THE RESEARCH AND DEVELOPMENT OF PASTURES IN PENINSULAR MALAYSIA

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ABSTRACT

The development of the ruminant industry in Peninsular Malaysia faces many problems. One of the major problems in ruminant production is the shortage of feeds particularly pastures at the farmers' level despite favorable environmental conditions for feed cultivation. Pasture research program in the country has introduced a number of exotic species for testing and exploitation as ruminant feeds. Selected improved species are found to be superior than the indigenous species when proper plant establishment, fertilization and management system of these pastures are taken care of. Higher animal liveweight gain and better production level were achieved from both nitrogen fertilized and legume-grass mixed pastures. The introduction and utilization of *Leucaena leucocephala* as high protein feed to animal through cutting or grazing have greatly improved ruminant production in both small holdings and grazing farms. Research results indicate that there is a good potential in ruminant production on existing green forage under plantation crops. In addition, the cattle ranches, the Goverment Grazing Reserves and uncultivated paddy land should be developed fully with pasture and fodder to accelerate the fulfilment of targeted self-sufficiency in ruminant production.

Introduction

Malaysia spends about 384 million ringgit to import 70% of her total needs in animal feedstuffs. Of all the animal feeds produced, 70-75% are formulated for the poultry, 25-20% for swine and only 1-2% for ruminants. Furthermore, this method for ruminant production based on formulated concentrates is too expensive, indicating that the production of ruminants has to rely solely on conventional green feeds or pasture and on some substitutes, derived from agro-by-products.

Malaysia is characterized by the total absence of natural grasslands except in Sabah which has about 80,000 hectares, but of which very little use has been made of. Since pasture is not the end product of livestock production (the ruminant, in particular) there has been a general lack of awareness of the importance of fodder and pasture as a crop in Malaysia, even though the conditions in Malaysia are favorable for the growth of these species. The government's target in the livestock sector for ruminant production is to achieve 80% self-sufficiency in beef and 20% in milk and milk products by 1990. There is therefore a urgent need to increase the ruminant population, through intensification of research and development on pasture to accelerate the fulfilment of targets.

Climate

Peninsular Malaysia has an equatorial climate. The mean monthly temperature at sea level lies between a mean maximum of 32°C to 33°C and mean minimum of 21°C to 22°C throughout the year. Generally, a drop of 0.6°C may be expected for a rise in altitude by every 100m above sea level. Relative humidity is uniformly high, ranging from 82% to 86%, and in the highlands it rises to about 90%. Rainfall is generally abundant, from 1,779mm to well over 3,444mm. The east coast region receives more than 50% of its total annual rainfall from the

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north-east monsoon during the end of the year. On the west coast, there are two peak periods of rainfall i.e. April-May and October-November. Towards the south, the rainfall is fairly well spread out with an average of more than 125-150mm monthly precipitation. Potential evapotranspiration is estimated at about 4.7mm per day, or some 1,700-1,800mm per year. As a consequence, there is no regular seasonal moisture deficiency and the growing period, as calculated by the FAO Agroecological zone method, is 365 days (FAO, 1980).

The amount of light energy received from the sun reaches a peak at around 2,400 microeinstein /M^2/sec during noon time. This implies that a greater amount of light energy is available in a year. However, it is believed that only 50% of this incoming light energy is suitable for photosynthesis with the wave bands around 400-700nm. Daylength is about 12½ hour throughout the year.

Constraints

Like other developing countries, Malaysia is facing problems and constraints in developing her livestock industry. Emphasis here lies only on the ruminant industries which include beef, dairy cattle and small ruminants, such as goats and sheep. Pasture research and development for the expansion of the ruminant industry are governed by some major factors (Syed Ali, 1980; Abdul Malik, 1984): (a) constraints in the ruminant industry and (b) problems in pasture development.

1 Constraints in the ruminant industry

1) Feeds

It is the general consensus among researchers, development specialists and farmers that the feed resources limit the animal number and animal production on the country. It is a common problem for both ruminants and non-ruminants. In the case of ruminants, the feed problem is likely to become more acute with time since only 1-2% of imported feed ingredient is accounted for by the ruminants. Moreover, the formulated compound feeds are good for a specific class of animals (i.e. calves and milking cows) as a concentrate supplement. Conventional green forage is the best solution to the problem.

Table 1 Changes in ruminant population in Peninsular Malaysia (1971-1982)

Year	Population			
	Cattle	Buffalo	Goat	Sheep
1971	317,011	214,570	321,856	37,257
1972	328,393	204,900	310,230	39,780
1973	328,256	200,780	303,620	40,930
1974	362,448	204,000	310,380	42,980
1975	385,989	212,705	328,590	45,495
1976	411,845	211,914	331,467	47,017
1977	439,364	211,408	332,000	51,544
1978	459,475	216,187	324,252	55,245
1979	462,090	199,883	321,802	62,624
1980	481,424	199,492	312,069	59,283
1982	503,051	179,636	—	—

Source: Statistics Department, Malaysia.

2) Low ruminant population

In the last ten years, the cattle and sheep populations increased by about 5% while those of buffaloes and goats declined (Table 1). The slaughter extraction rate of ruminants is already so high that domestic production cannot meet the demand.

The problem of declining ruminant population in the country was aggravated when double cropping of paddy was introduced in the rice-bowl areas where machines have replaced the animal power.

3) Socio-economic factors

The existing socio-economic factors have a great impact on farmers in relation to animal production. More than 90% of ruminants are reared by approximately 150,000 farmers who are scattered throughout the whole Peninsula; while only 5% are produced by either government farms or commercial ranches. Commercial ranchers or goverment farms, small holders' farm land and sizes are presented in Tables 2 and 3.

Animal rearing is only a form of investment to the farmer as an exchange for cash during emergency situations such as crop failure, for family celebrations, for milk and meat, and for draught purposes. One common but significant feature is that livestock raising has never been considered a major source of income to the family. No pastures or crops are grown for the animals, but fodder is cut from bunds and roadside verges away from the farm.

4) Low returns in ruminant production

The present low inputs and extensive production systems adopted by the small holders for the ruminants do not make the products competitive when compared to imported livestock products. Local beef production on commercial ranch costs M$ 4.84/kg liveweight but the

Table 2 Farm location and farm size for pasture and fodder production in Peninsular Malaysia

Farm/Station	Farm size (ha)	Farm type
Darabif Sdn. Bhd.	4,050	Commercial production
Pahangbif Sdn. Bhd.	4,050	
MARDI		Experimental
1) Bukit Ridan	500	
2) Kluang	500	
3) Serdang	275	
4) Sungai Baging	10	
Universiti Pertanian Malaysia	650	Teaching/Experimental
Veterinary Division		Training/Production
1) Air Hitam	2,020	
2) Batu Arang	200	
3) Behrang Ulu	1,700	
4) Cermin Kiri	100	
5) Chalok	100	
6) Ijok	200	
7) Jelai, Gemas	1,964	
8) Kluang Institut Haiwan	1,620	
9) Padang Hijau	2,020	
10) Pantai	320	
11) Tersat, Kuala Brang	2,020	
12) Tanah Merah	1,010	
13) Ulu Lepar	2,220	
Total area	25,529ha	

Table 3 **Farm size and animal number of small holdings at different locations in Peninsular Malaysia**

Location	Mean farm size (ha)	Range (ha)	Animal per farm (head)	Range (head)	Availability of land/pasture	References
Northern paddy area	1.54	0.08—19	1.44	1—3	No crops were grown for animal	Lai *et al*., 1973
Coastal area at Banting	0.3	—	6*	—	Most farmers have no land	Mohd, Najib and Hassan, 1980
MCC area at Jasin	1—2	—	4	3.5—5.4	(a) 59% farmers have no land (b) 17% farmers <1ha (c) 16% farmers 1-2 ha.	Hassan and Devendra, 1982

* Inclusive of calves.

price offered at farmgate is M$3. 52/kg liveweight (Abdul Malik, 1984). Furthermore, the gross returns from animal production per unit area are very much lower i.e. about M$424/ha/year at a beef price of M$2.10/kg liveweight (Eng and Chen, 1977), as compared to the net income from oil palm of M$5030.00/ha/year at an oil price of M$1,200.00/ton and from rubber of M$3651.00/ha/year at a rubber price of M$2.40/kg (Tunku Mansor and Sinclair-George, 1979). Local experience shows that it takes about ten to twelve years to break even on the total expenditure in cattle farming (Clayton, 1983).

2 Problems in pasture development

Problems in pasture development may be listed as follows:

1) Shortage of trained personnel for extension and the development of pasture and fodder as a crop. People are generally unaware of the interaction of pasture with soils and animals.

2) Limited choice of suitable pasture grass and legume species for specific usage in the open ranch, in small holdings and in plantations.

3) Insufficient information on the optimum usage of fertilizer for plant growth and animal production in relation to various soil types in Malaysia.

4) The management effect on production and persistence of nitrogen fertilized or legume-grass mixed pastures in the open, and the effect of pastures on the main crops of plantation land are not fully understood.

5) Lack of management systems for the development and maintenance of pastures in government grazing reserve land where technologies can be disseminated.

Research activities on pasture

Pasture research in Malaysia started off as early as in the 1930s mainly by the Department of Agriculture. However, it was interrupted and resumed later in the 1950s mainly with the introduction and evaluation of tropical grasses (Georgi *et al*., 1941; Henderson, 1955a; Ure and Mohamad Jamil,1957; Lim, 1968; Tan *et al*., 1973; Chin *et al*., 1974). The introduction of legumes, by the Rubber Research Institute of Malaysia (RRIM) was initiated in the 1920s (Watson, 1957), mainly for the purpose of water and soil conservation under rubber. The Malaysian Agricultural Research and Development Institute (MARDI) in 1970 has taken over the responsibility to conduct research on both grasses and legumes as forage crops for animals. In 1973, a joint pasture research program between MARDI and the Commonwealth Scientific and Industrial Research Organization (CSIRO)

Division of Tropical Pastures was initiated. Research projects such as plant introduction and evaluation, establishment, plant nutrition and soil fertility, integration of pasture with plantation crops, and assessment of pasture productivity with special emphasis on development and management of ranch pastures for both government and private farms were planned and implemented. However, research priority has shifted towards the improvement of feeds for small holders since the early part of 1980 simply because more than 90% of ruminant animals in the country are reared by small holders.

1 Pasture establishment

The most important factor in controlling germination, other than the viability of seed, is the soil moisture conditions before or after sowing or planting. Thus, the choice of planting time coinciding with rain is critical, and local experience shows that to achieve adequate seed-soil contact after sowing, some forms or rolling (using a cambridge roller) improve germination very much. Temperature is unlikely to limit germination in Malaysia.

The correction of soil nutrient deficiencies has been the most important factor for successful establishment of pasture legumes and grasses. Total N content in soils is low (0.05-0.1%) and this is aggravated by low pH values ranging from 4 to 5 (Coulter, 1972). There is a universal deficiency in phosphorus in soils but more so in this wet, humid environment (Kerridge and Tham, 1974; Tham, 1976). Besides, deficiencies in potassium, molybdenum, copper and calcium were also reported in both pot and field experiments (Tham and Kerridge, 1982).

On sandy soils (Bris soils), Tham and Kerridge (1979) used *S. guianensis* to demonstrate

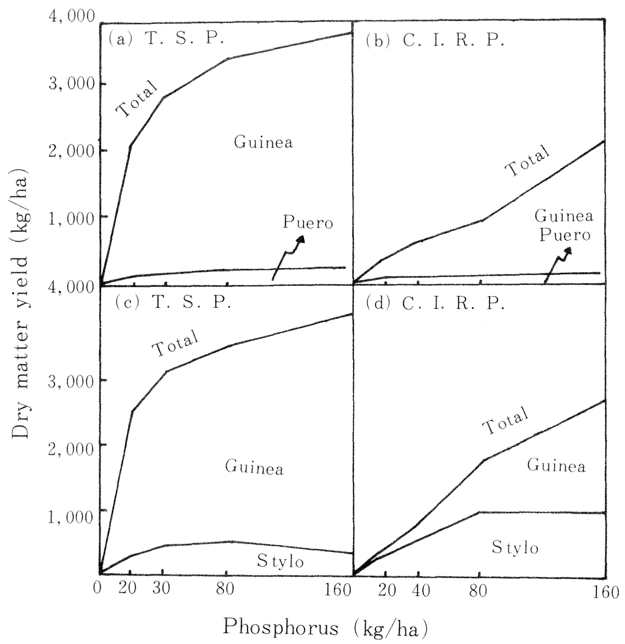

Fig. 1 Comparative response between triple super-phosphate and C.I.R.P. by two pastures, Common Guinea-Puero and Common Guinea-Stylo, grown on a Rengam series soil at seven-week growth.

Kerridge and Tham 1974.

T.S.P.: Triple super-phosphate C.I.R.P.: Christmas Island Rock Phosphate.

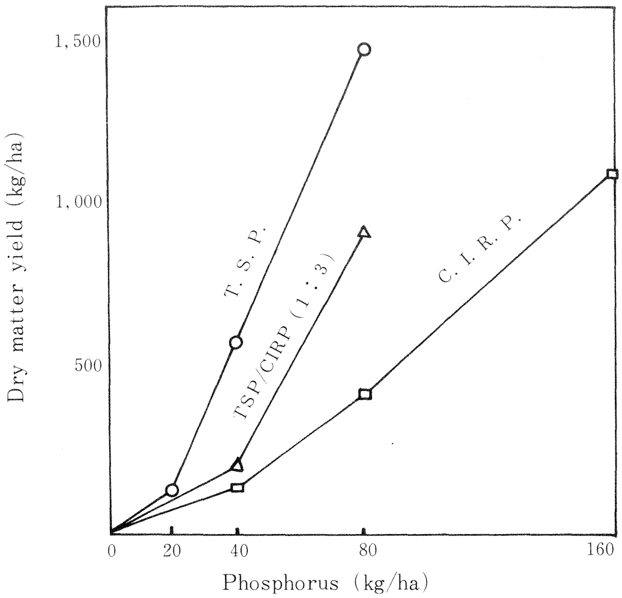

Fig. 2 Comparative response between triple-superphosphate, C.I.R.P., and a combination of triple-superphosphate and C.I.R.P., in the ratio 1:3, by a Common Guinea-Stylo pasture on a Munchong series soil.
Kerridge and Tham,1974.

the major responses to P, K, S and Cu, and to Ca, B, Mo, and Mg on certain Bris soil series.

Furthermore, Watson (1960) reported that the uptake of molybdenum by the legumes, *C. pubescens* and *P. phaseoloides,* at pH below 5 was so low as to limit plant growth. When the soil pH was raised to 6, the values of molybdenum and nitrogen in the plants increased along with the dry matter weight of plants. Good *Leucaena* establishment and rapid growth require liming up to 2 ton per hectare together with rhizobial inoculation with CB 81 and lime pelleting of seed (Tham *et al.,* 1977). Results from another experiment (Wong and Devendra, 1982) with solution-culture at varying aluminium concentrations illustrated that the growth of *Leucaena* was greatly reduced in solutions containing more than 4 ppm of aluminium. The detrimental effects of high aluminium concentration can be ameliorated to some extent by increased calcium levels.

There is an advantage in using triple super-phoshate fertilizer for establishment of pasture (Wan Mohamad and Kamarudin, 1977) as there is a delay of four to eight months before the same dry matter yields are obtained from equivalent amounts of CIRP as from triple super-phosphate (Fig. 1 and Fig. 2). The results in Figure 1 (b, d) suggest also that Stylo is more competitive than common Guinea for phosphorus for those treatments where phosphorus deficiency is severely limiting growth (Kerridge and Tham, 1974).

After pasture establishment, the grazing pressure on pasture in terms of biomass of animal total liveweight per unit area, should be slowly increased; in the first year at a low biomass level of 672 kg liveweight, in the second year at a medium level of 896 kg and in the third year at the optimal level of 1,064 kg live weight per hectare (Clayton, 1983).

Sometimes, oversowing legumes into the existing pasture is necessary because of poor and uneven germination during early planting or because of overgrazing later. In farm practice, minimum disturbance of the hard soil surface through disc harrowing or tining is needed, followed by a sodseeder to get the seed into the tillage. Prior to this, the existing forage must be slashed, burned or grazed right down by heavy stocking to facilitate oversowing and to favor the growth of young seedlings within old stands.

2 Pasture production

From 1972 to 1979, a total of 60 improved tropical grasses and 63 legumes were introduced into Malaysia for testing in forage production under the MARDI pasture research program at Serdang (Orthoxic Tropudult), at Jalan Kebun (Oligotrophic Peat) and at Sungai Baging (Marine Sand). The promising genera (1) for grass: *Brachiaria, Cynodon, Digitaria, Panicum, Pennisetum, Paspalum* and *Setaria* and (2) for legume: *Centrosema, Desmodium, Leucaena, Pueraria, Stylosanthes* and *Zornia* have been indentified and listed in Tables 4 and 5 (Wong, 1980b; Wong and Mannetje, 1981; Wong *et al*., 1982a; Wong *et al*., 1982b; Wong, 1982; Wong and Eng, 1983; Izham *et al*., 1983; Chen and Abdullah, 1984). Grass yields (dry matter) recorded ranged from 18 to 30 ton/ha/year cut at 6 weekly intervals on inland soils. Production on peat was quite similar to that on inland soils, while on sandy soils, it dropped generally by ½-⅔of the yield on the inland soils. Under small holder conditions,

Table 4 Mean annual dry matter yields (ton/ha) of some promising grasses defomiated at 6 weekly intervals in three regional stations

Grasses	Serdang⁺ (1973-1975)	Jalan Kebun (1975-1976)	Sg. Baging* (1975-1977)
Brochiaria brizantha	19.4	24.5	11.8
Brachiaria decumbens	24.7	26.3	16.5
Brachiaria mutica	8.1	16.0	8.1
Brachiaria ruziziensis	15.5	17.9	9.9
Cynodon plectostachyus	6.1	26.3	5.2
Coast Cross I	—	—	6.2
Panicum maximum cv. Tanganyika	27.7	30.3	—
Panicum maximum cv. Rangwe	19.0	28.0	—
Panicum maximum cv. Sigor	13.0	19.2	1.4
Panicum maximum cv. Gori	25.4	—	—
Panicum maximum cv. Typica	26.1	—	8.7
Panicum maximum cv. Coloniao	17.0	20.2	3.1
Panicum maximum cv. Hamil	15.5	19.6	2.8
Digitaria setivalva	20.5	25.4	3.8
Digitaria sp. *Slenderstem*	18.2	23.1	11.8
Digitaria sp. (H-10)	16.9	—	4.8
Digitaria sp. (X-46-2)	20.8	22.9	—
Digitaria decumbens	—	—	16.8
Paspalum plicatulum cv. Rodd's Bay	21.1	24.1	8.5
Pennisetum purpureum (Local)	30.0	16.3	3.4
Pennisetum purpureum (Uganda)	21.0	12.7	2.7
Pennisetum purpureum (Ex-Cameroon)	24.0	20.7	—
Setaria sphacelata var. Splendida	18.6	16.6	0.5
Setaria sphacelata cv. Kazungula	20.6	15.8	6.7
Tripsacum laxum	23.0	21.0	2.0
Average yield	19.9	21.3	8.9

⁺ Adapted from Wong C.C. (1980).
* Estimated yields.

(Wong, Chen and Agit, 1982a)

Table 5 Mean dry matter yield of some promising legumes grown with grass under cutting and grazing (kg/ha/year)

Species	Cutting[+]			Grazing[++]			References
	Legume	Guinea grass	Legume + grass	Legume	Guinea grass	Legume + grass	
C. pubescens	251	2,026	2,277	90*	2,377	2,467	
C. caeruleum	—	—	—	200	2,147	2,347	[+]Wang and Mannetje, 1981
P. phaseoloides	262	1,880	2,142	—	—	—	
D. ovalifolium	—	—	—	398	1,845	2,243	[++]Wong, 1982
D. heterophyllum	281	2,114	2,396	—	—	—	
S. guianensis cv. Schofield	706	1,813	2,519	723	1,545**	2,268	
S. guianensis cv. Endeavour	618	1,755	2,373	549	1,539**	2,088	
S. guianensis CPI No.							
33437	955	1,100	2,055	238	1,285	1,523	Wong and Eng, 1983
08231	811	1,195	2,076	352	1,444	1,796	
33978	644	1,212	1,876	334	1,461	1,795	
41218	647	1,545	2,921	378	1,090	1,468	
33706B	526	1,408	1,934	430	1,318	1,748	
40294	906	1,033	1,934	475	1,053	1,528	
40255	956	1,187	2,143	325	1,024	1,349	
S. scabra							
40205	613	1,599	2,212	575	1,550	2,125	
40292	304	1,548	1,852	492	1,350	1,842	

* Belalto Centro
** *Digitaria setivalva*

the mean pasture production of various promising grasses was reported to be around 15-19. 5 ton/ha/year of dry matter (Izham and Hassan, 1983); whereas in a commercial cattle farm it was around 13.9-19.7 ton/ha/year (Darabif, 1982) and 11 ton/ha/year under the plantation management (Tan *et al*., 1973). Dry matter production of promising legumes under mixed sward as shown in Table 5 ranged from 2 to 10 ton/ha/year, while under commercial management with a mixture of four legumes planted as cover crops under plantation crops the yield ranged from 3.6 to 5.4 ton/ha/year of dry matter (Han and Chew, 1981). More recently, a keen interest has been shown in the utilization of the leguminous browse plant *Leucaena leucocephala* as a source of high protein feed to ruminants. It is also believed that *L. leucocephala* is one of the species best suited either agronomically or nutritionally to introduction and combination in existing cropping systems of small holdings, in spite of the difficulties in plant establishment (Wong *et al*., 1983) and the 30% intake limitation of mimosine in cattle (Jones, 1979) and 50% in goat (Wong and Devendra, 1982). Of the 76 *Leucaena* accessions introduced from the Philippines at the end of 1974, two selections. i.e. ML1 and ML2, were released to farmers for cultivation in April 1983.

The responses of grasses to nutrient applications are well documented (Henderson, 1955b, c; Tan *et al*., 1973; Chew *et al*., 1975; Tham 1980). Napier dry matter yield increases with increases in nitrogen fertilizer but the marginal N recovery decreases with increasees in N rate. The decline was more marked under more frequent cutting. In phase I (1973-1974) the overall value decreased from 46% (4 weekly intervals) and 42% (6 weekly intervals) at 200-400kg N/ha/year to as low as 16% and 30%, respectively, at the higher rate of 800-1600kg N/ha/year. Whereas in phase II (1976-1977) the corresponding figures ranged from 32% and 48% to 22% and 33% (Tham, 1980).

The clear pattern of declining growth rate from 43.7kg DM/ha/day to 20.4kg DM/ha/day over a 5-year period from 1979 to 1983 reported in commercial farm (Bauer, 1984) confirms that further research is needed to look into the factors which determine the long-term productivity of pastures on inland soils and to establish the critical nutrient levels for the common pasture species in Malaysia.

3 Pasture management and utilization

1) Grazing on legume-based pastures

The first grazing experiment on a Guinea-legume mixed pasture was carried out in Kluang in southern Peninsular Malaysia in cooperation with CSIRO, Australia in August 1974 to look into the stocking rate and the effects of phosphorus on this pasture (Eng *et al.*, 1978a, b). Results show that the effects of the stocking rate and phosphorus fertilizers on both the pasture and animal liveweight gain were significant. Stable pasture was maintained at a stocking rate of 4 Kedah-Kelantan cattle (1 Animal Unit=280kg) after three years of grazing. With this optimal stocking rate, the experiment was modified to continue with the phosphorus treatments until the fifth year. Final results indicated that 20-40 kg P/ha/year in the form of CIRP is sufficient to maintain such a legume-grass pasture for optimal animal production (Eng, 1983). However in view of the reports on mineral deficiencies in both plant (Tham and Kerridge, 1982) and animal (Wan Zahari and Devendra, 1984) and the incidence of pasture yield decline in Darabif farm (Bauer, 1984), the subtle effect of minor elements in soil, pasture and animals could be most critical. For instance cobalt deficiencies reported in the above grazing animals by Mannetje *et al.*, (1976) and the treatment responses in animals reported by Dahlan (1983) and Wan Zahari and Devendra (1983) were really due to the low cobalt content in pasture plants (Kerridge, 1980).

With the reports on the utilization of *Leucaena leucocephala* (Izham *et al.*, 1982; Wong and Devendra, 1982; Izham and Hassan, 1984) in a mixture with *Brachiaria decumbens,* there is certainly a scope for the development of intensive cattle production in grazing pastures with the elimination of the cost of nitrogen fortilizers. The overall animal liveweight production in relation to stocking rates and grazing management with stable pastures under local conditions is summarized in Table 6.

2) Grazing on N-fertilized pastures

The advantage of grazing the animals over stall feeding in terms of animal liveweight gain, (Wong and Devendra, 1982; Abdullah Sani and Basery, 1982) calving interval, mortality rate and early maturity (Mustapha and Kamal, 1982) has justified the existence of grazing management of pastures. Of course, before implementation, one has to consider other important factors such as land availability, manpower and the economic returns of grazing production. Improved pastures respond very well to nitrogen fertilizer even up to 1,600 kg N/ha/year (Tham, 1980). Thus, uses of nitrogen fertilizer on grazing pastures to intensify the pasture and animal production will play an important role in the ranch management. N-fertilized pasture is beneficial as compared to legume-grass pasture (Eng and Chen, 1977), especially when urea is available at a reasonable price and local beef price is high. It is much easier to manage a nitrogen-fertilized pasture than to manage a legume-grass pasture. It has been suggested that each ranch should keep at least 20-30% of its total farm land for nitrogen-fertilized pasture to conserve feed for grazing animals during drought and for holding animals during sorting. The popular choice of species for grazing will be *Brachiaria decumbens.* However, the farm manager has to be cautioned in selecting *Brachiaria* species

Table 6 Summary of animal production in relation to stocking rate and grazing management from legume-based pastures in Peninsular Malaysia

Type of pasture and duration	Type of animal and stocking rate (head/ha)	Duration/ grazing system	Mean liveweight gain g/head/day	Mean liveweight gain kg/ha/yr	References
(a) Guinea+Centro+Puero+Stylo	4 K.K.	3 years continuous	281	410	Eng, Mannetje and Chen, 1978
(b) Guinea+Centro+Stylo+*D. ovalifolium*	2.6 D M	1 year continuous	448	433	
(c) Transvala Digit+Centro+Stylo+*D. ovalifolium*	2.6 D M	1 year continuous	366	353	Eng, 1981
(d) Native grasses+Centro+Stylo+*D. ovalifolium*	2-2.6 D M	1 year continuous	324	311	
(e) Native grasses+*Leucaena*	5 K.K. and Brahman x K. K.	40 weeks rotational (4 weeks on) (4 weeks off)	305	557	Izham, Eng and Ajit, 1982
(f) Signal grass+*Leucaena*	5 K.K. and Brahman x K. K.	rotational (same)	353	644	
(g) Signal grass+*Leucaena*	5 S x F	1 year rotational (2 weeks on) (6 weeks off)	433 (Grazing) 368 (Cutting)	788 669	Wong and Devendra, 1982
(h) Kazungula Setaria+Centro+Stylo+Puero	Biomass 1,064 kg/ha of K.K.	Continuous	360	—	Clayton, 1983
(i) Signal grass+*Leucaena*	7.3 K.K.	19 months rotational monthly	325	855	Izham and Hassan, 1984

K.K.=Kedah-Kelantan cattle=280 kg   B x K.K.=Brahman x Kedah-Kelantan cattle=330 kg
D M=Droughtmaster=380 kg   S x F=Sahiwal x Friesian=375 kg

Table 7 Summary of animal production in relation to stocking rate and grazing management from N-based pastures in Malaysia

Type of pasture	Type of animal and stocking rate (head/ha)	Year and grazing system	Fertilizer (kg N/ha/yr)	Mean liveweight gain		References
				g/head/day	kg/ha/ yr	
Digitaria setivalva	6 K.K.	2 years continuous	150 300	276 341	570 698	Chen, Ajit and Evans, 1981
Panicum maximum	6 K.K.	3 years continuous	150 300	335 403	665 789	
Brachiaria decumbens	8 K.K.	3 years continuous	150 300	286 353	752 902	
Digitaria setivalva	5.3 K.K.	2 years continuous	300	272	485	Chen and Othman, 1984 (In preparation)
	6.7 K.K.	4 years rotational	300	304	703	
Digitaria setivalva	20 goats	$1\frac{1}{2}$ years continuous	110	35	257	Chen and Devendra, 1984 (Unpublished results)
	40 goats	(same)	150	31	445	

as nitrogen-based pastures for his goat or sheep farm as cases of jaundice and photosensitization of grazing goats and sheep have been reported on *B. decumbens* (Abas Mazni *et al.*, 1983). The syndrome of jaundice and photosensitization is associated with liver damage caused by the hepatotoxin of the *B. decumbens* plant (Abas Mazni *et al.*, 1984). Work on nitrogen-fertilized pastures in relation to stocking rate and grazing management in Peninsular Malaysia is shown in Table 7.

3) Utilization of pastures under plantation crops

Indigenous grasses such as *Axonopus compressus* and *Paspalum conjugatum* which are treated as weeds for plantation management are generally more shade-tolerant than improved species (Chen and Bong Julita, 1983). It is not advisable to plant improved grasses under rubber and oil palm plantations except for specific purposes such as in the cut-and-carry system for stall feeding. This is because of the short economic production period of improved pasture in the shade of the tree crop canopies.

Tropical legumes are more shade-tolerant (Chen and Othman, 1984). Furthermore, most of the pasture legumes such as Centro, Puero, Calopo and *Desmodium* are common legumes used for the plantations as cover crops. It will be most desirable to make use of the existing "weeds" together with the plantation legumes as animal feeds rather than to plant improved tropical grasses.

Local experience shows that light is the most limiting factor controlling pasture growth underneath the tree canopy. Hence, as the tree crops grow and the canopy closes slowly, the amount of green vegetation thins down and reduces accordingly. The light transmission in mid-day under oil palms during the first and second year is about 97-90% of full sunlight while during the 3rd, 4th, 5th and 6th year, it is around 80%, 45%, 30% and 20% of full sunlight. In the 7th year, it amounts to 10% of sunlight and by then the amount of green undergrowth would be around 500 kg DM/ha which is estimated to be insufficient to support one grazing cattle. Similar light regimes could be found under the rubber canopies of similar age, whereas there is more light penetration in the coconut plantations. Mohamad Sukri *et al.* (1982) pointed out that the suitable time to commence grazing under oil palms is around 12 to 18 months after transplanting of main crop. The carrying capacity under tree crops is expected to decrease with time. Under young oil palms (2-3 years old) about 3 K.K. cattle can be carried per hectare but under 5-7 years old oil palms only one K.K. per hectare may be stocked. Table 8 lists the studies carried out by local researchers to evaluate the performance under different plantation crops.

4 On-farm research

In addition to the research program undertaken in various stations, as reported above, research activities are also carried out in farmers' land. Promising pasture species identified at station level are then evaluated in small holders' farms (Izham and Hassan, 1983). Studies on fertilizer applications in pastures in comparison with the utilization of cowdung for pasture production are currently carried out in various areas. Techniques for oversowing legumes into native pastures on coastal sandy areas (Izham *et al.*, 1981) and on inland soil (Izham and Hassan, 1982) are also being developed. With the release of two *Leucaena* selections in 1983, the Department of Veterinary Services and MARDI are promoting the production of *Leucaena* as animal feed which has gained popularity among the farmers.

Long-term experiments on pasture nutrition and soil fertility in cattle ranches have been reported (Tham and Kerridge, 1982). Trials on nodulation problem of *Centrosema* showed that *Rhizobium* strain SB 1923 was most suitable for plant growth.

Further, MARDI and DVS have been able to provide information on land clearing, land preparation, pasture species, pasture establishment, fencing and performance of different types of pasture.

Table 8 **A summary of published data on animal grazing under plantation crops in Peninsular Malaysia**

	Type of pasture	Type of animal and stoking rate (head/ha)	Duration/ grazing system	Age of tree crop (year)	Mean liveweight gain g/head/day	Mean liveweight gain kg/ha/yr	References
(a)	Guinea+Stylo+Native grasses under oil palm	1 K.K. cattle	23 months continuous	5-7	321 123-303	117 100	Chen, Chang, Ajit and Hassan, 1978
(b)	Native grasses+Stylo+Centro+Puero+*D. ovalifolium*+Calopo under young oil palm	1 K.K. cattle 2 K.K. cattle 3 K.K. cattle	24 months continuous	1-3	379 321 260	138 234 284	Chen and Othmar, 1983
(c)	Native grasses under rubber						
	(1) Copra cake (1% body wt)	2 goats	26 weeks continuous	6	75	55*	Mohd. Jaafar and Mohd Khusahry, 1983
	(2) Cattle pellet (1% body wt)	2 goats	26 weeks continuous	6	63	45*	
(d)	Native pasture under rubber supplemented with improved pasture	10 sheep 8 goats 10 sheep	3-6 months continuous	3-5	70 60 95	255* 175* 346*	Lee *et al.*, 1978
(e)	Native pasture under rubber	21-118 sheep in 120 ha	25 months continuous	—	65 (4 month's record)	—	Wan Mansor and Tan, 1982
(f)	Native pasture under coconut (1) Grazing+copra (2) Stallfed+copra (3) Grazing (4) Stall feeding	LID x AMZ cattle	368 days grazing and stall-feeding	—	(a)900* g/day (b)835* g/day (c)769* g/day (d)725* g/day	331 307 283 267	Abdullah Sani and Basery, 1982
(g)	Guinea+Centro+*D. heterophyllum*+Puero under young oil palm	Biomass: 720-960 kg liveweight of K.K. cattle	30 month/grazing/cutting (a) 12 month stall feeding (b) 18 month stall feeding	1-2½	(a) 804* (b) 789*	735 (30 months) 718 (30 months)	Mohd. Sukri, Rosmawati and Musaddin, 1982

* Estimated value.

Pasture development

The Division of Veterinary Services is directly involved in pasture development in the country. It is logical that most pasture development programs be centered around the small holdings where 90% of the ruminants are reared. The work involves mainly (1) Homeplot pasture projects in Milk Collecting Center (MCC) areas and Pawah Cattle Schemes; (2) Development of 20% (or 8,100 ha) of gazetted grazing reserve land; (3) Cultivation of existing total animal farm hectarage of 25,500 ha; (4) Intercropping of pastures with plantation crops; (5) Training programs (Osman Din, 1980). The major objective is to provide good quality fodder to farmers' animals. Planting materials are provided free to farmers. Seedings of Guinea grass and *Leucaena* in polybag are easily available from the nearest Veterinary Office. Farmers are encouraged to use cowdung or animal wastes as fertilizer to reduce the cost of maintenance of pasture and fodder.

In the grazing reserve development project, about 80% of the efforts are aimed at the creation of mini-livestock farms; whereas 20% of the efforts are directed to the setting up of common grazing and holding grounds for general use of farmers. The mini-livestock farms will be used mainly for rearing, breeding and improvement of cattle, buffalo, goat and sheep in the country, and partly for production of green forage, hay silage and pelletized feeds for distribution or sale to small holders. These farms will produce also seeds and planting materials for farmers.

The prospect of pasture production based on local resources

1 Pastures under plantation crops

In Peninsular Malaysia, there are about 2.1 million hectares of rubber, more than 1.2 million hectares of oil palm and around 0.4 million hectares of coconut, accounting for over 80% of the total agricultural land use. All these tree crops are in monospecific plantations and small holdings with fixed planting distances for optimal density of trees and maximal production in yield. Yet there are about 70-80% inter-row areas available for inter-cropping, particularly during the premature stage of tree crops which ranges from 1 to 7 years before the canopy closes. Actually there is a wide range of high density natural undergrowth comprising grasses and broad-leaved weeds if the interrow areas are not weeded or disturbed. It is believed that plantation area provides good grounds for animal production if proper management of stock and monitoring of botanical species are worked out in relation to tree crop production.

2 Government livestock grazing reserve land

This refers to the land allocated by the state governments for use by the public as common grazing grounds for livestock. Total area available for ruminant production amounts to 38,934 hectares but is scattered over 629 locations throughout the Peninsula (Table 9). However, there are restrictions in the utilization of the grazing reserves mainly due to the unsuitability of the land for pasture and fodder production. The reserves are either in hilly areas or in low-lying land not accessible to machinery, or are problem soils such as waste mining land of sandy texture, peat soils and acid sulfate soils where special management and correction of soils are needed for forage production. Even after developing the grazing reserves the life-span of effective pasture is very short because of uncontrolled stocks from the community which causes overgrazing of the pasture. Subsequently, the system of management be it cut-and-carry system or grazing systems, needs to be developed for successful management of grazing reserve land.

Table 9 Total area of grazing reserves by state in Peninsular Malaysia, 1974

State	Number	Total area (ha)	No. used	Area used (ha)	Area-cultivated: Fodder	Area-cultivated: Pasture	1975 cultivated %
Pahang	230	11,955	66	2,015	49	—	1.3
Perak	95	4,603	52	2,601	6	19	4.5
Kelantan	50	5,265	7	62	62	3,239	34.1
Johor	28	3,729	16	1,526	54	854	—
Trengganu	61	4,029	7	281	—	—	7.8
Kedah	67	4,702	24	1,677	33	30	12.0
N. Sembilan	84	3,597	23	750	—	99	37.0
Melaka	1	40	—	—	—	—	—
Perlis	—	—	—	—	—	—	—
Penang	—	—	—	—	—	—	—
Selangor	13	1,014	3	145	—	105	0
Total	629	38,934	198	9,057	4,550		
			31.5%	23.2%	11.7%		5.8%

After Chin, F. Y., Division of Veterinary Services.

3 Paddy production areas

Currently there are about 404,000 ha of land available for paddy cultivation, representing 12% of the total arable land in Peninsular Malaysia. Of this area, 230,000 ha are used for double cropping in the north, and the rest remains as rainfed single cropped areas which are scattered mostly in the states of Kelantan (44,000 ha), Kedah (28,000 ha), Trengganu (27,000 ha), Pahang (16,000 ha), and a few hectares in Melaka, Negeri Sembilan and Johor. In terms of livestock production in the double cropped area there is very little room left for future expansion. However, in the rainfed single cropped areas, ruminant production is potentially possible, in addition to the planting of tobacco, vegetables, maize, mungbean, sorghum and soybean. Lately, the migration of rural folk to urban areas has aggravated the labor situation resulting in land being left idle (uncultivated), particularly in the rainfed single croppiog areas. This may be best suited to pasture and animal production, especially when the labor shortage is taken into account. However, a practical system for land development and management needs to be designed, as it involves a large number of small holders with an average farm size of about one hectare.

The future ruminant production is closely associated with the continuation of efforts in developing and producing sufficient pasture and fodder, particularly in areas where large ruminant populations are concentrated. Through the intensification of pasture research with special emphasis on locally available resources, it is hoped that in the very near future Malaysia will be able to satisfy the local demand in ruminant production.

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Discussion

Kitamura, Y. (Japan): Do you encounter any problem of toxicity with *Leucaena*?

Answer: We sometimes observe a moderate enlargement of the thyroid in cattle. However *Leucaena* accounts for only 20% of the total intake. Goats seem to be able to tolerate a rate of 30% and sheep 75% in the total intake.

Kawanabe, S. (Japan): I was surprised to note that you could achieve such a high liveweight gain (800kg/ha). What are the reasons for such a performance?

Answer: I do not know. These figures apply to the local Kedah-Kelantan cattle.