EFFICIENCY IN FEED RESOURCE UTILISATION AND ANIMAL PRODUCTION

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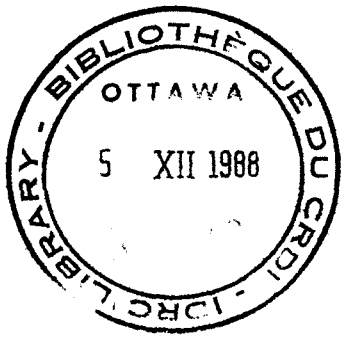

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Efficiency in the utilisation of the available feed resources is an important prerequisite for maximising animal production. The approach is justified in the Asian region, by variable feed supplies, inefficient feeding systems, low per animal performance and sizeable animal populations. The latter includes in terms of total world population, approximately 97% buffaloes, 81% ducks, 48% goats, 47% pigs, 33% cattle, 32% chickens and 18% sheep. The productivity of non-ruminants (pigs and poultry) has been particularly outstanding, but by comparison, ruminants (buffaloes, cattle, goats and sheep) have been less successful. The latter has resulted in problems concerned with access to food, national targets for animal proteins not being met, and doubts about the efficiency of existing animal production systems. Since dietary protein represents the principal limiting factor to high performance, conservation and economic use of indigenous protein sources is essential. Potential possibilities for increasing current productivity from animals are discussed in the context of the attributes of individual animal species, characteristics in the available feeds, inherent limitations, innovative feeding systems to support all year round feeding, and measures to overcome prevailing constraints. These strategies together provide for improved efficiency in the utilisation of the available feed resources, and increased future productivity from animals.

Maximising food production in the developing countries assumes, in concept, that all domestic animals of value to man will be fuly exploited. This concept is consistent with the search for efficiency in the utilisation of the available resources, notably feeds and animals, and the need for self-reliance. In comparison to crops, the position regarding animals, and particularly ruminants, is of concern. This is because the latter has failed to keep pace with the requirements of about 2.8% per annum growth rate in human population in the developing countries. The situation is such that national targets for animal proteins are far from being realised relative to the contribution by crops, which in turn has raised doubts about the efficiency of existing animal production systems, and the utilisation of the available resources for food production. This implies that in situations where economic use of land is the main thrust in agriculture and animal proteins constitute a very important objective of food production, the role of animals and priorities for their economic use, need to be reexamined in the context of the opportunities for increasing the overall contribution from them.

The structure of the animal industries in the developing countries, definition of production objectives, the prevailing production systems and in particular, the efficiency of utilisation of the available feed resources are therefore important considerations. Both large scale, intensive, and small

farm systems need to be considered relative to the choice and appropriateness of species, consumer preferences and demand, and realistic production targets. The reference to small farm systems is especially important because they constitute the pivot of traditional agriculture, involving many million hectares of land under crops, millions of farm animals and several millions of peasants, landless labourers and tenant farmers (1). These systems which combine animals and mixed cropping are a dominant feature of the agriculture of the developing countries except in Latin America and the Near East. Between regions, Asia has the largest land area under arable and permanent crops, within which there is a preponderance of small farms. It is also noteworthy that in Asia, more than 90% of the total population of buffaloes, cattle, goats and sheep and smaller populations of chickens, ducks and pigs are owned by small farmers, emphasising that the animals represent important resources within the small farm operations.

An important aspect of maximising productivity from animals to include both ruminants (buffaloes, cattle, goats and sheep) and non-ruminants (chickens, ducks and pigs) concerns efficiency in the utilisation of the available feed resources (concentrates, forages, crop residues, agro-industrial by-products and non-conventional feeds) in appropriate and economic feeding systems. The utilisation of these feeds is generally inefficient presently and is reflected in low per animal performance, relatively lower contribution from especially the ruminants, and

inefficient feeding systems.

This paper is concerned with current trends, scope for improved efficiency in feed resource utilisation, the role of animals, and more particularly, strategies that are potentially valuable for increasing productivity from animals with specific reference to Asia.

ANIMAL POPULATIONS IN ASIA

The Asian region has a large variety of animal populations of economic importance. The magnitude of these is reflected in Table 1. Notable among these, in terms of percentage of the total world population are, 97% buffaloes, 81% ducks, 48% goats, 47% pigs, 33% cattle, 32% chickens, and 18% sheep. In addition to these, there also exist sizeable populations of camels, horses, donkeys and mules, which make very valuable contributions in developing countries (3).

It is pertinent to draw attention to the fact that the ruminants (buffaloes, cattle, goats and sheep) are numerically more important than non-ruminants and are generally also widely reared. Both species are however, widely owned by small farmers, landless peasants and agricultural labourers. They are renewable resources and have varied functions from food production (meat, eggs and milk) to various miscellaneous benefits such as security, draught power, fertiliser (dung and urine), fuel, utilisation of coarse crop residues, social values and recreation (1).

TABLE 1

Animal Resources in Asia[a] (2)

Species	Population (10^6)	As % of total world population (%)	Annual growth rate (1977-87) (%)
I. Ruminants			
Buffaloes	133.5	96.5	1.8
Cattle	426.1	33.3	1.4
Goats	242.5	48.3	1.9
Sheep	202.5	17.5	1.1
II. Non-Ruminants			
Chickens	2979.0	31.5	8.3
Ducks	403.0	80.6	2.9
Pigs	397.7	47.4	1.4

[a] Includes all countries east of, and including, Iran except the Pacific Islands, Japan, Australia and New Zealand.

Over the period 1977-1987, the annual growth rate of individual animal population suggest that among ruminants, the goat and buffalo populations grew the fastest, followed by cattle and sheep. Among non-ruminants, chickens grew at a very rapid rate, followed by the duck population.

Between ruminants and non-ruminants, pigs and poultry constitute advanced animal industries in many countries in Asia. The main reasons for this are associated with the availability and successful transfer of proven technology from industrialised countries mainly in temperate regions, support by large private feed mills, the ease of importing feedstuffs, a large and ready market for the products, credit facilities and the rapid turnover of capital investment. In most countries, the two industries have already assumed industrial proportions and are usually found in urban-fringe areas which can absorb the growing domestic market outlets for the products.

Table 2 presents data on food production from animals. The contribution by each species is expressed on percentage of total world output, including the annual rate of growth of the products between 1977-1987. The table indicates that the rate of growth of the non-ruminant sector was distinctly higher than that of ruminants, and probably reflects the higher market demand for these products. Meat and milk production from buffaloes constituted a relatively high proportion of the total world output.

TABLE 2

Food Productivity from Animals in Asia[a]

Category	Production (10^3 mt)	As % of total world output (%)	Annual growth rate (%) (1977-1987)
I. Ruminants			
Meat			
Buffalo beef	1031	83.4	4.7
Cattle beef	2499	19.3	4.0
Goat meat	1168	52.9	4.8
Mutton and lamb	1075	16.7	4.0
Milk			
From buffaloes	32.2	94.7	3.9
From cattle	29.2	15.8	5.7
II. Non-ruminants			
Chicken meat	3720	12.1	7.1
Pig meat	21153	34.4	8.9
Hen eggs	9097	26.9	8.7

[a] Includes all countries east of, and including Iran except the Pacific Islands, Japan, Australia and New Zealand.

VALUE TO MAN

Table 3 summarises the value of each species to man. All species have primary, secondary and miscellaneous identifiable functions which need to be kept in perspective. Among ruminants, water buffaloes, cattle, goats and sheep are valued for meat and milk production. Goats are also useful for fibre (mohair and pashmina [cashmere]) and sheep for wool. Chickens and ducks are important for either meat or egg production or both, whereas pigs are only useful for meat. In all cases, several miscellaneous functions exist, and include value in recreation and culture.

THE FEED RESOURCES

For purposes of this meeting, with its specific focus on vegetable proteins, four categories of feed resources are identifiable : concentrates, crop residues, agro-industrial by-products and non-conventional feed resources (NFCR). These can, for convenience, be grouped into three categories :

(i) energy rich feeds from bananas, citrus fruits, pineapple, sugarcane and root crops (eg. banana waste and molasses).

(ii) protein supplements such as oilseed cakes and meals, animal by-products, by-products from the food industries and fishmeals (eg. coconut cake and feather meal).

(iii) by-products from cereal milling and palm oil refining (eg. rice bran and POME).

TABLE 3

The Value of Animals to Man

	Species	Primary	Secondary	Miscellaneous
I.	Ruminants			
	Milch buffaloes (river)	Milk	Draught	Dung, skin, recreational and cultural
	Water buffaloes (swamp)	Draught	Meat	Dung, skin, recreational and cultural
	Cattle	Meat/Milk	Draught	Dung, skin, recreational and cultural
	Goats	Meat	Milk/Fibre[a]	Skin, hair, dung, recreational and cultural
	Sheep	Mutton/ Wool	Milk	Skin, dung, hair, recreational and cultural
II.	Non-ruminants			
	Chickens	Meat/Eggs	Dung	By-products, recreational
	Ducks	Meat/Eggs	Dung	By-products
	Pigs	Meat	Dung	By-products

[a] Mohair, pashmina (cashmere) and coarse wool.

PRIORITIES FOR FEED RESOURCE USE

Table 4 summarises the priorities for using AIBP and NCFR in Asia according to their potential value and importance especially to individual species of animals. It categorises the broad types of feeds, their essential characteristics and the main species which currently utilise them.

Priorities for the utilisation of the available feeds are essential to ensure efficiency, expanded use of the available feeds, reduced reliance on imported feeds, spiralling feed costs, excess capcity and inadequate use especially, of the more important NCFR. Such priorites are consistent, as well as ensure the well known fact that the dairy cow has the highest efficiency of conversion of feed protein to food protein, followed by poultry and egg producing birds, pigs and ruminants producing meat. Concerning feed energy, pigs come first, followed by dairy cattle, poultry and meat producing ruminants. Table 5 demonstrates typical data concerning various species.

FEED BALANCE SHEETS

Feed balance sheets provide an important means to assess adequacy or the extent of inadequacy concerning the nutrition of the animal resources. More particularly, they enable the development of two alternative strategies. One concerns measures to increase feed production, their availability and the development of systems for their more intensive and efficient use. The

TABLE 4

Priorities for the Utilisation by Animals of Agro-industrial By-products (AIBP) and Non-conventional Feed Resources (NCFR) in Asia (4).

Feed Source	Characteristic	Species
1. Energy and protein concentrates (eg. rice bran, coconut cake, soyabean meal, poultry litter)	High energy High protein	Pigs, poultry, ducks, lactating ruminants
2. Good quality crop residues (eg. cassava leaves)	High protein High energy	Pigs, ducks, lactating ruminants and use as supplements in meat animals
3. Medium quality crop residues (eg. sweet potato vines)	Medium protein	Pigs, ruminants (meat and milk), camels and donkeys
4. Low quality crop residues (eg. cereal straws and bagasse)	Low protein Very fibrous	Ruminants (meat and draught), camels and donkeys

[a] Ruminants refer to buffaloes, cattle, goats and sheep

TABLE 5

Efficiencies of Protein and Energy Conversion in Animals (Adapted from 5)

Category	ME[a] (%)	Protein[b] (%)	Protein (g/Mcal ME)[c]
Beef	7.0	6.0	2.6
Lamb	3.0	3.0	1.3
Pork	23.0	12.0	6.0
Poultry	13.0	20.0	11.0
Eggs	15.0	18.0	11.0
Milk	21.0	23.0	10.0

[a] (Edible energy X 100) divided by (total metabolisable energy consumed)

[b] (Edible protein X 100) divided by (total feed proteins consumed)

[c] (Edible protein [g]) divided by (total metabolisable energy consumed, Mcal)

alternative strategy is to expand animal production commensurate with excess, under-utilised feeds, and issues of conservation and feed security. These contrasting situations are exemplified by India and Pakistan in the first category, and Malaysia in the alternative situation. It is therefore appropriate to briefly discuss these country comparisons.

Table 6 summarises the situation in India in 1984. The feed deficits in terms of metabolisable energy (ME) and digestible crude protein (DCP) for the animal resources were about 32% and 54% respectively.

Table 7 provides a trend in the feed balance situation in India, between 1870 and 1984. Two major conclusions are apparent. Firstly, feed deficits and the malady of under-nutrition was a continuing problem. Secondly, there has been a trend towards a reduced feed deficit despite increased animal population over the 14 years. The trend towards reduced deficits is probably reflective of improved feeding systems, more efficient use of the available feeds and increasingly intensive systems of production. Whether in terms of scale and magnitude, these approaches are adequate, and can be further improved is a matter of debate.

Table 8 illustrates a parallel situation in Pakistan also for the year 1984. The deficits in terms of total digestible nutrients (TDN) and DCP are about 25% and 41% respectively.

TABLE 6

Feed Availability and Requirements in India in 1984 (Adapted from 6)

Principal feed source	Availability[a]		Total requirements[b]	
	Energy (10^7 Mcal ME)	DCP (mt)	Energy (10^7 Mcal ME)	DCP (mt)
Crop residues and agro-industries by-products	5022.3	7437	-	-
Fodder crops	1228.0	3411	-	-
Grasses[c]	1149.0	2660	-	-
TOTAL	7399.3	13508	10933.5	33396
% Deficit	-	-	32.3	54.0

[a] ME - Metabolisable energy; DCP - Digestible crude protein

[b] Of herbivores (buffaloes, cattle, goats, sheep, asses, mules, yaks, and chauri) and non-ruminants (poultry and pigs)

TABLE 7

Trends in Feed Balances in India (adapted from 6)

Nutrient	1970			1984		
	Availability[a]	Requirement[b]	% Deficit	Availability	Requirement	% Deficit
Energy (10^7 Mcal ME)	6162.8	9877.9	37.6	7399.4	10933.5	32.3
DCP (10^4 mt)	113.2	297.8	61.9	135.1	344.0	54.0

[a] ME - Metabolisable energy; DCP - Digestible crude protein

[b] Of herbivores (buffaloes, cattle, goats, sheep, asses, yaks and chauri) and non-ruminants (poultry and pigs)

TABLE 8

Feed Availability and Requirements in Pakistan in 1984 (7, 8)

Principal feed source	Availability (10^3 mt)[a]		Total Requirements[b] (10^3 mt)	
	TDN	DCP	TDN	DCP
Crop residues and agro-industries by-products	8359.9	947.5	-	-
Fodder crops	18059.5	692.8	-	-
Grasses[c]	11200.0	700.0	-	-
TOTAL	37619.4	2340.3	50096	3951
% Deficit	-	-	24.9	40.7

[a] TDN - Total digestible nutrients; DCP - Digestible crude protein

[b] Of ruminants : buffaloes, cattle, goats and sheep

[c] From canals, banks, road sides, orchards, flood plains and rangelands

By comparison, Table 9 presents an alternative situation in Malaysia where it has been estimated that land under native and cultivated grasses contributed a total annual dry matter (DM) production of about 3838 X 10^3 tonnes, and from roughage by-products 2935 X 10^3 tonnes, giving a total of 6,773 tonnes. This was in excess of the estimated total requirements by ruminants of 1,580 tonnes (11).

IMPORTED FEEDS

Associated with feed balance sheets is that of dependence on import of feeds, notably animal proteins and mineral-vitamin supplements, especially for intensive poultry and pig production. The principal protein supplement is soyabean meal. Over the last two decades, production has been increasing and associated with this, exports as well. The meal also accounts for approximately 75% of the total world trade of oilcakes and meals. Cottonseed cake and fish meal are the next two most important protein feeds, but the rate of production of these do not compare with that of soyabean production. Recently, the effects of drought and dependence on soyabean meal utilisation have resulted in a significant rise in the cost of the meal, which has necessitated more judicious use of the protein source in feeding systems especially for non-ruminants.

The magnitude of these imports is variable between countries, and is significantly influenced by government policy and financial considerations. These countries can be grouped into two categories. The first group involves those countries

TABLE 9

Total Availability of Dry Matter (DM) and Requirements by Ruminants in Malaysia (9)

Component	Availability (10^3 mt)
Grazing[a]	3839
Agro-industrial by-products[b]	3942
Requirements[c]	1580

[a] From herbage under plantation crops, grazing lands, road sides and padi bunds

[b] Includes non-conventional feeds

[c] By ruminants (buffaloes, cattle, goats and sheep)

which have controlled imports of feeds to sustain components of the animal industries. Examples in this group are Pakistan, India, Thailand, Philippines and Indonesia. The other group represents those who have the capacity to liberally export to meet animal feed requirements, notwithstanding the availability of considerable supplies of indigenous feeds. These include countries such as Singapore and Malaysia.

There is no doubt that soyabean meal and fish meal will continue to dominate efficient feeding systems, associated with use of superior genetic stock, sophisticated management systems and improvements in the environment especially for non-ruminants and ruminants. These factors together have resulted in significant improvements to feed efficiency over the past four decades. Table 10 reports these improvements which are reflective of typical performance in several countries in the Asian region. Further improvements in feed efficiency are feasible, but these are likely to be small.

Preformed proteins are especially important to both non-ruminants in ruminants since they are often the main limiting factor in the diet, efficiency of feed utilisation and level of performance. With ruminants, a small amount of protein has a catalytic effect on rumen metabolism, manisfesting in a significant effect on intake and efficiency of feed utilisation (10, 11). The implication of this result is that protein resources within individual countries need to be conserved and used especially carefully in the context of exports of indigenous

TABLE 10

Improvements in the Efficiency of Feed Conversion (EFC) in Pigs and Poultry

Year	EFC (units of feed required/ unit live weight gain) Pigs	Poultry
1945	4.1	3.5
1955	3.8	3.0
1965	3.4	2.8
1975	3.1	2.5
1985	2.5	2.2
1988	2.3	2.0

protein meals and imports of milk products. The significance of this is reflected in their use in lactating cattle for example, fed on low quality cereal straw diets supplemented with 100-500 g/day/cow of proteins. It has been calculated, that this strategy and the potential availability of say 20,000 mt of proteins fed catalytically in any country would stimulate the additional production of 80 million litres of milk annually (13).

Impinging on the controlled utilisation of imported feeds, notably maize, soyabean meal, mineral-vitamin supplements, and various problems associated with these, are the rising costs related to their use. Future approaches are thus likely to address and investigate more thoroughly, those factors that can effectively reduce the cost of feeding with no loss in performance. Judicious and controlled use of imported feeds, are thus likely to be coupled with more intensive use of such other protein feeds as cereal brans, coconut meal and cowpea seed meal.

NON-CONVENTIONAL FEEDS

Notable in this connection is greater attention to the use of indigenous feedstuffs, including non-conventional feeds produced in Asia. Table 11 indicates the magnitude of the contribution from the latter category, much of which is under-utilised. Table 12 gives examples of the utilisation of five types of non-conventional feeds, with an indication of optimum dietary levels for feeding non-ruminants and ruminants. Table 13 gives a specific example concerning the utilisation of rice bran

TABLE 11

The Availability of Non-conventional Feed Resources in Asia and the Pacific (13)

Category	Availability (10^6 mt)
Field crops	230.3
Tree crops	7.4
Total	237.7[a]

[a] Represents 46.3% of the total availability of feeds from field and plantation crops

TABLE 12

Optimum Level of Utilisation of Some Non-conventional Dietary Vegetable Proteins for Farm Animals in Asia

Non-conventional feedstuff	Species	Location	Optimum level of dietary inclusion(%)	Reference
1. Castor				
- Castor bean meal	Buffaloes	India	30	(14)
	Sheep	India	10	(15)
2. Mango				
- Mango seed kernel	Calves	India	20	(16)
	Bullocks	India	40	(17)
	Cows	India	10	(18)
3. Oil Palm				
- Palm oil mill effluent	Sheep	Malaysia	40	(19)
- Palm oil mill effluent	Poultry	Malaysia	10-15	(20)
- Palm oil solids	Poultry	Malaysia	10-15	(21)

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Non-conventional feedstuff	Species	Location	Optimum level of dietary inclusion (%)	Reference
4. Rubber				
- Rubber seed meal	Pigs	Malaysia	20	(22)
	Poultry	Sri Lanka	20	(23)
	Poultry	Sri Lanka	20	(24)
	Calves and cows	India	20	(25)
	Calves	India	30	(18)
	Cows	India	25	(18)
	Pigs	India	40	(26)
5. Sal				
- Sal seed meal (untreated)	Poultry	India	5	(27)
- Sal seed meal (untreated)	Poultry	India	20	(28)
	Cows	India	30	(29)
	Bulls	India	40	(30)

TABLE 13

Effects of Feeding Rice Bran in Diets with Two Levels of Energy and Protein on Performance of Laying Hens[d] (adapted from 31)

Treatments Rice bran (%)	I 38.5	II 33.0	III 18.5	IV 12.5
Feed intake (g/b/day)	117.6±.0[b]	120.1±.9[a]	122.5±.6[a]	119.1±1.3[ab]
ME intake (kJ/b/day)	1182.0±9[a]	1232.0±10[a]	1384.0±7[b]	1345.0±9[b]
Protein intake (g/b/day	14.1±.1[a]	18.0±.1[b]	14.7±.1[a]	17.9±2[b]
H.D. Egg Prod. (%)	65.7±2[a]	70.7±2[ab]	73.4±1[b]	74.6±2[b]
FCR (kg feed/kg egg)	3.11±.09[b]	2.79±.09[a]	2.76±.04[a]	2.74±.04[a]
Egg weight (g)	58.4±1.1[b]	61.6±.8[a]	60.1±1[a]	59.3±1.3[a]
Egg mass (g)	38.3±1.2[a]	43.5±1.4[b]	44.1±.7[b]	44.2±1.5[b]

[a,b,c] Values in a row with different superscripts are significantly different ($P < 0.01$)

[d] Means for 12 weeks

by poultry, which was used to partially replace soyabean meal. The results indicated that laying hens can be fed with up to 33.0% rice bran with no loss in performance on low energy diets (10.1 MJ/kg) with a minimum dietary protein level of 15%.

The utilisation of various by-products and NCFR are not without problems of collection, transportation, storage, processing considerations, and also deleterious principles which affect animal performance. Table 14 provides a summary of various types of toxic substances in individual feeds. The list is not exhaustive but provides information on the type of toxic principle and approximate contents. With some of these, such as HCN in cassava, methods are now available to detoxify the substance to render the feed more useful. More information is required on these toxic principles, and in particular, methods to reduce the deleterious effects on animals.

INTENSIFYING FEED RESOURCE UTILISATION

Two important prerequisites for intensifying the efficiency of feed resource utilisation in the future concerns identification of their value in terms of priorites (Table 14), and more particularly wider efforts to include them in intensive feeding systems (32, 33, 4, 13, 34). These considerations also necessitate their definition into two categories as follows :

Primary feedstuffs : ingredients that form the main base in a feeding system. These constitute about 70-80% in the diet.

TABLE 14

Examples of Toxic Principals in Some Common Non-conventional Feeds

Type of feed	Toxic principal
Banana waste, stems and leaves	Tannins
Cassava leaves, peeling and pomace	NCN (17.5 mg/100g in leaves)
Castor seed meal	Ricinoleic acid
Cocoa seed husks	Theobromine (Trace)
Coffee seed hulls, pulp	Caffeine and tannins (2.8% DM)
Cottonseed cake	Gossypol (0.05-0.20%)
Cowpea seed meal	Trypsin inhibitor
Guar meal	Trypsin inhibitor and gum
Kapok	Cycloponopenoid acid
Mango seed kernel	Tannin (5-10%)
Neem seed cake	Tannin
Palm oil mill effluent	High ash (12-16% DM)
Rubber seed meal	HCN (9 mg/100g)
Sal seed meal	Tannin (6.2-13.7%)
Spent tea leaf	Tannin (12% DM)

Secondary feedstuffs : minor ingredients that are supplements in the diet. These constitute up to 20-30% in the diet.

Table 15 sets out examples of the more important AIBP and NCFR which merit particular attention, and whose efficient utilisation are likely to make a significant impact on the low level of animal performance prevailing in most countries. Associated with the utilisation of these feed ingredients is the wider utilisation of a variety of proteinaceous forages whose potential value has been emphasised (35, 36).

Both ruminants and non-ruminants are involved, and innovative feeding systems that can include these feeds in suitable proportions for all year round feeding systems, can go a long way to increase the current contribution, and future productivity from the animal resources.

TABLE 15

Some Examples of Primary Feeds for Intensive Utilisation by Location (4)

Type of primary feed	Location	Species
Bananas	Philippines	Beef cattle, ducks
Cassava - Leaves	Thailand, Indonesia Philippines	Beef cattle, goats, swamp buffaloes
- Pomace	Thailand, Indonesia Philippines	Pigs, ducks, lactating cattle and goats
Maize stover	Philippines, Indonesia	Beef cattle, swamp buffaloes, goats and sheep
Oil Palm - POME, palm press fibre, palm kernel cake	Malaysia	Beef cattle, swamp and buffaloes

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Type of primary feed	Location	Species
Rice		
- Bran	Thailand, Indonesia, Philippines	Pigs, poultry and lactating ruminants
- Straw	Thailand, Sri Lanka, Philippines, Thailand	Beef cattle and swamp buffaloes
Sugar cane		
- Tops, bagasse	India, Pakistan, Thailand	Beef cattle and swamp buffaloes
Wheat		
- Bran	India, Pakistan	Pigs, poultry, lactating ruminants
- Straw	India, Pakistan	Beef cattle and swamp buffaloes

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