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PROBLEMS IN FEEDING AND NUTRITION OF LACTATING RUMINANTS IN ASIA

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FOREWORD

The paper published in this bulletin was presented by the coauthor, Dr. Metha Wanapat at the international seminar on 'Dairy and Dairy-beef Development in Asia' held in Chiang Mai, Thailand, December, 1985. Sponsors of the seminar were the Food and Fertilizer Technology Center, Chiang Mai University, Maejo Livestock Research Institute, Chiang Mai, Kasetsart University, Bangkok, and, the Department of Livestock Development, Kingdom of Thailand.

Drs. Devendra and Wanapat are well known for their work in animal nutrition in the Asian and Pacific Region. The data presented is expressly oriented toward the development of feeding systems for the small dairy farmers of the region. Examples of several low cost feed resources and suitable forages are given with explanation of their possible role in feeding systems. It is very practical material, for the farmer and extension worker.

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SUMMARY

Under and poor nutrition are consistent features of low productivity and continue to prevail in Asia. The most critical elements are inadequate feed supplies, variations in feed quality, the requirements for supplements and practical problems of feeding and nutrition. The latter include use of concentrates, dietary composition, stage of lactation, dependence on different diets and use of feeding standards. Supplementary concentrates are required but only justified if increased milk yield returns a profit over the cost. The use of urea-treated straws and leguminous forages are very promising. Feed deficits and reducing dependence on imported concentrate necessitate more complete utilisation of the local feed resources including non-conventional feeds. The development strategies include increasing the feed supply base, improved systems of feeding and adequate support services.

摘　要

亞洲地區普遍而持續存在導致低生產力的動物營養不足及不良等兩大主要特徵。最嚴重的因素有飼料不足、飼料品質變異、補充飼料規格及實際飼料與營養的問題。後者包括精料的使用、日糧的組成、不同日糧的依存度及飼養標準的應用等項。只有在增加產乳量而得到超過成本的利潤時,農民才考慮補充精料。使用以尿素處理的稻草及豆科芻料頗爲可行。由於缺乏飼料並減低進口精料之依賴性，促使包括非傳統性飼料在内的本地飼料得以充分利用。增加飼料餵與量、改進飼養方法及加強技術輔導均爲改進飼養與營養的策略。

摘　要

アジアでは低榮養による低生產性が一般的に今でも續いている。もつとも危機的な要素は不適當な飼料供給、不揃いな飼料の品質、補足成分への要求、飼料や榮養における實際的な問題である。最後の項目には濃厚飼料の使用、消化成分、授乳期、種々の食餌への依存、飼育標準などの問題が含まれている。補足的に濃厚飼料を使う必要があるが、これは增加した牛乳生產により使つた費用以上の利益が得られる場合に限られる。尿素處理したわらや豆類飼料を使用することは非常に有望である。飼料不足に對處し輸入濃厚飼料を減少させる爲には、今まで利用してきた飼料以外のものも含むそれぞれの地方の飼料資源をより完全に利用する必要がある。發展計畫の中には飼料供給源をふやすこと、飼育法の改良、適當な支持活動が含まれる。

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INTRODUCTION

Throughout the Asian region, dairy production generally from dairy cattle, but in Pakistan and the Indian sub-continent from dairy buffaloes as well, represents the most developed ruminant production. Although technological and capital inputs have been on a massive scale continuing environmental problems still exist.

Feeding and nutrition is the main problem affecting milk production. Two critical elements which influence quality and quantity of the milk produced are feed supplies and their efficient utilization[10]. The types of feeds available of those that are essential for milk production is important and in existing systems whether there are constraints to current sources of feed supplies and the extent of dependence on purchased feeds are critical. Efficient utilization is affected by feeding system pattern of utilization, types of ingredients and nutritive values, level of supplementation and feed efficiency in cost effectiveness of the conversion to milk. Production systems in the South East Asian and South Pacific region are unlikely to change in the immediate future or in the longer term[24] and the problems must be solved.

This paper will consider adequacy of feed supplies, variations in feed quality, management factors that affect milk yield and composition and development strategies that can facilitate high milk production in the Asian region.

INADEQUATE FEED SUPPLIES

Inadequate feed supplies is the most limiting constraint to high milk production and milk of good quality. The problem is exacerbated by the high cost of imported high quality energy (maize and cassava) and protein ingredients (soyabean meal, groundnut cake and fish meal) necessary for high milk production. Thus the extent to which these are used in dairy feeding systems, and when limiting, the need for imports from overseas considerably influences the cost of production. It has been shown that the direct financial benefits to a developing country are considerable in terms of milk produced per unit of foreign currency (or foreign aid) when all the available protein meals within the country are used efficiently[23].

The situation is acute in Asia where the feed requirements by livestock are in excess of current supplies. Recent analyses of the feed resource base in Asia in terms of the area under pasture and fodder corps, quantities of available feed grains, oil cakes and agricultural by-products, the number of livestock necessary to provide human requirements and the services required suggest a quantitative and qualitative insufficiency of feeds for livestock growth, reproduction and production[45]. In India it has been estimated that there is a shortage of 8.5 million tonnes of concentrates (44%), 38.4 million tonnes of dry fodder (11%) and 129.4 million tonnes of green fodder (38.4%) for dairy animals. The report indicated that only 70% of digestible crude protein (DCP) requirement of dairy animals, 50% of the requirement of dry animals, 40% of the requirement of adult cattle and about 20% of the requirement for young cattle were being met from the available feeds. This situation has been projected to continue till the turn of the century[27]. A similar situation exists in Pakistan where despite the availability of 14.2 x 10^6 tonnes of total digestible nutrients (TDN) and 1.4 x 10^6 tonnes of crude protein, there is still a deficit of 49% energy and 42% digestible crude protein (DCP). On the other hand in Malaysia feed resources are in excess of the requirements of farm animals[8]. A similar situation may also prevail in other very humid countries of South East Asia.

Non-conventional feeds are under utilized. Table 1 summarizes the total feed availability from field and plantation crops in Asia and the Pacific (FAO, 1982). The non-conventional feed resource is very much higher than these figures suggest as they do not include all field crops. Additionally, neither residues and wastes from animal sources and the processing of food for human consumption have been included nor have the abundant variety of tree fodders that are used for feeding ruminants.

Table 1. The availability of non-conventional feed resources in Asia and the Pacific

Category	Availability (10^6 tonne)
Field Crops	189.9
Tree Crops	4.2
Total	194.1[a)]

a) Represents 44.9% of the total availability from field and plantation crops.
Devendra (1985).

VARIATIONS IN FEED QUALITY

Tropical grasses generally have lower voluntary intake and dry matter digestibility than temperate grasses due to higher fiber content, lower protein and other essential mineral contents[26] (Figures 1, 2, 3 and 4).

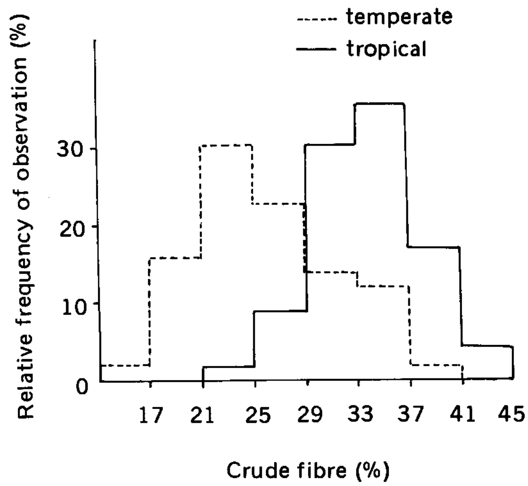

Fig. 1. Frequency distribution of fibre contents in a wide range of tropical and temperate grasses cut at many stages of growth (Minson, 1980).

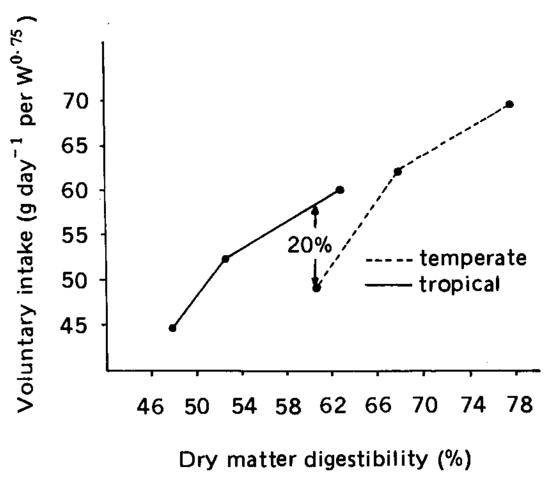

Fig. 2. Reaction between mean voluntary intake and dry matter digestibility for a wide range of tropical and temperate grasses (Minson, 1980).

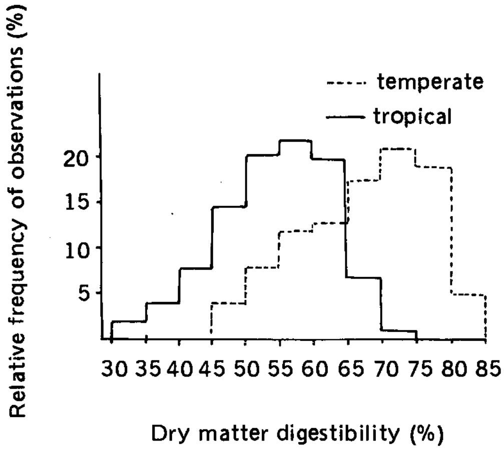

Fig. 3. Frequency distribution of tropical and temperate grasses cut at many stages of growth (Minson, 1980).

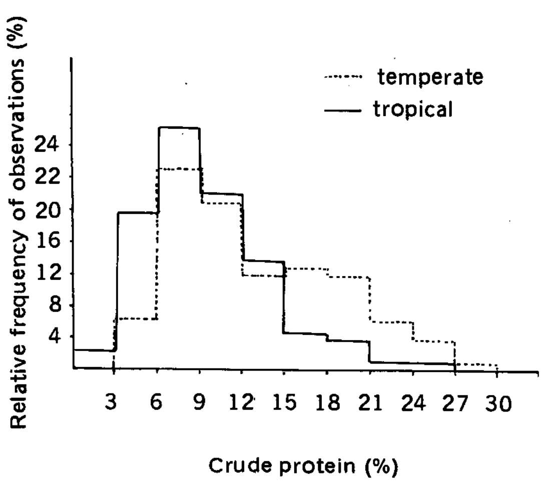

Fig. 4. Frequency distribution of crude protein in a wide range of tropical and temperate grasses cut at many stages of growth (Minson, 1980).

Variations in quality of ruminant feedstuffs has a major influence on milk yield and quality, which is essentially dependent both on the level of feeding and more particularly on the types of feed ingredients: roughages, concentrates or lipids. Variations in the proportions of acetic, propionic and butyric acids in the rumen affects milk fat (Figure 5). Increasing intake of roughages singly has little effect on the molar proportions of the acids present[3,53], but with hay-concentrate mixtures where the proportions are kept constant as intake increases, the ratio of acetic to propionic acid narrows. It was found[2] that when daily hay intake of dairy cows was reduced from 7.3 to 1.8 kg, the milk fat content decreased from 3.6 to 2.5%. Furthermore, 8.6 kg of ground hay reduced milk-fat percentage even further to 1.9%, emphasizing the importance of coarse as apposed to ground roughage. Thus, long fibre is essential in the maintenance of a relatively high milk-fat content and is reflected in the important relationship of volatile fatty acid proportions.

While dietary fibre is essential for maintaining rumen function and motility, in excess which is common in many parts of Asia, it limits milk yield. Forage quality is also important in the context of digestibility and the requirement for additional nutrients. The bulk of the maintenance needs are met from forage with possibly a small portion for production. The relationship between forage quality and the extent of concentrate supplementation, is dependent on the digestibility of the grass fed. This point was demonstrated in Malaysia using Guinea grass (Table 2). The digestibility of the concentrate fraction was about 80% and the requirement for concentrates was based on a milk fat content of about 4% for a cow weighing 350 kg live weight. It demonstrated that increasing forage quality decreases the requirement for concentrate supplementation, and that with high milk yields if digestibility of forage is high, the requirement for concentrates is very much reduced, and in essence the efficiency of concentrate utilization improved. In practice however, very seldom do tropical grasses have digestibility as high as 70%, and high intakes are limited by sheer bulk. Stage of maturity of the forage plant influences its quality as a feed more than any other factor; as maturity advances its protein content declines and energy becomes less available; optimum cutting time is important.

FEEDSTUFF	DIETARY FIBRE	STARCH	LIPIDS
	(Hay & Straws)	(Grain)	(Saturated and Unsaturated)
RUMEN	Low conc. of total VFA Relatively low bacterial count High pH (6.5) Slow decomposition	High conc. of total VFA Relatively high bacterial count Low pH (5.7) Rapid decomposition	Low conc. of total VFA Relatively low bacterial count High pH (6.0) Reduced decomposition
	Relatively high acetic acid Low propionic acid Little butyric acid	Relatively less acetic acid More propionic acid Relatively more butyric acid	Reduced acetic acid on low roughage diets, little change on high roughage diets
MILK	Relatively high milk-fat content (milk yield reduced)	Low milk-fat content (milk yield increased)	Variable response on milk-fat content (milk yield increased)

Fig. 5. The effect of type of feedstuffs on rumen processes and milk-fat. Devendra and Lewis (1974)

Table 2. The requirement for concentrate supplementation in relation to forage quality (kg)

Milk yield/day (kg)	Digestibility of dry matter (%)			
	55	60	65	70
6	3.2	0.7	—	—
10	4.9	2.5	0.8	—
14	6.6	4.8	1.1	0.3
18	8.2	6.0	3.0	0.7
22	9.8	7.7	5.4	1.7

Devendra (1975).

THE REQUIREMENTS FOR SUPPLEMENTS

Supplement feeding is justified in three particular situations:

1. Draught animal feeding where there is a scarcity of feeds either periodically or long term as is common in many countries. It has been clearly demonstrated that draught animal condition is affected by seasonality of feeds in terms of quantity and quality[47].

2. Low level of nutrition due to poor feed nutrition, management variables, specific nutrient deficiencies or genetic factors is prevalent

throughout Asia. Low nutrition in buffaloes influences reproductivity. Buffalo cows in Indonesia in poor condition, weighing about 275 kg and showing no ovarian activity were allotted to a high or low plane diets for 30 weeks. After which 17 of the 18 cows on the high plane compared with only 10 out of 17 in the low plane of nutrition showed signs of commencement of ovarian activity[38]. Table 3 forcefully demonstrates the importance of good nutrition on lactation performance of two outstanding goat breeds, Barbari (meat and milk) and Jamnapari (milk) goats, in India. In both breeds, the total milk yields were improved by mean values of between 226-315% over five consecutive lactations. A significant finding was that in both breeds low nutrition tended to affect milk yields in the fourth and fifth lactations. For meat production in Katjang goats live weight at slaughter, hot carcass weight, dressing percentage and weight of meat were improved by as much as 53.8, 79.3, 7.1 and 47.1%, respectively[7] on improved feed. Thus the nutrient requirements of goats and production requirements must be considered in their feeding and management.

Table 3. Effect of plane of nutrition on lactation milk yields of two dairy breeds of goats (Barbari and Jamnapari) in India

Lactation number	Barbari			Jamnapari		
	(MH)a)	(LL)b)	Difference	(HH)c)	(LL)b)	Difference
	— (liters) —		(%)	— (liters) —		(%)
1	101.0	27.8	263.3	153.7	44.0	249.3
2	129.7	30.3	328.1	196.0	58.4	235.6
3	100.4	21.7	362.7	131.8	45.2	191.6
4	106.8	...	...	128.0	...	...
5	109.2	...	...	...	...	...
Mean	110.4	26.6	315.0	160.5	49.2	226.2

a) Medium-high plane of nutrition.
b) Low-low plane of nutrition.
c) High-high plne of nutrition.
Adapted from Sachdeva *et al.* (1973).

3. High producing lactating animals have maximum requirements for supplements and good management. The utilization of tropical grasses and the need for supplements is discussed in two publications. A review of the nutritive value of tropical grasses in the Philippines reported that most could supply sufficient amounts of digestible crude protein (DCP) for maintenance and production of about 10 kg of milk daily, but that the total digestible nutrients of grasses would limit actual output to not more than 5 kg milk per cow per day[17]. Dairy cows grazing improved tropical pastures are capable of milk production up to about 2000 kg per lactation[40]. With Murrah buffalo or dairy cows and goats in lactation concentrate feeding is essential. Generally recommended is a total metabolisable (ME) concentration of 10-12 MJ/kg DM, provided the roughage is in coarse form, either chopped or very coarsely ground.

The justification for concentrate supplementation, (mainly energy and protein), is associated with four factors:

1. Deficiency of nutrients for milk production quantitatively and or qualitatively
2. Restriction in energy uptake imposed by bulky roughages
3. Low price of alternative mixed feeds using home grown or purchased concentrates
4. Increased milk yield of a monetary value greater than the cost of the feed required to produce it.

Forage: concentrate ratios are important. When the ratio of hay to concentrates is reduced, the yields of lactose and protein or SNF increase by 20-40% and milk-fat decreases[42]. Reducing the ratio of hay to concentrates from 40:60 to 20:80[14], results in falls of about 40% milk fat (Table 4).

It is considered[20] that a ration having digestibility of about 67% is the critical level for minimum grain feeding to attain maximum forage intake. Below 67% ration digestibility, 1.8-2.7 kg of concentrates increase milk production as a result of its stimulating effect on rate of digestion in the rumen and increased ration digestibility which results in increased dry matter intake. Additional amounts of grain will result further in increasing digestible dry matter intake until the digestibility is raised above 67%. Above 67% digestibility, factors other than ration digestibility and the rate of digestion limit intake.

Table 4. Milk production in cows given diets of lucerne hay and maize-based concentrates diets provided similar amounts of digestible energy (164-177 MJ/d).

Parameter	Concentrates (%)		
	40	60	80
Milk yield (kg/d)	20.4	20.9	18.1
Fat yield (kg/d)	0.76	0.63	0.46
Protein yield (kg/d)[a)]	0.63	0.67	0.56
SNF[b)] yield (kg/d)[a)]	1.69	1.73	1.45
Milk energy (MJ/d)	58.3	55.1	43.6
Fat content (g/kg)	35	30	27
Protein content (g/kg)	31	32	31
SNF content (g/kg)	83	83	80

a) Calculated from given yield and composition of milk.
b) SNF = solids-not-fat.
Flatt *et al.* (1969)

PRACTICAL PROBLEMS IN FEEDING AND NUTRITION

Use of Concentrates

The amount of concentrates used is determined by the type and quality of grasses given and the level of milk produced. It is also dependent on accessibility to cheap good quality concentrates, and knowledge on how best to use them. Most farmers lack this knowledge and must rely on extension personnel for assistance. The competence of the extension services thus also influences the efficiency of feeding and management.

Some idea of the degree of variability in management and also use of concentrates is seen in the results of a recent survey of the Milk Collection Centre (MCC) in Jasin, Malacca, Malaysia[19]. The MCC Jasin, in operation since 1974, is the premier milk collection centre in Peninsular Malaysia with a total of about 500 farmer members and a daily milk production of about 4500 litres. There is now a total of 39 milk collection centres in Malaysia. The survey was conducted in the form of a detailed questionnaire interviewing farmers at their convenience, usually in the evening, as well as other farm visits. A total of 357 farmers were interviewed, the remaining 28.6% of the farmers being either disinterested or having abandoned dairying. The survey covered an area of 19 km radius, covered by the MCC. About 97% of farmers interviewed obtained cut fodder from outside of their farms, travelling an average distance of about 4.8 km. The fodder was made into bundles or 31% used gunny sacks each weighing about 50 kg and transported by motorcycle or bicycle. The average time spent cutting forages was about 1.5 to 2.0 hr/day. Concentrates were fed by 87% of farmers but amounts fed varied from 0.2 to 9.1 kg/cow/day (Table 5). About 28% of the farmers added molasses and water to the concentrates; 85% of the farmers gave common salt to their cows, the average amount fed being 128 g/cow/day.

The daily milk production ranged from 0.7 to 13.6 kg/cow, about 50% of the farmers reported daily milk yields of about 2 to 5 kg/cow. There were distinct differences between breeds in milk yields, with local Indian dairy cattle (LID), LID crosses and Sahiwal x Friesian crossbreds giving 3.0, 6.5 and 6.1 kg/cow, respectively. The corresponding lactation milk yields were 508, 1531 and 1445 kg and lactation periods 171, 237 and 238 days, respectively. Table 6 summarizes these details and also includes data on milk composition. It can be seen that for total solids and milk-fat percentage, the figures for the three breed types were 11.0, 11.0, 10.7% and 3.49%, respectively.

The beneficial use of concentrates in beef cattle has been is demonstrated in the results of feeding trials in 36 yearling American Brahman cattle (Table 7 & Fig. 6). Average daily gain increased with increasing concentrate supplementation, but the best profits were achieved with a daily concentrate intake of 1.74 kg/per head/day[48].

Table 5. Concentrate feeding by farmers in the Jasin area, Malaysia

	Conc.		No conc.		Average amount fed[a)]	Range
	No. farmers	%	No. farmers	%	(kg/cow/day)	(kg/cow/day)
Estate	181	87.0%	27	13.0%	8.1	0.2—9.1
Village	106	89.1%	13	10.9%	2.8	0.3—7.2
Urban-fringe	22	73.3%	8	26.7%	2.0	0.2—5.0
Total	309	86.6%	48	13.4%	2.2	0.2—9.1

a) These were fed in three types of feeding systems (intensive, semi-intensive and extensive grazing); concentrates were mostly used in the first two systems.
Hassan Wahab and Devendra (1983).

Table 6. Dairy cow performance in the Jasin area, Malaysia

Parameter	LID	LID crossbred	Sahiwal Friesian
Daily milk production (kg/cow)	3.0	6.5	6.1
Lactation milk yield (kg/cow)	508	1531	1445
Lactation length (days)	171	237	238
Total solids (%)	11.0	11.0	10.7
SNF (%)	7.50	7.28	7.23
Crude protein (%)	3.5	3.4	3.3
Fat (%)	3.51	3.71	3.49
Ash (%)	0.57	0.56	0.58

Based on data for 44, 45 and 76 farms respectively.
LID = Local Indian Dairy Cattle.
Hassan Wahab and Devendra (1983).

Table 7. Effects of level of concentrate supplement* on voluntary dry matter (DM) intake and performance of purebred American Brahman yearlings.

Item	Level of supplementation, kg/hd/d			± SEM
	1	2	3	
No. anim, hd.	12	12	12	
Days in exp., d	153	153	153	
Avg. initial wt., kg	149.3	150.7	142.9	
Avg. final wt., kg	222.9	378.6	283.8	
Avg. daily gain, g/hd	468[a]	840[b]	928[c]	2.66
Voluntary DM intake				
Urea-treated rice straw, kg/hd/d	5.81[a]	6.22[b]	4.35[c]	.06
Urea-treated rice straw, % BW/d	3.02[a]	2.78[b]	1.95[c]	.04
Concentrate, kg/hd/d	.87	1.74	2.62	
Total DM intake				
kg/hd/d	6.68[ac]	7.96[b]	6.97[c]	.06
% BW/d	3.48[ab]	3.60[a]	3.17[b]	.05
Feed/gain, kg	14.28[a]	9.48[b]	7.51[c]	.11
Net profit, US $/hd	28.7	61.7	58.4	

a, b, c Means in the same row with different superscripts differ ($P < .05$).
*) Concentrate compositions were 65.6% rice bran, 22% broken rice, 10.9% SBM, 0.5% bone meal and 1% salt (on wet basis).
Wanapat *et al.* (1985).

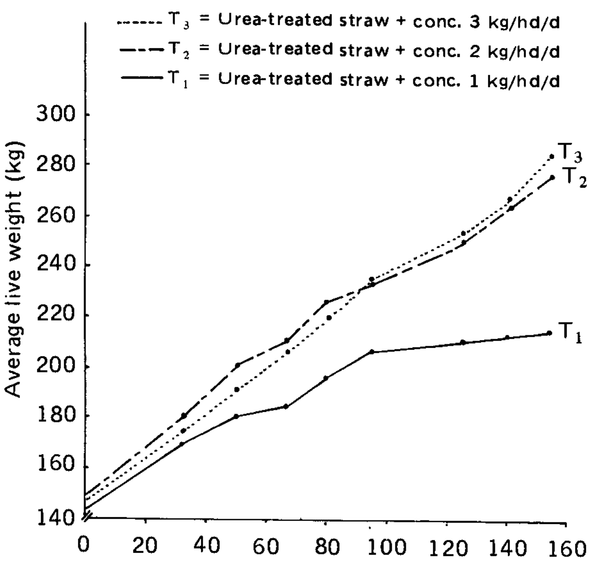

Fig. 6. Weight changes of yearling American Brahman cattle as affected by levels of supplementation (Wanapat *et al.*, 1985).

Dietary Composition

Where farmers are affluent and can afford to purchase concentrates at relatively high cost, or are provided with good ready made concentrate diets by either government agencies or cooperatives, the problem of dietary composition is not one of concern. On the other hand, where they use recommended formulations that involve locally available ingredients with potential prospects of reducing the cost of feeding, then the quality of feed ingredients, diet composition and appropriate use during lactation become of concern. One solution to this is to buy feed ingredients that have consistent quality due to government certification, or to purchase in bulk directly from producers who can deliver according to specification. In either case, the objective should be to use locally produced feed ingredients to reduce costs.

Table 8 summarizes a list of the more important feed ingredients that supply energy and proteins. Cassava chips are potentially very valuable energy sources and Thailand alone produces approximately 18 million tonnes annually. With the cut back in its use by the EEC countries, its price has reduced significantly, an advantage for users in the livestock industry. Cassava chips have been used in diary cattle diets at 40%[5] and also reported to increase milk production and reduce cost of feeding in Holstein x Zebu cows[25]. In Nigeria, cassava was used at higher levels of up to 79.1% in diets and reported to increase milk and fat yields in White Fulani cattle[30].

Table 8. Feed ingredients potentially valuable for lactating ruminants in Asia

Energy supplements		Protein supplements
Barley	— broken grain	blood meal
	bran	castor seed cake
Cassava	— chips	coconut cake
		cotton seed cake
	waste	fish meal
Maize	— bran	groundnut cake
		leucaena leaf meal
	germ meal	meat meal
Millet	— broken grain	mustard seed meal
Rice	— broken grain	palm kernel cake
		poultry litter
	— bran	rape seed meal
	— waste	rubber seed meal
Sago	— waste	rubber seed meal
Sugarcane	— molasses	sal seed cake
Wheat	— broken grain	soyabean meal
	bran	cassava leaf meal
		water hyacinth leaf meal

Solubility and degradability of protein and energy feeds[35] in the rumen influences efficiency of their utilization. Evaluation of numerous sources of feeds for their potential to supply by-pass protein and glucogenic compounds is shown in Table 9[35]. These are important in ingredient selection for formulation of a concentrate mixture.

Table 9. Ratings of some feed ingredients according to their potential to supply by-pass protein and glucogenic compounds

	By-pass protein (B-P)	Glucogenic compounds (C_6-E)
Sugar cane bagasse	0	0
Straws (rice, wheat)	0	0
Elephant grass	0	0
Molasses (sugar cane)	0	0
Sugar cane juice[a)]	1	2
Sorghum grain	1	4
Maize grain	1	5
Alfalfa/Berseem hay	2	1
Leucaena leaf	2	1
Wheat bran	3	3
Maize gluten meal	4	4
Soybean meal	4	4
Meat meal	4	1
Fish meal	5	2
Cottonseed meal	5	4
Rice polishings	4	5

a) Contains no by-pass protein but it appears to support highly efficient rumen microbial protein production. Preston and Leng (1984.)

Lipids are an alternative energy source which has not been adequately exploited, particularly red plam oil in Malaysia[41]. Dietary levels of such lipids should not however exceed 8% in the diet, as higher levels were shown to inhibit fiber digestibility[21] (Figure 7). However, utilization as a soap (Ca-soap) reduced this phenomenon[32] (Figure 8).

Protein is the most expensive part of the diet. Although Thailand and Indonesia produce soyabean meal, imports are still necessary, groundnut meal is less popular but is also used, fish meal is consistently imported because of inadequate supply and more particularly because local fish meal is of poorer quality (25-40% crude protein), higher salt content and occassionally contamination with salmonella. Palm kernel cake is exported to Europe and is not easily available. Two further protein sources are poultry litter and urea. Asia and the Pacific produce as much as 13 million tonnes of poultry excreta annually, equivalent to 3.2 million tonnes of crude protein, but its use is generally limited. Recent research in Pakistan has demonstrated the economic benefits of its use (Table 10). Urea-molasses block licks have considerable potential in Asia[23].

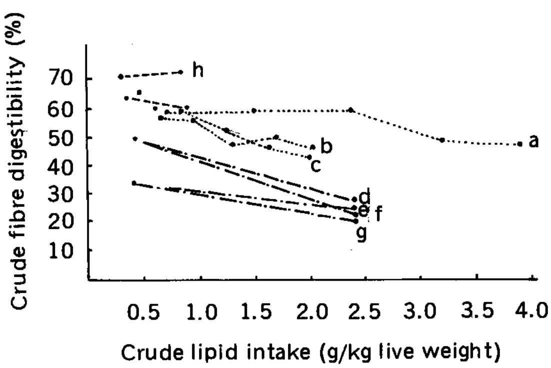

Fig. 7. Effect of animal fat supplementation on digestibility of crude fibre in wethers (Honing *et al.*, 1981)

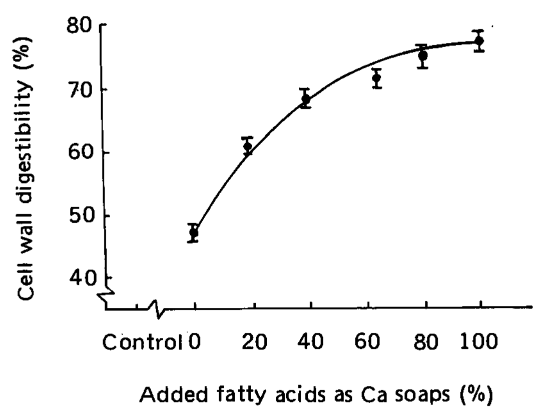

Fig. 8. Effect of increasing proportion of calcium soaps on cell wall digestibility *in vitro*
Control: 30% concentrate: 70% timothy hay;
Experimental: 25% concentrate: 65% timothy hay: 10% soya oil fatty acids (Palmquist and Jenkins 1981)

Table 10. Economic advantage of feeding poultry litter in diets for milk production in Pakistan

Item	Normal ration	Ration with 30% poultry litter	
Feed cost/hd/d	14.34	8.50	Rs.
Feed cost/hd/90 d	1296.80	765.00	Rs.
Avg. milk yield/hd/d	6.76	7.28	Lt.
Feed overheads	2.12	1.17	Rs./Lt.
Income from milk/hd*	21.97	23.40	Rs.
Income over feed cost	7.63	14.90	Rs.
Difference in income/hd/d	—	7.27	Rs.
Feed saving over 90 d/hd	—	654.30	Rs.
Feed saving over 300 d/hd	—	2181.00	Rs.

* 1 litre of milk costs 3.25 Rs.
Hasnain (1983).

Leucaena leaf meal, especially if detoxified, with average crude protein content between 22-25%, can be used beneficially in dairy cattle diets. The plant grows throughout most parts of Asia, and increased use could reduce the dependence on imported protein feeds.

Stage of Lactation

Some evidence suggests that patterns of concentrate allocation which distribute more concentrates in early rather than late lactation will result in enhanced total lactation yield[4]. Related also is the potential of the cow, i.e. low or high dairy merit. However, more recent observations in several studies, indicate that different patterns of distribution of concentrates and forages over the lactation, and between cows of different yield capacities has little effect[31]. This later finding is based on the use of good quality forages and needs to be extended to investigate a wider range of forage.

Use of Different Diets

The question of concentrate ratio in the diet, compounded already with problems of variable quality ingredients, is further complicated by the need for different diets for lactating and dry animals. Farmers often do not have the knowledge, ability, time and resources to attend to this having in addition to maintain diets for the pre-weaning and weaned animals and for males. Unless readily available and cheap few farmers will use alternative diets.

In recent years, increasing attention has been given to an alternative approach to feeding dairy cattle, namely complete diet feeding. The complete diet system involves the feeding of dietary ingredients, normally the whole diet to include the forage and concentrate fractions on *ad libitum* basis. The advantages are simplicity of management, mechanization of feeding, economy of feeding space, safety and flexibility for inclusion of a wide range of ingredients[31]. The main disadvantage however is high capital cost. The complete diet feeding system may have a place in situations where it is expedient to integrate both the forage and concentrate fractions. It has special application in many parts of Asia in the use of a range of coarse roughages and protein feeds especially if forage cultivation is and grazing areas are limiting and there exist considerable supplies of crop residues and other agro-industrial by-products.

Application of Feeding Standards

A continuing problem faced by nutritionists, extension workers and the more elite farmers relates to the use of appropriate feeding standards. These standards are generally complicated and their application calls for knowledge and skill to use them effectively with some flexibility. The problem is also exacerbated by which Asian standard to use[1,29] or even European standard, adapted to tropical situations[22]. There is no easy solution to this problem but the use of any one set of recommendations can be considered useful as a first approximation, so long as it is appreciated that such recommendations represent only a guide to what is required by the animal; a starting point from which success will depend on efficient management of the sources available to ensure productivity in the lactating cow. Graham discusses the principles and problems related to the use of feeding standards[16].

DEVELOPMENT STRATEGIES

There are a number of development strategies pertinent to feeding and nutrition.

Increasing the Feed Supply Base

Increasing the total feed supply base is of the highest priority since lactating animals require high quality feeds in adequate amounts. This needs to be coupled to more complete utilization of existing feeds. Much more needs to be done to cultivate forages on existing land, including waysides and rice bunds. Such fodders as Napier grass, *Pennisetum purpureum* , Guinea grass, *Panicum maximum* and Signal grass, *Brachiaria decumbens*, and legumes calopo, *Calopogonium mucunoides*, leucaena, *Leucaena luecocephala* and pigeon pea, *Cajanus cajan* are valuable. A study in swamp buffalo steers on chemical compositions, voluntary feed intake and nutrient digestibility of *Panicum maximum* cv. Guinea and *Brachiaria decumbens* cv. Signal at three regrowth cuttings (week 4, 8, 12) was conducted. Dry matter, acid detergent lignin contents increased whereas ash, crude protein and neutral detergent fiber contents decreased, as the plants matured. Acid detergent fiber fraction remained similar for all cuttings. Voluntary dry matter intake and digestion coefficients of nutrients were relatively high at week 4 and 8 and markedly low at week 12 for both species. Signal grass fed to buffaloes had higher intakes and digestibilities than those fed with guinea grass[51] (Tables 11, 12).

In many parts of Asia, inadequate production and utilization of the feed resources from the land, rather than limitations in the availability of land *per se*, represents the principal constraint to high productivity from farm animals and viability of small farm systems. Considerable opportunities exist for increased production of feed from land that has not been, or is inadequately cultivated, including the utilization of dry matter yields in the undergrowth of tree crops. Small farmer dairy development in India for example, has now been expanded to assist

Table 11. Chemical compositions (% dry matter) of *Panicum maximum* cv. Guinea and *Brachiaria decumbens* cv. Signal at three different regrowth cuttings

Species	Regrowth cutting (week)	Dry matter	Ash	Crude protein	Neutral detergent fiber	Acid detergent fiber	Acid detergent lignin
		%					
Panicum maximum cv. Guinea							
	4	27.7	7.1	14.6	74.2	44.6	5.3
	8	38.2	6.6	9.3	71.5	44.1	5.5
	12	49.4	5.6	10.5	68.8	43.1	5.7
Brachiaria decumbens cv. Signal							
	4	32.5	6.0	13.3	72.2	39.6	3.8
	8	36.3	5.7	9.5	69.1	40.1	4.8
	12	43.1	5.0	9.9	67.1	37.0	4.4

Wanapat and Topark-Ngarm (1985).

Table 12. Voluntary dry matter intake and digestion coefficients of nutrients of *Panicum maximum* cv. Guinea and *Brachiarea decumbens* cv. Signal at three regrowth cuttings by swamp buffaloes

Item	*P. maximum* cv. guinea			± SEM	*B. decumbens* cv. signal			± SEM
Cutting (weeks)	4	8	12		4	8	12	
No. buffaloes	3	3	3		3	3	3	
Dry matter intake								
kg/d	5.90^a	6.70^b	4.98^c	.28	7.29^a	7.51^a	6.30^b	.21
% BW/d	2.36^a	2.71^b	1.99^c	.12	3.15^a	2.98^a	2.37^b	.31
g/kg $W^{.75}$	93.8^a	107.5^b	79.2^c	4.7	123.3^a	118.7^a	95.6^b	4.9
Digestion coefficients (%)								
Dry matter	69.6^a	58.6^b	55.6^b	2.5	74.1^a	63.7^b	61.5^b	2.2
Organic matter	70.2^a	59.8^b	58.2^b	2.2	75.1^a	65.1^b	64.7^b	2.0
Crude protein	80.7^a	67.8^b	60.3^b	3.4	80.9^a	—	69.1^b	2.8
Neutral detergent fiber	72.3^a	61.5^a	57.4^b	2.6	72.0^a	65.7^a	62.8^a	1.5
Acid detergent fiber	65.5^a	51.7^b	44.2^b	3.6	69.7^a	56.0^b	55.0^b	2.7

abc Means within the same line for each species are significantly different ($P < 0.5$).
Wanapat and Topark-Ngarm (1985).

some 10 million rural milk producers who, by mid-1985, will rear about 15 million crossbred cows and improved buffaloes. Implicit in this programme which calls for more complete utilization of the available resources is the task to select and breed more productive forages, especially berseem and lucerne that can be used in these situations. More complete use of the available on-farm crop-by-products and agro-industrial by-products is also important. Systems proposed to increase the feeds for small holder farmers include backyard pasture establishment[52] and a three-strata-forage (grass-shrub-tree plant) system[28] in attempts to ensure continuous supply of feeds throughout the year.

Improved Systems of Feeding

In cereal straw especially after nutritive up-grading, urea-treated or ammonia-treated straw, is in common use. Urea-treatment increases intake and digestibility[46] as shown in Sri Lanka with Surti buffaloes (Table 13). Milk yield can be further increased by supplementation of tree leaves or by-products, for example cassava leaves, (*Manihot esculenta,* Crantz) and water hyacinth leaves (*Eichhornia crassipea,* Mart) for buffaloes in Thailand[49,50]. Studies in Thailand[36,37] (Tables 14, 15) with dairy cattle clearly demonstrated that urea-treated rice straw compares favorably to fresh grass for milk production, composition and net income obtained. A comparison made of treated straw and untreated straw supplemented with dried leucaena leaf fed to dairy cattle shows both to be comparable (Table 15).

Support Services

Support services need to consider supply of germplasm, seeds and fertilizer, credit, research and technology. Training, field programmes and demonstration centres are essential for providing education on all aspects of mixing feeds, improved methods of feeding animals and management of animals. Extension assistance of periodic visits and occassional provision of seeds, root stock or feed are inadequate to stimulate pro-

Table 13. The effect of feeding urea-ammonia treated straw with supplements to lactating Surti buffaloes in Sri Lanka

Parameter	Treatment					
	TRS	TRS+ G (212 CP)++	TRS+ L (251 CP)	TRS+ CC (191 CP)	TRS+ G + CC (406 CP)	TRS+ L + CC (448 CP)
Milk yield, kg/day	2.41[a]	2.60[a]	2.73[ab]	3.09[ac]	3.18[c]	3.36[c]
Milk fat yield, g/day	221[a]	242[a]	238[a]	311[b]	319[b]	325[b]
Milk fat, %	9.18	9.34	8.71	10.08	10.03	9.65
Margin over costs (S.L. — RS)	4.07	5.19	4.57	8.34	8.52	8.53

\+ TRS-Urea-ammonia treated rice straw; G – Gliricidia; L – Leucaena; CC – Coconut cake
++ Amount of crude protein provided.
abc Means on the same row with different superscripts differ ($P < 0.05$).
Adapted from Perdok *et al.* (1983).

Table 14. The performance of milk cows given fresh grass, fresh grass + urea treated rice straw and urea treated rice straw[a)]

Parameter	Fresh grass	Fresh grass + treated straw	Treated rice straw
Dry matter intake (roughage), kg/hd/d	5.88	7.37	5.93
Dry matter intake (concentrates), kg/hd/d	4.40	4.40	4.40
Total dry matter intake, kg/hd/d	10.28	11.77	10.33
Milk production, 4% FCM,			
kg/hd/30 d	176.1	268.4	269.9
kg/hd/d	9.2	8.9	9.0
Fat, %	3.08	3.28	3.25
Protein, %	3.08	3.28	3.25
Blood urea nitrogen, mg %	8.0	8.5	8.0
Blood ammonia, µg %	660	667	660
Ruminal pH	6.5	6.6	6.6
Net income, U.S. $/hd/d	.396	.488	.671

a) No significant differences among treatment means ($P > 0.05$).
Adapted from Promma *et al.* (1985).

Table 15. The performance of lactating cows given 6% urea treated rice straw, 4% urea treated rice straw and untreated rice straw plus leucaena leaves (L) in Thailand[a)]

Parameter	6% urea treated straw	4% urea treated straw	Untreated straw + L
Roughage dry matter intake,			
kg/hd/day	7.2	6.8	7.0
g/kg $W^{0.75}$/day	86.6	81.4	84.8
% BW	1.98	1.86	1.95
Concentrates dry matter intake, kg/hd/day	4.03	3.9	4.12
Total dry matter intake, kg/hd/day	11.23	10.7	11.12
Feed efficiency, kg feed/kg FCM milk	1.28	1.27	1.31
Milk production (4% FCM),			
kg/hd/28 days	245.0	234.9	236.0
kg/hd/day	8.8	8.4	8.5
Milk fat, kg/hd/28 days	9.4	9.2	8.9
Average fat, %	3.7	3.7	3.4
Milk protein, kg/hd/28 days	9.03	8.62	8.9
Average protein, %	3.5	3.5	3.4
Weight changes, g/day	96	96	72
Net income, U.S. $/hd/d	.738	.736	.664

a) No significant differences ($P < 0.25$) were observed.
Promma *et al.* (1984).

gress; continuous contact can ensure that the inputs provided are put to the very best use and for the precise reasons for which they were provided. Extension assistance needs demonstration work that not only proves the point, but also motivates the farmers into self-reliance. Creation of marketing opportunities and the fullest possible use of local resources are essential.

CONCLUSIONS

Nutrient requirement for high and economic milk production is the most pressing issue faced by farmers in dairy production. Home grown feeds and home mixing of feeds are within their control, but the quality of purchased feed ingredients and their cost as well as marketing outlets are factors beyond their control. Varying levels of management, inadequate knowledge, poor support services and the need for continuous training at various levels hamper development. The availability of adequate feeds and their efficient utilization are critical elements and need to be continuously addressed to ensure economic milk production and effective use of superior animals in Asia.

REFERENCES

1. A.R.C. 1980. *Nutrient Requirements of Ruminant Livestock*, Commonwealth Agric. Bureaux, Farnham, Royal, Buck, England, 351 pp.
2. Bach, C. C., D. A. Balch, S. Bertlelt, Z. D. Hosking, V. W. Johnson, S. J. Rowland and J. Turner. 1954. Studies on the secretion of milk of low fat content by cows on diets low in hay and high in concentrates. 3. The effect in the variations in the amount and physical state of the hay and a comparison of the Shorthorn and Friesian breeds. *Journal of Dairy Research* 21: 172-178.
3. Bath, I. H. and J. A. F. Rook. 1963. The effect of cattle foods and diets in terms of ruminant concentration of volatile fatty acids. 1. The effect of level of intake, frequency of feeding, the ratio of hay to concentrates on the diet and supplementary feeds. *Journal Agricultural Science Cambridge* 61: 341-349.
4. Broster, W. H. and C. Thomas. 1981. The influence of level and pattern of concentrate input on milk output. In *Recent Advances in Animal Nutrition* 1981, Eds. W. Haresign, Butterworths Ltd., p. 49-69.
5. Cardosa, R. M., J. Campos, D. H. Holl, J. F. de Silva, Coelha. 1968. Efito de substituticao gradativa du milho pela raspa de mandioca, no producao de leite *Revista Ca,* 14: 308-328.
6. Devendra, C. 1975. Efficient feeding and management of dairy cows. *Symposium on Bridging the Dairy Gap, Bull No. 140,* Ministry of Agriculture and Rural Development, Malaysia, 149-161.
7. Devendra, C. 1979. Goat and sheep production potential in the ASEAN region. *World Animal Review F.A.O.* 32: 33-41.
8. Devendra, C. 1982a. An assessment of the feed requirements from the resources and implications for animal production in Peninsular Malaysia. *Proc. Conf. on Exotic and Crossbred Livestock Performance in Malaysia,* 11-12 Sept. 1981, Genting Highlands, Malaysia, 235-261.
9. Devendra, C. 1982b. Goats: Dietary factors affecting milk secretion and composition. *Goat and Sheep Resources* 2: 61-76.
10. Devendra, C. 1983. Developing the feed supply sub-system for small scale milk production: problems in practice in Malaysia. *FAO Expert Consultation on Improving the Efficiency of Small Scale Livestock Production in Asia: A systems approach,* 6-10 Dec. 1983, Bangkok, Thailand (Mimeograph, 21 pp).
11. Devendra, C. 1985. Non-conventional feed resources in Asia and the Pacific. *APHCA/ FAO Monograph No. 6,* FAO Regional Office, Bangkok, Thailand, 140 pp.
12. Devendra, C. and D. Lewis. 1974. Fat in the ruminant diet: A review. *Indian Journal*

of Animal Science 4: 917-938.

13. F.A.O. 1982. *Production Yearbook,* Vol. 36, F.A.O., Rome 320 pp.
14. Flatt, W. P., P. W. Moe, L. A. Morre, N. W. Hooven, R. P. Lehmann, E. R. Orskov and R. W. Heinken. 1969. Energy utilization by high producing dairy cows. In *Energy Metabolism of Farm Animals,* Eds. K. L. Blaxter, G. Thorbek and J. Kielanowski, Oriel Press, 221-234.
15. Gibson, T. 1984. Experiences with low-input dairying on ley pasture in Nikhom Ubolratana. In: *Proc. "Viable Farming systems for the Infertile Uplands of Northeast Thailand* (Eds. S. Simaraks and T. Gibson). Khon Kaen University, Thailand.
16. Graham, N. McC. 1983. Feeding standards: an outmoded concept in ruminant nutrition. In *Recent Advances in Animal Nutrition.* Eds. D. Farrell and P. Vohra, 184-191.
17. Hardison, W. A. 1966. Chemical composition, nutrient content and potential milk producing capacity of fresh tropical grasses. *Resources Bulletin No.* 1, Dairy Training and Research Institute, Philippines.
18. Hasnain, H. 1983. Feed-the key to more food in Pakistan. *Proc. FAO/PARC Workshop or Least Cost Ration Formulation,* 12-14 March 1983, Islamabad, Pakistan, p. 4-24.
19. Hassan Wahab and C. Devendra. 1983. An assessment of feed resources, feeding systems and problems concerning small-holder dairy cattle production in the milk collection centre, Jasin, Malacca. *MARDI Report* No. 77, 47 pp.
20. Hibbs, J. W. and H. R. Conrad. 1975. Minimum concentrate feeding for efficient milk production. *World Animal Review* 15: 33-38.
21. Honing, Y. van der, B. J. Wieman, A. Steg and B. Donselaar. 1981. The effect of fat supplementation of concentrates on digestion and utilization of energy by productive dairy cows. *Netherlands Journal Agricultural Science* 29: 29-92.
22. Kearl, L. C. 1982. *Nutrient requirements of ruminants in developing countries Int. Feedstuffs Institute,* Logan, Utah, U.S.A., 381 pp.
23. Leng, R. A. and T. R. Preston. 1983. Nutritional strategies for the utilization and agro-industrial by-products by ruminants and extension of the principles and technologies to the small farmer in Asia. *Proc. Vth World Conference on Animal Production Vol.* 1: 310-318.
24. Mahadevan, P. and C. Devendra. 1985. Present and production systems in South East Asia and the South Pacific. *Proc. Int. Workshop on Forages in South East Asia and the South Pacific* (In press).
25. Mandioca, E. 1969. Batata-doce aumentum leit na seca. *Coopercotia,* 19: 52-56.
26. Minson, D. J. 1980. Nutritional differences between tropical and temperate pastures. In: *Grazing Animals* (Ed. F.H.W. Morley). Elsevier Scientific Pub., Amsterdam.
27. *National Commission on Agriculture. 1976. Part VII.* Animal Husbandry, Ministry of Agriculture and Irrigation, Govt. of India, New Delhi, India, 531 pp.
28. Nitis, I. M. 1985. *Present state of grassland production and utilization and future perspectives for grassland farming in humid tropical Asia.* Paper presented at the XV Into Grassld. Congr. Kyoto, Japan. Aug. 24-31.
29. N. R. C. 1978. *Nutrient Requirements of Dairy Cattle 5th Revised Edn.,* National Academy of Sciences, Washington D.C., U.S.A., 76 pp.
30. Olaluku, E. A., A. M. Egbuiwe and V. A. Oyenuga. 1971. The influence of cassava in the production ration on the yield and composition of White Fulani cattle. *Nigrian Agricultural Journal* 8: 36-43.
31. Owen, J. B. 1984. Comple diet feeding for cattle. *Livestock Production Science* 11: 269-285.
32. Palmquist, D. L. and T. C. Jenkins. 1980. Fat in lactation rations (Rev.). *Journal*

of Dairy Science 63: 1-14.

33. Perdok, H. B., M. Thomotaram, J. J. Blom, H. Van Den Born and C. Van Veluw. 1982. Practical experiences with urea-ensiled straw in Sri Lanka. *Proc Maximum Livestock Production in Minimum Land,* Eds. T. R. Preston, C. H. Davis, F. Dolberg, M. Haque and M. Saadullah, Bangladesh Agricultural University, Mymensingh, Bangladesh, p. 123-124.
34. Perdok, H. B., G. S. Muttetuwegama, G. A. Kasslhieter, H. M. Boon, M. M. Wageningen, V. Arumugam, M. G. F. A. Linders and M. C. N. Jayasuriya. 1984. Production responses of lactating or growing ruminants fed urea-ammonia treated paddy straw with or without supplements. In *The Utilization of Fibrous Agricultural Residues as Animal Feeds,* Ed. P. T. Doyle, School of Agriculture and Forestry, University of Melbourne, Parkville, Victoria, Australia, p. 213-220.
35. Preston, T. R. and R. A. Leng. 1984. Supplementation of diets based on fibrous residues and by-products. In: *Straw and Other Fibrous By-Products as Feed* (eds: S. Sundstol and E. Owen). Elsevier Scientific Pub., Amsterdam.
36. Promma, S., S. Tuikumpae, A. Ratnavanija, N. Vidhyakorn and R. W. Roemert. 1984. *A study on the effect of urea-treated rice straw on growth and milk production of crossbred Holstein Friesian dairy cattle.* Paper presented at the IV AAFARR Annual Meeting. Khon Kaen, Thailand. April 10-14.
37. Promma, S., S. Tuikampee, V. Himarat and M. Vidyahorn. 1984. Production responses of lactating cows fed urea-treated rice straw compared to untreated rice straw supplemented with leucaena leaves. *Proc. Relevance of Crop Residues as Animal Feeds in Developing Countries,* Eds. M. Wanapat and C. Devendra, Khon Kaen, Thailand, p. 301-314.
38. Putu, Gede, I. Fletcher and G. A. Riding. 1983. Effect of nutrition on overian activity in Indonesian swamp buffaloes. *Buffalo Bulletin* 2: 7-8 (Abstr.).
39. Sachdeva, K. K., O. P. S. Sengar, S. N. Singh and S. L. Indahl. 1973. Studies on goats. I. Effect of plane of nutrition on the reproductive performance of does. *Journal of Agricultural Science Cambridge* 80: 375-379.
40. Stobbs, T. H. and P. A. C. Thompson. 1975. Milk production from tropical pastures. *World Anim. Rev.* (F.A.O.), 13: 27-31.
41. Storry, J. E., A. J. Hall and V. W. Johnson. 1968. The effects of increasing amounts of dietary red plam oil on milk secretion. *British Journal of Nutrition* 22: 609-616.
42. Sutton, J. D. 1981. Concentrate feeding and milk composition. In *Recent Advances in Animal Nutrition,* 1981, Eds. W. Haresign, Butterworths Ltd., p. 35-48.
43. Sutton, J. D., J. D. Oldham and I. C. Hart. 1980. Cited by Sutton, J. D. (1981). In *Recent Advances in Animal Nutrition,* 1981, Eds. W. Haresign, Butterworths Ltd., p. 35-48.
44. Verma, M. L. 1983. Bio-ecological and socio-economic considerations in feed resources development and principal strategies for their efficient utilization in Asia. *Proc. World Conference on Animal Production* Tokyo, Japan, Vol. 1: 294-300.
45. Verma, M. L. and M. G. Jackson. 1984. Straw etc. in practical rations for cattle and buffaloes with special reference to developing countries. *In Straw and other Fibrous By-products as Feeds,* Eds. F. Sundstol and E. Owen, Elsevier, Amsterdam, The Netherlands, p. 414-430.
46. Wanapat, M. 1985a. Improving rice straw quality as ruminant feed by urea-treatment in Thailand. In: *Relevance of Crop Residues as Animal Feeds in Developing Countries* (Eds. M. Wanapat and C. Devendra). Funny Press, Bangkok.
47. Wanapat, M. 1985b. Nutritional status of draught buffaloes and cattle in Northeast Thailand. In: *Draught Animal Power for Production* (Ed. J. W. Copland). ACIAP

Proc. Series No. 10.

48. Wanapat, M., S. Duangchan, S. Pongpairote, T. Anakewit and P. Tongpanung. 1985. *Effects of various levels of concentrate fed with urea-treated rice straw for purebred American Brahman yearlings.* Paper presented at the V. AAFARR Annual Meeting. Bogor, Indonesia. April 13-17.

49. Wanapat, M., S. Praserdsuk and S. Chanthai. 1983. Effect of ensiling rice straw and supplementing with dried cassava leaves on digestion by water buffaloes. *Proc. Vth World Conference on Animal Production,* Tokyo, Japan, Vol 2: 397-398.

50. Wanapat, M., P. Sriwattanasombat and S. Chanthai. 1984. The utilization of diets containing untreated rice straw, urea-ammonia treated rice straw and urea-ammonia treated rice straw and water hyacinth. In *The Utilization of Fibrous Agricultural Residues as Animal Feeds.* 156-165, Ed. P. T. Doyle, School of Agriculture and Forestry, University of Melbourne, Parkville, Victoria, Australia. p. 156-165.

51. Wanapat, M. and A. Topark-Ngarm. 1985. *Voluntary intake and digestibility of two selected tropical grasses by swamp buffaloes.* Paper presented at the XV Int. Grassld. Congr., Kyoto, Japan. Aug. 24-31.

52. Wilaipon, B. and V. Pongskul. 1983. Pasture establishment in the farming systems of northeast Thailand. *FFTC/ASPAC Ext. Bull.* No. 199.

53. Williams, V. J. and K. R. Christian. 1956-57. Rumen studies in sheep. 2. The effect of feed intake on the concentrations of microbial end-products. *New Zealand Journal of Science and Technology,* A38: 403-409.

DISCUSSION

Q. (Pramot Seetakoses)
In the practical problems of feeding and nutrition you refered to the application of a feeding standard. Can you give a feeding standard applicable to tropical countries?

A. First there is no fixed set of procedures. I would suggest any available set of standards taken from similar conditions be adapted. There are such sets of standards available for the Philippines or Malaysia for example, but always they will need modifying. Where one does not have access to such a set of standards then use those of developed countries and further modify them. There are sets of procedures which cover an international range which have been published by Dr. Kearl of the International Feed Center in Utah, USA, they especially consider Asia and Africa. Those sets of nutrient requirements are very useful references for us.

A simple way to look at supplementation in order to get sufficient nutrients is to look at the nutrient value that is currently being fed. Then look at the digestibility of the grasses in use, for tropical grasses this is usually below 60%. From there we can develop the level of nutrient supplement required as concentrate to get out maximum yield potential. A high fat content needs to be secured and more importantly the economic return need be taken into consideration. The feeding needs to be justified in terms of the purpose of the animal, whether it is for dairy, beef or draft. Data pertinant to optimum production levels need constant investigation in response to changes.

Comment: (Charan Chantalakhana)
There are many problems for small dairy farms in the tropics. One very important parameter is the economics of production. Absolute yield, the ultimate breed and optimum feeding ratios alone do not answer the economic problem. Nutritionists must take into account the roughage and concentrate available from place to place and fully consider the cost and return in any study. From most nutrition tables, I cannot know if the farmers will make money or not should they adopt the recommended feeding practice.

Comment: (Metha Wanapat)
The comment is very valid. Whatever the farmers use as feed, where the price is based on the milk fat content, then whatever is fed the farmer needs to maintain high fat to guarantee a good price. That is why an optimal level of roughage is stressed in the diet and we look forward to a cost analysis of our approach in the future.

Comment: (Anders Sorensen)
This is exactly the task of extension centers; to translate research results into applicable methods. I agree it is essential to test the economics of research before use.

Q. (Boonlom Cheva-Isarakul)
I am interested in the utilization of *Crotararia junicia* for feeding ruminants. Can you give more information about the feed value, fresh or dry and how common its use?

A. It is a good protein source; however, in fresh leaves there are alkolids called pyrrolizidines which are toxic at high levels. Feeding trials using dried *C. junicia* supplemented up to 75% with straw were quite satisfactory. One management concern is that the pasture crop is quite pest sensitive.

NOTE

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