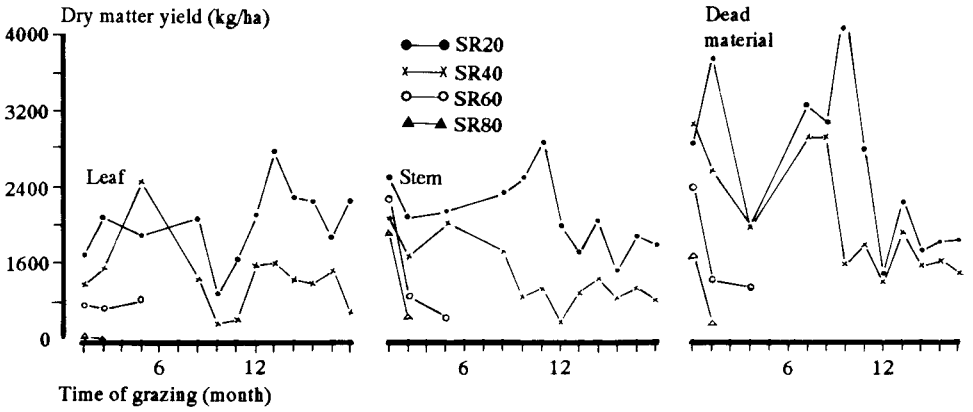

Figure 1. Changes in dry matter yield of leaf, stem and dead material of MARDI Digit grazed under four stocking rates by goats

Table 2. Changes in monthly dry matter yield on offer of MARDI Digit grazed by goats at four stocking rates

Harvest	Dry matter yield (kg/ha) at 4 stocking rates			
	SR20	SR40	SR60	SR80
1	4 637ab	6 243a	2 793b	2 836b
2	4 555a	4 128ab	3 453b	2 073c
3	5 530a	3 423b	1 426c	460d
4	3 620a	4 093a	1 242b	-
5	5 260a	3 700a	-	-
6	4 437a	2 773a	-	-
7	6 773a	2 261b	-	-
8	4 661a	2 550b	-	-
9	3 594a	2 288a	-	-
10	4 200a	2 449a	-	-
11	3 122a	1 844b	-	-
12	3 232a	2 145a	-	-
13	3 536a	1 444b	-	-
Total	57 157a	39 341b	8 914c	5 369c
Mean	4 397	3 027	2 229	1 790

SR20, SR40, SR60 and SR80 = 20, 40, 60 and 80 goats/ha respectively
Means with different letters within row are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test

components (DM = y) are as follows:

Leaf DM: y = 1 587.0 - 20.98x ; r = 0.74 (p <0.01)

Stem DM: y = 1 492.7 - 13.34x; r = 0.52 (p <0.01)

Dead material DM: y = 2 241.3 - 22.30x; r = 0.48 (p <0.01)

At the lower stocking rate of SR20, the pasture sward contained more green leaves (27.7%) than that of SR40 (26 .3%), SR60 (18.7%) and SR80 (2.0%) *(Table 3)*. Similarly, the stemmy material decreased with the increase of stocking rate while the dead material showed little changes ranging from 41.7% to 47.0%. It was observed that the well grazed pastures were constantly showing good leaf to stem ratio of about 1:1. The significantly high dead plant materials recorded in SR20 *(Figure 1)* proved that the pastures were actually under utilized.

Table 3. Effects of stocking rate on mean dry matter yield of different pasture plant components

Component	Dry matter yield (kg/ha) at 4 stocking rates			
	SR20	SR40	SR60	SR80
12-month grazing				
Total	4 785a	3 497b	2 040c	1 267c
Leaf	1 148a	819b	382*	26*
Stem	1 448a	957b	729*	685*
Dead material	2 189a	1 722b	929*	556*
16-month grazing				
Total	4 396a	3 027a	-	-
Leaf	1 220a	796b	-	-
Stem	1 341a	811b	-	-
Dead material	1 835a	1 420b	-	-

SR20, SR40, SR60 and SR80 = 20, 40, 60 and 80 goats/ha respectively
Means with different letters within row are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test
*Incomplete replication due to discontinuation of treatments

Table 4. Effects of goat grazing on botanical composition of pasture

Stocking rate	Botanical composition (%) at 9 samplings (month of grazing)								
	1st	5th	6th	8th	9th	10th	14th	17th	20th
MARDI Digit									
SR20	69.1a	71.2a	76.4a	75.1a	61.5a	62.1a	66.5a	59.0a	57.0a
SR40	63.7a	68.9a	61.2ab	72.4a	73.5a	79.1a	60.7a	48.0a	36.0a
SR60	62.7a	54.0a	35.1b	56.3a	56.9a	39.1a	-	-	-
SR80	54.4a	21.1b	-	-	-	-	-	-	-
Bare ground									
SR20	11.6c	8.4b	3.2b	1.0a	3.0a	3.7a	1.6a	1.7a	1.5a
SR40	13.0c	14.3b	10.0ab	0.9a	1.4a	1.8a	5.0a	6.7a	3.4a
SR60	23.1b	34.6a	54.3a	18.9a	10.5a	8.8a	-	-	-
SR80	36.1a	52.1a	-	-	-	-	-	-	-
Weeds									
SR20	8.1ab	11.8ab	12.1a	13.2a	26.2a	23.4a	23.7a	27.4a	32.4a
SR40	9.2a	6.0b	16.0a	11.9a	17.5a	11.2a	24.7a	30.6a	46.1a
SR60	2.1b	6.0b	7.0a	16.7a	26.8a	48.5a	-	-	-
SR80	5.7ab	25.7a	-	-	-	-	-	-	-
Legumes									
SR20	11.2a	8.6ab	8.4a	10.3a	8.4a	11.0a	8.0a	11.9a	9.1a
SR40	14.5a	10.6a	12.8a	14.8a	7.5a	7.9a	9.6a	14.7a	14.5a
SR60	12.2a	5.3bc	3.6a	8.1a	5.8a	3.5a	-	-	-
SR80	3.8b	1.2c	-	-	-	-	-	-	-

SR20, SR40, SR60 and SR80 = 20, 40, 60 and 80 goats/ha respectively
Means with different letters within each coloumn of treatment are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test

Physiologically, the lower portion of pasture swards accumulated more senescent leaves or dead materials under existing canopy, with less severe defoliation. It has a self-shading effect (Donald 1961; Rhodes 1973).

It was noted that neither the amount of rainfall nor the number of dry days had any effect on the forage plant part components, except the total forage production. Significant (p <0.01) correlations (r = 0.59)

between rainfall factor (adjusted to forage sampling dates) and mean forage production were found and given the following regression relationship on DM yield, $y = 2\,753.2 + 1.87x$ (Where x = rainfall units).

Botanical composition

MARDI Digit grass was very sensitive at the high stocking rate (SR80). It dropped drastically from about 70% at low stocking rate (SR20) to 54.4 % at high stocking rate (SR80) after one month of grazing. As grazing proceeded to the fifth month, the pasture deteriorated further. With the high stocking rate (SR80), 21.1% of Digit was left in the sward, which was significantly lower than the rest of the treatments *(Table 4)*. Subsequently with the recorded deaths of four animals due to starvation, this treatment was discontinued.

A similar situation occurred with treatment SR60 within 10 months of grazing. The treatment had to be stopped because there was less than 40% Digit grass in the field. At the end of the experiment, low percentage of MARDI Digit grass (36%) in treatment SR40 was recorded, but it still gave good animal production. The animals in treatment SR40 also utilized 46.1% of the volunteer weeds other than the MARDI Digit grass *(Table 4)*. The weeds comprised mainly of *Axonopus compresses, Ottochloa nodosa, Paspalum conjugatum* and *Digitaria adscendens*. The SR20 treatment maintained the most stable forage on Digit (range 57.0-69.1%) throughout the grazing trial, with 1.5% bare ground, 32.4% weeds and 9.1% volunteer legumes.

Through the over grazing process, good pasture was removed, resulting in bare ground which was later covered by weeds *(Table 4)*. The occurrence of bare-ground invasion was closely associated with the very high grazing pressures (SR60 and SR80). Similar findings on MARDI Digit for cattle production have also been reported (Chen et al. 1981; Chen and Othman 1986). The amount of volunteer legume in the pasture sward was rather constant (around 10%) throughout the experimental period. Considering the high preference in selection for feeds by grazing goats (Malachek 1970; Carrera 1971). It was observed that in this experiment the goats did not really for other species despite being on mono-cultured Digit grass. The legumes were mostly *Calopogonium mucunoides* mixed with some *Centrosema pubescens* and *Pueraria phaseoloides*. The volunteer legumes were from the previous cultivation of cover crops under rubber.

Forage mineral concentration

Results showed that there were changes in mineral concentrations of the grazed pastures *(Table 5)*. However, there were no significant differences between stocking rates, except for manganese (Mn) at the early stage of grazing, and calcium (Ca), iron (Fe) and copper (Cu) at later stages. The concentrations of Ca, Mg, Mn, Cu and Zn generally declined with sampling dates, while phosphorus and potassium increased.

The mineral profile in the forage sward was generally sufficient to satisfy the dietary needs of growing goats, especially for the macrominerals (Ca, P and Mg). Due to unstable concentrations of Ca and P during grazing, the Ca:P ratios were fluctuating and fell below the normal range of 2:1 to 7:1 (Underwood 1966). Field observations showed that the drop in Ca status may be tied up with the forage availability and sward structure as affected by increased grazing pressures. It is commonly known that phosphorus is the mineral most likely to be deficient in the ranch forages, especially in high rainfall and high acidic soils. To ensure sufficient dietary needs for various physiological stages of grazing animals in the ranch are met, supplementation of P and Ca needs to be considered.

Since the dietary needs of goats for Cu is 5 ppm, the availability in the forage (5.03-12.20 ppm) appears to be adequate.

Table 5. Changes in mineral concentration in grazed MARDI Digit

Element	Stocking rate	At 5 sampling dates				
		1	2	3	4	5
N (%)	SR20	2.26	2.00	2.27	2.03	2.51
	SR40	2.29	1.93	2.37	2.03	2.50
	SR60	2.66	2.15	1.73	2.08	-
P (%)	SR20	0.15	0.24	0.34	0.31	0.20
	SR40	0.16	0.24	0.33	0.33	0.21
	SR60	0.15	0.25	0.37	0.34	-
K (%)	SR20	2.81	2.53	2.54	2.50	1.79
	SR40	1.60	1.93	2.42	2.46	1.62
	SR60	1.56	1.77	2.72	2.64	-
Ca (%)	SR20	0.44	0.32	0.38	0.07b	0.02
	SR40	0.43	0.38	0.47	0.29a	0.06
	SR60	0.34	0.38	0.36	0.35a	-
Ca : P ratio	SR20	2.90:1	1.33:1	1.11:1	0.22:1	0.10:1
	SR40	2.75:1	1.58:1	1.43:1	0.89:1	0.29:1
	SR60	2.43:1	1.54:1	0.94:1	1.03:1	-
Mg (%)	SR20	0.19	0.15	0.18	0.11	0.12
	SR40	0.22	0.17	0.22	0.12	0.15
	SR60	0.22	0.20	0.25	0.14	-
Mn (ppm)	SR20	77.30b	57.73b	75.13	43.30	48.77
	SR40	79.60b	79.63ab	88.23	76.53	59.30
	SR60	126.30a	106.50a	159.10	74.30	-
Fe (ppm)	SR20	137.60	276.27	164.53	128.33b	135.70
	SR40	143.87	251.33	133.83	193.63a	158.50
	SR60	212.25	321.70	121.85	208.88a	-
Cu (ppm)	SR20	9.75	10.20	10.50	8.70a	11.90
	SR40	8.77	9.20	10.33	5.03b	11.27
	SR60	12.20	8.20	11.50	5.70b	-
Zn (ppm)	SR20	39.60	39.43	38.43	34.73	41.27
	SR40	40.50	36.37	40.43	35.77	41.87
	SR60	45.55	39.55	52.10	38.50	-

SR20, SR40, and SR60 = 20, 40, and 60 goats/ha respectively
Means with different letters within each column of treatment are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test

Table 6. In-vitro dry matter digestibility of different plant parts and of grabbed MARDI Digit samples

Forage sward/ component	Dry matter digestibility (%) at 3 stocking rates		
	SR20	SR40	SR60
Plant part component			
Leaf	58.1a	52.3b	-
Stem	47.5a	45.8a	-
Dead material	39.9a	39.4a	-
Grabbed forage sward sample			
13/12/82	67.1a	57.8a	53.2a
9/4/83	59.4a	53.6a	-

Means with different letters within row are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test

Forage digestibility

Different plant parts are eaten in different quantities by grazing goats and these differences including those of physical properties, affect significantly the digestibility and voluntary intake. As expected, the dry matter digestibility of the leafy portion of Digit grass was 14-22% higher than that of the stem in SR20 and SR40 treatments, which in turn was higher than that of dead material *(Table 6)*. This finding was opposite to that reported by Laredo and Minson (1973) probably due to differences in the methods of herbage separation.

The grabbed samples, simulating the conditions of pasture grazed by animals, have higher digestibility values than those of different plant part components. The overall mean DM digestibility of grabbed samples was 26.1% (or 12.3 digestibility units) higher than the mean values of plant part components. It also indicated that grazing animals could be selecting more digestible portions of grass than if they were provided with cut forage.

Apparently, digestibility declined when grazing pressure increased. The values were 67.1, 57.8 and 53.2% for the stocking rates of SR20, SR40 and SR60 respectively. This is equivalent to a decline in the range of 13.9-20.7% or 9.3-13.9% digestibility units. The decline was basically attributed to the significantly lower availability of green leaf material, and proportionally higher stems and dead materials in the swards *(Table 3)*. A higher proportion of stems and dead materials in the forage of higher stocking treatments, affected animal production partly because of forage shortages and partly because of the differences in sward structure that affected forage intake. The causes are believed to be related to the physical properties of the fractions or plant parts rather than the differences in chemical composition *(Table 5)* and the variation in bite size during grazing (Stobbs 1973). In Australia, Laredo and Minson (1973) showed that the leaves of five tropical grasses were taken in larger quantities than stems of similar DM digestibility, and subsequently increased the mean voluntary intake of leaf by 46% by sheep. In this trial, better liveweight gain and animal production were obtained in leafy pastures at SR20 and SR40 *(Table 7)*.

The lower digestibility value obtained in the second grabbed sampling was mainly due to an advanced stage of grazing where more stem was available.

Animal production

It was observed that goats grazing on improved tropical pasture MARDI Digit grass in mono-cultured sward were able to achieve good animal performance, reflected by the normal growth curve from liveweight gain in *Figure 2*. Under such a continuous and intensive grazing system, the problems of parasites such as worms and ticks were controllable when the routine health care was properly implemented. The results clearly demonstrated that at an optimum stocking rate specific to a particular grass, and with the control of management and supporting animal husbandry, goats can achieve very good animal performance. The finishing weight of the Katjang goats from the best treatments i.e. SR20 and SR40 averaged at 27.1 kg/head.

The effect of stocking rate on animal liveweight gain was apparent. The extreme stocking rates of SR60 and SR80 gave average liveweight gains of 36.4 and 16.8 g/head per day respectively. Because of inadequate feed, these treatments had to be terminated at the 14th and 22nd weeks of grazing respectively. The best animal production was recorded for SR40 at 409.3 kg/ha per year liveweight gain (equivalent to 31.6 g/head per day) after 48 weeks of grazing and 496.5 kg/ha (or 22.3 g/head per day) throughout the experimental period *(Table 7)*. It was followed by the SR20 treatment giving 236.2 and 314 kg/ha (equivalent to 34.8 and 27.7 g/head per day) respectively. The animal performance obtained in this experiment was comparable

Table 7. Effects of different stocking rates on average daily gain and animal liveweight production of Katjang goats grazing MARDI Digit grass

Trait	At 4 stocking rates (goats/ha)			
	20	40	60	80
Average daily gain (g/head)				
16th week grazing	48.9a	49.7a	36.4a	16.8b
32nd week grazing	40.7a	37.1a	30.6a	-
48th week grazing	34.8a	31.6a	-	-
64th week grazing	29.8a	24.8a	-	-
80th week grazing	27.7a	22.3a	-	-
Animal liveweight production (kg/ha)				
16th week grazing	109.5b	225.9a	244.2a	152.8b
32nd week grazing	179.3b	334.1a	364.8a	-
48th week grazing	236.2a	409.3a	-	-
64th week grazing	271.7a	440.3a	-	-
80th week grazing	314.2a	496.5a	-	-

Values with different letters within row are significantly different from each other (p <0.05) in the Duncan's Multiple Range Test

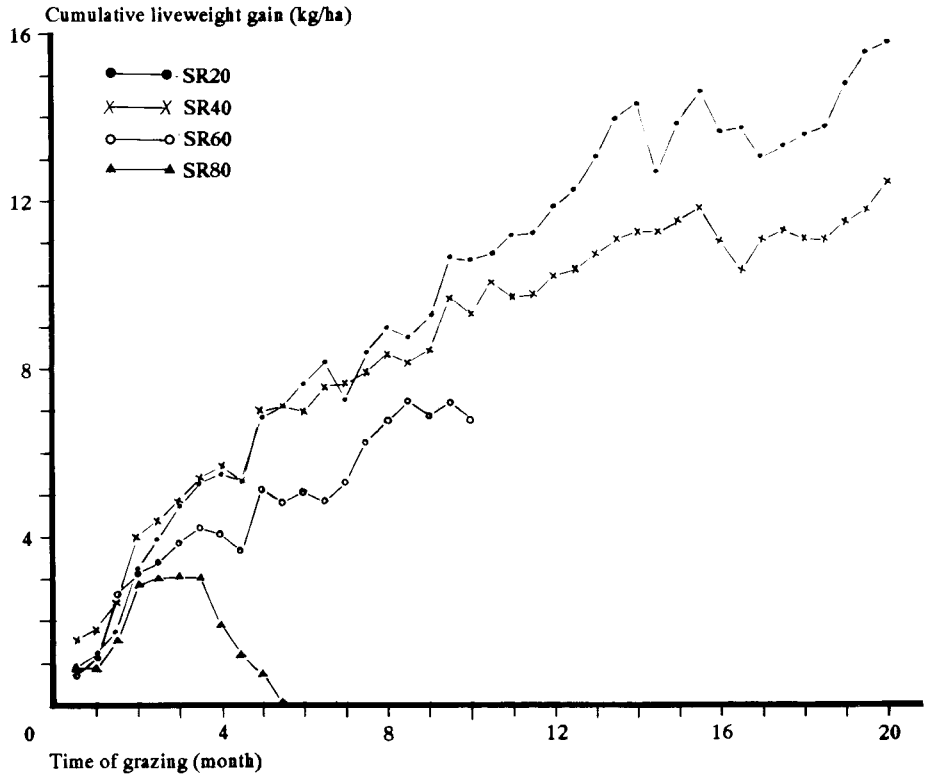

Figure 2. Stocking rate effects on cumulative liveweight gain of Katjang goats on MARDI Digit

to that from other production systems. Mukherjee (1986) reported that local goats grazing under rubber and coconut plantations with concentrate supplements gave liveweight gains of 35-43 g/head per day, while stall feeding of Katjang goats with Guinea grass and concentrate gave a year-long average of 24.7 g/head per day

(Abdul Wahid, Jemalos et al. 1987; Mohd. Khusahry 1984). Grazing Guinea grass pasture in the open with supplements produced 33.7 g/head per day (Abdul Wahid, Kamal Hizat et al. 1987) and grazing under coconuts without supplements produced 46.1 g/head per day (Wong et al. 1988).

Despite the good animal performance recorded, the pastures for SR40 at the termination of this experiment were not stable in terms of different species composition in the swards *(Table 4)*. It contained 46.1% volunteer weeds and 36.0% planted Digit in the paddocks as compared with 32.4% and 57.0% respectively at SR 20 *(Table 4)*. Considering also the total availability of existing forage in the paddocks (*Table 2* and *Table 3*) the optimal animal production on nitrogen-fertilized MARDI Digit grass was 20-40 goats/ha. The continuous set stocking with goats gave a stable pasture which supported good animal performance.

Implication of the findings

The results indicate that nitrogen fertilized MARDI Digit is able to support the production of 20-40 goats/ha on single-species feeding regime. Considering the high feed selectivity by grazing goats, it was observed that the grazing goats did not really go for other species available (about 10% legumes) within the confined environment *(Table 4)*. Further research is needed to verify their preference in the selection of fodder.

The mineral profile in the forage *(Table 5)* was generally sufficient in satisfying the dietary needs of growing goats. However, in the wet tropics with low pH soil, the ranch pasture may be low in phosphorus either due to environmental stress or overgrazing of pasture. It subsequently disturbs the leaf:stem ratio and upsets the Ca:P ratio too. The legume components or multiple species of browse plants can be introduced to such intensive production systems. Further studies on forage selectivity and its nutritional effects on the grazing goats would be critical.

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