Strategies for Animal Improvement in Southeast Asia

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Abstract

Although Southeast Asia is endowed with a large amount of resources necessary to create a viable animal industry especially in the ruminant sector, the resources are not well-utilized due to technology constraints. Animal productivity is being enhanced through various crossbreeding programs. The swamp buffalo is a draught and meat animal but crosses with the riverine type can increase milk yield 2 ½ times. Similarly, the indigenous cattle grow slowly and produce very little milk but display a very high reproductive efficiency. The dairy industry in the region is still in infancy but steps are taken to introduce *Bos indicus* and *Bos taurus* crossbreds which have a greater milking ability. Mutton and goat meat production is being increased by integrating the animals with the cropping systems - which is a very sustainable form of agriculture. Grazing experiments indicated that with well-managed pastures as well as the application of strategic feeding in the form of supplementation, the grazing intensity can be raised and yield of up to 1,100kg/ha per year of body weight can be achieved. Crop residues and by-products can be utilized for animal production but in the majority of the cases, the nutritive value needs to be improved either by pre-treatments or by increasing the microbial fermentation ability. Among the by-products, Palm Kernel Cake (PKC) has been found to be a valuable feed material because it has a high protein content and is highly degradable.

Introduction

Southeast Asia is rapidly expanding its manufacturing industry but agriculture will continue to be the mainstay of the rural economy. Southeast Asian agriculture is crop-based producing abundant feedstuffs (conventional and non-conventional) which can be utilized for animal production. In spite of the increased demand for animal products caused by rapid urbanization and improved standards of living, the local production is inadequate to meet the demand. For example, Malaysia's self-sufficiency in beef is 37%, in mutton, 8% and in liquid milk, only 5%. The slow growth of ruminant production in Southeast Asia, in spite of readily available resources (especially feeds), may be attributed to the inefficiencies in their utilization - the consequence of inappropriate technological development and application. The aim of this paper is to highlight the fundamental and applied research necessary for creating new strategies for increased animal production in Southeast Asia.

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Genetic resources

Buffalo

The domesticated buffaloes of Southeast Asia, mostly of swamp type, are used principally for draught and meat but the population is declining due to (1) redundancy caused by mechanization in rice production and, (2) lack of an appropriate breeding policy for sustained production. Although highly adaptable to the environment, the production capacity of swamp buffaloes is rather low. Over a lactation period of 240-250 day, milk yield ranges from 245-490 kg (Table 1), which is well below the performance of the riverine buffaloes. The latter produces 1,765-1,813 kg of milk per lactation ranging from 283-313 days (Bhat *et al.*, 1980).

Table 1 Milk production of swamp buffaloes

Country	Milk yield (kg)	Lactation length (day)
Malaysia	245	240
Thailand	333	250
Philippines	490	245

Source : Bongso and Mahadevan, 1989.

The mean ranges for size and growth rate of swamp buffaloes in Thailand are indicated in Table 2. Weight at birth could be as high as 38 kg but the majority will likely to be within the lower limit. Swamp buffaloes usually attain maturity around 4-5 years and can weigh as much as 650 kg. Females are about 20% lighter than the males.

Table 2 Body size and growth characteristics of swamp buffaloes

Traits	Thailand[Z]	Malaysia[Y]	Vietnam[X]
Birth weight (kg)	26-38	30-31	22-35
Pre-weaning gain (kg)	0.34-0.41	0.55	0.39-0.56
Yearling weight (kg)	135-200	152-287	—
Post-weaning gain/day (kg)	0.34-0.75	0.68-0.73	—
Mature weight (kg)			
Male	450-650		
Female	350-450		
Combined			350-450

Source : [Z] Chantalakhana, 1989, [Y] Jainudeen, 1989 ; [X] Le and Nguyen, 1989.

The carcass characteristics are shown in Table 3. The dressing percentage of swamp buffaloes in Thailand is highly variable, ranging from 43-51%. It is less variable in the case of Malaysian buffaloes. However, the proportion of boneless meat is comparable for both countries although the value for Thailand is slightly lower.

Buffaloes, in comparison to cattle, are generally considered as slow breeders. According to Jainudeen (1989), they mature later than cattle and produce the first calf between three to four years of age. Due to the long gestation period (330 days) and often delayed conception, the calving interval is about two years.

Buffaloes in Southeast Asia are usually used for traction in ploughing of rice fields and for transport. The single most important factor determining the draught potential of buffaloes is body size (Chantalakhana, 1989). In Thailand the female buffalo can work for as long as 146 day and plough at the rate of 0.20-0.32 ha/hr.

Table 3 Ranges of mean carcass traits in swamp buffaloes

Traits	Range of x	
	Thailand[Z]	Malaysia[Y]
Dressing percentage (%)	43-51	47.5-48.2
Slaughter weight (kg)	300-600	236-380
Carcass length (cm)	111-118	120-141
Boneless meat (% of carcass)	73-75	76-79
Cold shrinkage (%)	3.1-4.5	1.0-9.8

Source : [z] Chantalakhana, 1989, [Y] Liang *et al.*, 1980.

Cattle

The beef and dairy industries in Southeast Asia are not very well developed. The indigenous cattle grow slowly and produce very little milk. For example, in Malaysia, studies on the performance of the Kedah-Kelantan breed (an indigenous breed) provided useful indication of the breed potential (Devendra *at al.*, 1973, Devendra and Lee, 1978, Dahlan *et al.*, 1981). The body size and growth characteristics are shown in Table 4. Kedah-Kelantan cattle sre a small breed, with a mature weight of 300kg, the male being heavier than the female. A small body is advantageous in the tropics since it allows more rapid transfer of heat, thus preventing stressful conditions. Besides, the demand for nutrients would be lower. High fertility is the most important breed characteristic. A conception rate of 80-95% has been reported by Devendra and Lee (1978). They also found that the body weight at 24 months increased by 133% and at age at first service by 94%, indicating that Kedah-Kelantan cattle can respond to higher plane of nutrition.

Table 4 Body size and growth characteristics of Kedah-Kelantan cattle

Traits	Range
Birth weight (kg)	
male	14-16[z]
female	13-15[z]
Pre-weaning gain/day (g)	259-332[Y]
Weight at weaning (kg)	61-73[Y,X]
Mature weight (kg)	
male	300-312[z,X]
female	299-240[z,X]

Source : [Z] Devendra *et al.*, 1973 ; [Y] Devendra and Lee, 1978 ;
[X] Dahlan *et al.*, 1981.

Genetic improvement

Buffalo

The role of buffaloes as a source of draught power and meat may not be adequate to intensify their production. A number of projects are implemented to develop a multi-purpose buffalo breed by crossing the swamp buffaloes with more productive riverine type.

In nearly all the studies, the F_1 crosses between swamp and river buffaloes have shown considerable genetic improvement. The weight of the F_1 crossbred at Universiti Pertanian Malaysia (UPM) farm is found to be intermediate between the swamp and riverine types. In Indonesia, the F_1 population is found to be larger than both the parents (Situmorang, unpublished).

The milk production of the Philippine carabao, Phil-Murrah (F_1 crossbred) and Murrah buffalo is shown in Table 5. The Phil-Murrah produces 2 ½ times more milk than the native carabao (Ranjhan *at al.*, 1989). Other traits such as working capacity and carcass quality also indicated the superiority of the F_1 crossbred.

Table 5 Milk yield from three buffalo genotypes

Milk yield	n	Philippine carabao	n	Philippine Murrah	n	Murrah
Lactation yield (kg)	17	451	9	1,242	8	1,310
Daily yield (kg)		1.50		4.14		

Source : Ranjhan *et al.*, 1989.

The potential of the hybridization of swamp and riverine buffaloes is constrained by a single major factor - the possible reduction in male fertility. River and swamp types have different chromosome constitution - 50 in the river type and 48 in the swamp. Crossbreeding between the two types resulted in a tandem fusion to produce an intermediate crossbred with 49 pairs of chromosome. Studies by Bongso *at al.* (1983) have indicated poorer sperm quality amongst the F_1 males. Bongso and Mahadevan (1989) suggested that by introducing *inter se* mating and high selection pressure the fertility of F_1 males can be improved.

Beef cattle

The Kedah-Kelantan breed is highly prolific and well-adapted to the environment but it has a slow growth rate and low milk yield. At present, no concerted effort is being made to increase the genetic potential of this indigenous cattle through selection or by crossbreeding. As a first step, it is proposed that a nuclear herd be created to breed superior bull progenies for distribution to the farms. The use of superior bulls at the farm level will probably have the greatest impact in increasing the genetic values of the animals. However, indiscriminate breeding may lead to a decline in the genetic base of the breed. This can be prevented through a genetic conservation program. A breeding plan should aim at (1) upgrading the genetic potential, and (2) conserving the genetic variability of the animals.

Dairy cattle

The dairy industry in Southeast Asia is still in its infancy. More than 90% of the milk is imported. The drive by many regional governments to expand the local dairy industry is restricted by constraints such as land, capital, labour and resource availability (animals and feeds). With the exception of a few, the majority of the dairy farms operate on a small scale with a mean of 8 adult head (Sivarajasingam, 1988).

There is no indigenous cattle breed with high milking ability. The small dairy herds are composite of *Bos indicus* and *Bos taurus* derivatives. For example, in Peninsular Malaysia, the total dairy cattle population stands at slightly more than 100,000 head, of which 67% are

Table 6 Performance of dairy cattle in Malaysia

Genotypes	Milk (kg)	Cage (Mo)	CI (day)	IC (No)	CM (%)	LL (day)
Local Indian Dairy (LID)	502- 941	48.4	412	—	4.0	230
Sahiwal-Friesian	511-2,771	39	424	1.4	—	230-330
Australian Milking Zebu	1,248-1,922	—	374-424	—	15.44	276
Friesian-LID	1,758-3,174	33	411-416	2.3	—	215
Jersey	165-1,519	—	374-423	2.2-4.3	23-29	285-300
Jersey-LID	1,185-1,200	37	402	2.5	—	272

Note : Cage = first calving age ; CI = calving interval ; IC = calving interval
CM = calf mortality ; LL = lactation length.

Source : Sivarajasingam, 1988.

of Local Indian Dairy (LID) type. The rest are LID crossbreds and Sahiwal-Friesian imported from Australia and New Zealand.

The data in Table 6 demonstrate the relative potential of Friesian crosses in the tropics. From an analysis on grades of Friesian-LID crosses, Sivarajasingam and Kumar (1986) revealed an optimum range between 58% and 77% Friesian inheritance. The heterosis estimates were significantly high, 25% for milk yield and 8% for first calving age.

Breeding programs

The sustainability of the dairy industry in the region depends on the availability of reasonably high milk-yielding animals. Although the indigenous cattle (e.g. LID) produce little milk, they have other good adaptive attributes such as disease tolerance and high reproductive rates. The *Bos taurus* breed has the potential for high milk yields but lacks other adaptive qualities. As such, nearly all the breeding programs combine the two main genotypes to ensure that the progenies possess both adaptive and productive traits. The other factors to consider in the breeding plan are the choice of breeds (local and exotic), the level of gene contribution of each parent and the magnitude of heterosis and additive effects. For maximum gain, it is suggested that the exotic genes should range between 58% to 77% (Sivarajasingam and Kumar, 1986).

Enhancing small ruminant production

The sheep in many parts of Southeast Asia are poor producers except for the breeds in Indonesia. Table 7 shows the litter size and growth characteristics of sheep in Indonesia and Malaysia. The Javanese Thin-Tailed exhibits a superiority in every trait studied. This is not surprising as the Indonesian sheep have been known for their breeding qualities and high performance under the tropical climate. In Malaysia, the local Malin breed is crossed mainly with Poll Dorset. According to Arope, 1988, the crossbreds with a high survival rate of 95% can gain as much as 200% more weight than the pure Malin breed.

The production of small ruminants (sheep and goats) is being intensified through integration with tree crops. In Southeast Asia, the integration concept has been practiced extensively by farmers over a long period. However, large scale commercialized integrated crop/livestock operation utilizing rubber, oil palm and coconut holdings, is a recent phenomenon. Forage production under plantation crops is of high quality and can carry 20 ewes/ha on rotational grazing. The small ruminants (goats and sheep) are more suitable for integrated farming because they cause less damage to the crops, require less capital investment and yield high profit. The data in Table 8 illustrate the growing population of sheep in West Malaysia. The number of sheep reared in large land holdings (plantations) is increasing at a relatively fast rate which is an indication of husbandry trend.

Table 7 Litter size and growth characteristics of sheep

Traits	Country	Range of value
Litter size (no)		
Javanese Thin-Tailed	Indonesia	1.36
Poll Dorset × Malin	Malaysia	1.09
Dorset crosses	Malaysia	1.05
Pre-weaning gain/day (g)		
Javanese Thin-Tailed	Indonesia	151-173
Poll Dorset × Malin	Malaysia	
Age at weaning/day (no)		
Javanese Thin-Tailed	Indonesia	91
Poll Dorset × Malin	Malaysia	90
Post-weaning gain/day (g)		
Javanese Thin-Tailed	Indonesia	200
Poll Dorset × Malin	Malaysia	120

Source : Arope, 1988.

Table 8 Sheep population in West Malaysia (1000 head)

	1965	1980	1983	1984	1985	1986	1987
Entire Population	37	59	60	68	78	90	125
In plantation	—	—	1	3	7	16	26
% In plantation	—	—	—	4.4	8.9	17.3	20.6

Source : Arope, 1988.

The potential to expand small ruminant farming under plantation crops is indeed large but a major limiting factor is the inadequacy of the technology itself. Integration of animal and crop requires a practical technological package that takes into consideration the relationship between the animal, forage, soil, crop, and above all, the human element. Of these, the most critical is in human resources with expertise on crop and animal management. The future of the small ruminant industry in the region will depend, to a large extent, on whether such expertise is readily available. In this respect, providing more training opportunities at all levels and establishing demonstration farms will enhance both the capability of the management and the skills of the farm operators.

Feeding systems for ruminants

Pasture utilization

The standard of feeding should be improved along with the increase of the genetic potential of the ruminants in Southeast Asia. Southeast Asia has a sizeable land area covered with natural pastures, especially in Indonesia where it is more than twice the area under cropping systems. Fresh fodder is also produced at a rate of 5-10 ton/ha from land under crops. A major part of the roughage intake for ruminants in Southeast Asia is provided by about 20×10^6 ha of permanent pastures. Using a conservative yield estimate of 5 ton dry matter/ha per year, these patures should produce about 100×10^6 ton dry matter per year-sufficient to supply the requirements of all large ruminants in the region (Ranjhan, 1985). There are at least 60 species of naturally grown forages, of which 70% are palatable. Due to poor soil quality and rapid maturity, tropical forgages are low in nutritive value. However, with phosphorus dressing, a stocking rate of 4 Kedah-Kelantan cattle per ha is possible. Individual liveweight gain range from 281-448 g/day but in terms of annual liveweight gain per ha, the highest yield, at 855 kg, was obtained on mixed grass-*Leucaena* pasture with a stocking rate of 7.3 animals per ha. The grazing intensity can be raised to 10 animals per ha on fertilized grass pasture, yielding 1,100 kg/ha per year, if accompanied by moderate supplementation of concentrate such as palm kernel cake.

Non-conventional feeds

The non-conventional feeds, such as crop residues and by-products, are fast emerging as an alternative source of nutrients for intensive ruminant production. In Southeast Asia, rice cultivation and oil palm production produce the largest quantity of residues and by-products. The total quantity of fibrous crop residues available in Malaysia is more than 300×10^3 tons (comprising mainly rice straw and palm press fiber (PPF)) which is an enormous amount. Rice straw utilization has been widely reported but information on the potential use of oil palm by-products as animal feeds is lacking.

In Malaysia, research to promote a viable, low cost ruminant production system based on oil palm by-products as the main source of nutrients is being undertaken. By-products such as PPF, oil palm trunk (OPT) and oil palm fronds (OPF) are very fibrous but potentially rich in energy, while palm kernel cake (PKC) is a proteinous material. Table 9 shows the chemical composition of oil palm by-products. The fibrous residues, e.g. PPF and OPT are characterized by a poor digestibility due to the high lignin content. They are also low in crude protein. Treatment of PPF with 8% sodium hydroxide increased the dry matter digestibility from 43.2% to 58.0%. Physical treatment with steam at 12.5 kg/cm^2 for 5-10 minutes increased the digestibility marginally from 26% to 28% (Oshio *et al.*,1990). The response of OPT to chemical and physical treatment is found to be similar to that obtained for PPF.

Table 9 Chemical composition of oil palm by-products

Residues	DM	Crude ash	Protein	NDF	ADF	EE	Lignin	GE
Palm press fiber	92.1	2.9-6.1	6.2-6.5	84.6	66.3	4.7	21.3	4,684
Palm oil mill effluent	91.9	20-23	13.0-14.5	62.5	50.5-52.6	14.0	—	3,828-4,519
Palm kernel cake	87.0	5.1	16.2	91.1	49.9	1.0	—	4,262
Oil palm trunk	92.6	3.4	2.4	74.4	52.2	0.0	—	4,375
Oil palm leaf	—	3.8	14.8	—	—	3.2	27.6	—
Oil palm petiole	—	0.6	1.9	—	—	0.5	17.4	—

Source : Jalaludin, 1985 ; Oshio *et al.*, 1990.

Studies on animal growth conducted at UPM showed that swamp buffaloes maintained on a PPF-based diet responded differently to varying dietary regimes. When fed urea-treated PPF alone, the buffaloes lost 0.25 kg/day of body weight but when supplemented with fish meal the growth rate increased to 0.12 kg/day and when supplemented with fish meal and cassava, the growth rate increased further to 0.34 kg/day.

PKC on the other hand, has been found to be a suitable concentate feed for ruminants especially for feedlot operations. Recent studies have showed that the digestibility of PKC is about 70%. Feeding trial with cattle fed 6-8 kg PKC, combined with small quantities of feed additive, produced growth rates of 0.7-1.0 kg/day. In another study, lamb fed wholly PKC gained by as much as 150 g/day. Two full scale feedlot trials were conducted by Jelan *et al.* (1991) to study the responses of the animals to PKC under farm situation. A PKC-based diet with 15% crude protein, comprising 85% PKC, 13% rice bran, 1% urea and 1% mineral mixed was fed *ad libitum* to cattle with varying genetic make-up. The results in Table 10 show that the daily weight gain could be as high as 750 g/day with a 52.5% dressing percentage. The positive response of PKC on animal growth might be due to its influence on rumen fermentation. Initial investigations indicated that animal fed PKC diets lack protozoa in the rumen and had higher proportions of propionate, isobutyrate and isovalerate acids-creating conditions which can enhance rumen fermentation (Abdullah and Hutagalung, 1988).

Table 10 Performance of breed type in smallholder feedlot

	Draught Master	Others	FS-Jersey	FS mixed FS-AMZ	Jersey Crosses
Growth (g/d)	750[a]	680[b]	660[b]	680[b]	620[b]
Dressig (%)	52.5[a]	44.4[b]	51.2[a]	51.6[a]	52.0[a]

Note : Means in the same row with different superscript differ significantly at $p<0.05$.
FS : Friesian-Sahiwal ; AMZ : Australian Milking Zebu.
Source : Jelan *et al.*, 1991.

Rumen ecology

The pre-treatment procedures on the fibrous crop residues do not neutralize completely the presence of the indigestible components in the feeds. Thus, the microbes are unable to reach the specific target nutrient, causing incomplete digestion and wastages. It is very unlikely that improvement in the digestion of fibrous feed materials can be achieved by applying only pre-treatments. The long-term strategy would be to enhance the microbial digestive ability to degrade fractions in the plant cell.

Studies on two of the rumen microorganisms - the rumen bacteria and the anaerobic rumen fungi for the degradation of PPF - are in progress at UPM. So far, 90 cellulolytic bacterial colonies have been isolated from the rumen of buffaloes fed with PPF. Ho *et al.* (1988a, b) have also demonstrated the ability of the rumen fungi in colonizing and degrading cell wall components. Further research will be carried out to select highly cellulolytic bacteria and fungi for improving the nutrition of ruminants fed fibrous diets.

Conclusion

The potential for increasing animal productivity in Southeast Asia is vast due to the demand and availability of under-utilized resources such as animal and feeds. The major constraint is the lack of suitable technology which can match the production system. Advances in research conducted locally have, to a limited extent, provided the necessary scientific and technological inputs towards creating strategies for animal improvement in Southeast Asia.

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Discussion

Murata, N. (Japan) : The attempt made to improve the water buffalo is very interesting. Could you indicate what is the future of the F_1 breeding program between swamp and river buffaloes. Are these improved animals well accepted by the farming community? Is the breeding progam *per se* desirable in relation to the social structure and environment, for example in terms of forage utilization, etc.

Answer : This program is very popular in China and in the Philippines. The farmers accept the F_1 swamp x river buffalo crossbreds due to their superiority in milk production, working capacity, etc. The only problem I can foresee is how to sustain the genetic gain in the F_1 crossbreds at the village or farm level. Further breeding may eventually retard the performance due to gene segregation. Also this program requires a strong institutional backup. Since the culling rate must be high the program is costly.

Argañosa, A. S. (Philippines) : In the Philippines the animals are well accepted by the farmers.