PROCEEDINGS OF THE INTERNATIONAL WORKSHOP

STUDIES ON FEEDS AND FEEDING OF LIVESTOCK AND POULTRY

FEED COMPOSITION, DATA DOCUMENTATION AND FEEDING SYSTEMS IN THE APHCA REGION

1980

L.C. KEARL AND L.E. HARRIS, EDITORS

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Foreword

The battle against hunger and deprivation is the most important task facing the world today. Hundreds of millions of people must exist on diets deficient in protein and energy. An increasing population is exerting a steadily mounting pressure on the world's food production capabilities.

To organize the forces of agriculture in the struggle against hunger and deprivation, two things must be done. We must find new resources for production, and we must find better ways of utilizing the resources available (present and future). Animal and plant production must be integrated into one efficient production system providing a variety of quality products for man's consumption.

Scientific knowledge and its application transcend national boundaries. The free interchange of scientific information on the many aspects of animal agriculture is essential in a world made small by the common interests of all people for food, clothing, and shelter. This workshop provided the opportunity for scientists and technicians from several countries in Southeast Asia to exchange information concerning the breeding, feeding, management, and health care for the livestock and poultry industries in the Animal Production and Health Commission for Asia, the Far East and Southwest Pacific (APHCA) Region.

The workshop was organized to bring together representatives from the feed industry, ministry of agriculture, and the scientific community from several APHCA countries in a forum to focus attention on the importance of developing the agricultural sector and specifically the livestock and poultry industries within this region. The topic of the workshop was relevant because most of the developing countries in the region are importers of livestock products and are in the process of expanding their animal resources to overcome this dependency and to improve the diet of their people.

Finding solutions to the problems ahead will be a difficult task. Hopefully, the exchange of information among all interested parties in workshops and conferences such as this will hasten the day when nutritious food is available to all mankind. The organizers and sponsors of this workshop are confident that the exchange of ideas and information presented at these meetings will be beneficial in improving the efficiency and utilization of livestock and poultry resources in the production of animal products.

Appreciation is extended to all those who assisted in making the workshop a success. Special thanks are extended to the Government of the Republic of the Philippines, FAO Regional Animal Production and Health Commission for Asia, the Far East and Southwest Pacific (APHCA), the United States Agency for International Development (USAID) and the International Feedstuffs Institute, Utah State University for their generous financial and administrative support.

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Food and Agriculture Organization
of the United Nations (FAO)

INTRODUCTION

Demand for and Production of Livestock Products

The Asian and Far East region have a varied geographical, climatic, and economic structure. It contains three developed countries (Australia, Japan, and New Zealand) and 25 developing countries (including groups of Pacific Islands) at different stages of economic advancement.[1] Because of the developing countries' weight of population and growth potential, most of the analysis in this paper is concerned with the demand for and production of feedstuffs in those areas. Particular attention is given to trends in a selected group of developing market economies[2] (including the main net exporters and net importers of feedstuffs) for which information is relatively available, and which can be used to illustrate the chief problems and policy issues in the developing parts of the region.

The region contains about half of the world's land area but consumes only 30 percent of the world's output of eggs, 24 percent of its meat and 14 percent of its milk. Excluding the centrally–planned economies, the per capita consumption of livestock products in the developing countries is the lowest of all the main world regions, supplying in 1972–74, 6 percent of the calorie and 15 percent of the protein in China and one–third of the calories and over 50 percent of the protein in developed countries.

The low per capita consumption of livestock products in the developing countries of the region reflects (on the supply side) poor animal productivity, particularly of the large bovine herds, and (on the demand side) low average incomes of uneven distribution. Protein food consumption has therefore been restricted to a relatively small segment of the population.

However, as a result of the continuing growth in population, rapidly rising incomes in a number of countries, and a growing desire for more varied diets, the total demand for livestock products has expanded appreciably in recent years. The increasing shortage of fish, too, has contributed to a change in eating habits, leading (in Japan particularly) to stronger demand for meat. Between 1972–74 and 1978, regional consumption increased by 4.1 percent a year for meat, 3.0 percent for eggs, and 2.3 percent for milk (Table 1). Trends among the developing countries were uneven, including very fast rates of growth in the Republic of Korea, Malaysia, the Philippines, and Pakistan (except for milk), a small decline in meat consumption in Thailand, and a slow growth rate of 1.0 to 1.3 percent a year for all livestock products in India. Nonetheless, the growth in total consumption of the developing countries was above the regional average in the case of eggs at 3.7 percent a year and only slightly below it for meat and milk (3.8 percent and 2.2 percent a year, respectively).

Recent FAO projections to 1985, based on 1975 prices and on the assumption of no major policy changes, indicate that the demand for livestock products in the region should continue rising in the 1980's. Over the period 1972–74 to 1985, the regional demand for meat is projected to grow at 3.1 percent a year, though (if recent trends continue) this figure may need to be adjusted upwards. The projected demand for eggs and milk at 2.8 percent and 2.3 percent, respectively, are close to their recent rates of growth. In the developing countries, the demand for beef is expected to grow at a rate (3.0 percent a year) close to the regional average, while the demand for eggs and milk could grow appreciably faster than for the region as a whole. In the developed countries, the demand for meat is expected to continue to expand strongly though that for eggs and milk (except in Japan) could slow in view of the already high per capita consumption of those products.

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1 The list of countries included in the Region is shown in Appendix 1.

2 India, the Republic of Korea, Malaysia, Pakistan, the Philippines, and Thailand.

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

TABLE 1 Regional Consumption of Meat, Eggs, Milk

	Production			Consumption[a]			Growth Rates			
							Production		Consumption	
	1972–74	1978	Projected 1985 (Basic)	1972–74	1978	Projected 1985 (Basic)	1972–74 to 1978	1972–74 to 1985 (Proj.)	1972–74 to 1978	1972–74 to 1978 (Proj.)
	. . . million metric tons . . .						. . . percent per annum . . .			
Asia and the Far East Region										
Meat[b]	26.9	32.5	38.4	25.5	37.1	36.9	3.8	3.0	4.1	3.1
Milk[c]	58.8	62.6	74.8	56.2	63.0	74.8	1.3	2.0	2.3	2.3
Eggs	6.7	7.8	9.3	6.7	7.8	9.3	3.0	2.8	3.0	2.8
Developing										
Meat[b]	21.5	25.7	30.6	21.5	25.9	30.7	3.7	2.9	3.8	3.0
Milk[c]	41.4	45.1	56.0	43.5	48.5	60.2	1.9	2.6	2.2	2.8
Eggs	4.6	5.5	6.8	4.6	5.5	6.8	3.7	3.3	3.7	3.3
Developed										
Meat[b]	5.4	6.8	7.8	4.1	5.2	6.1	4.5	3.1	5.0	3.2
Milk[c]	17.7	17.5	18.8	12.8	14.5	14.6	0.3	0.5	2.5	1.1
Eggs	2.1	2.2	2.5	2.1	2.2	2.5	1.4	1.4	1.4	1.4

[a] Production plus net imports.

[b] Beef and veal, sheep and goatmeat, pigmeat and poultry meat.

[c] In fresh milk equivalent

Pork is by far the most important meat produced in the region. With production rising by 4 percent a year from 1972–74, it accounted for 54 percent of the total meat output in 1978 (Table 2). Over 80 percent of the pork production takes place in China, where it is not only the preferred meat in domestic consumption, but is also a significant export commodity. Pork production is also increasing in other parts of the region, particularly among the ASEAN countries, where emphasis is being placed on pork and poultry production as ways of increasing the incomes of small farmers. In the developed countries pork production is chiefly important in Japan, where it has been expanding by nearly 6 percent a year since the early 1970s and forms over half of all the meat production in the country.

Poultry meat represents 17 percent of the region's meat output. China is again the major producer, accounting for some 60 percent of the total, but the most rapid production progress in both meat and eggs in recent years has been made in a number of other developing countries – among them the Republic of Korea, Malaysia, and the Philippines – partly because religious taboos on the consumption of eggs and poultry meat are being relaxed and also because modern production technology has been adopted by big commercial enterprises in a number of countries. The rate of expansion has been very marked in Japan where poultry meat production increased tenfold during 1972–74. Though a plateau appeared to have been reached in 1976–77, production resumed its rapid growth in 1978 and is expected to continue to expand at over 5 percent a year into the 1980s.

Pork and poultry production is based almost exclusively on concentrate feedstuffs and the output expansion of recent years has been possible only with a substantial addition to feedstuffs supplies. In a number of countries the pork and poultry industries have in recent years become heavily reliant on imports of feedgrains and other concentrates.

TABLE 2 Meat Production in Asia and the Far East Region

	Production			Growth Rates	
	1972–74	1978	Projected 1985 (Basic)	1972–74 to 1978	1972–74 to 1985 (projected)
	. . . million metric tons . . .			. . . percent per annum . . .	
Asia and the Far East Region					
Beef and Veal	5.62	7.00	7.47	4.5	2.4
Pork	14.34	17.45	20.26	4.0	2.9
Poultry meat	4.49	5.39	7.65	3.7	4.5
Sheep and goatmeat	2.46	2.64	2.99	1.4	1.6
Developing					
Beef and veal	3.52	3.95	4.74	2.3	2.5
Pork	13.11	15.99	18.27	4.0	2.8
Poultry meat	3.58	4.25	5.99	3.4	4.4
Sheep and goatmeat	1.29	1.55	1.57	3.8	1.7
Developed					
Beef and veal	2.10	3.05	2.74	7.8	2.2
Pork	1.22	1.46	2.00	3.6	4.2
Poultry meat	0.90	1.50	1.66	4.9	5.2
Sheep and goatmeat	1.18	1.09	1.42	1.6	1.6

Outside China, however, beef is still the most important meat in the region. In the developing countries most of the production results from the slaughter of draft animals after the completion of their working lives. Annual off-take and meat yields are low. This is partly the result of institutional and religious influences which restrict herd culling, as in India which possesses almost half of the region's buffalo and cattle but produces less than three percent of the beef and veal. It may also reflect greater emphasis on milk production — India's bovine herd produces over 40 percent of the region's milk. Beef production, based on modern feeding methods, represents as yet only a small proportion of the output in the developing countries, but is gaining ground in a number of countries, notably the Republic of Korea, the Philippines, and to a lesser extent, Thailand. The expanding beef production of Japan is also based on concentrate feeds, but the recovery in beef output in Australia in recent years from the recession in the beef feed-lot industry in the early 1970s has been largely based on grassland, with some supplementary feeding of concentrates for finishing.

Modern dairy farming, using concentrate feed rations, is also making progress in some areas, but (as with beef) in a number of countries the greater part of the region's milk is provided by buffalo and cows whose primary role is that of providing draft power. Their yields are low since draft animals normally receive only a minor share of concentrate supplies and their common rations of stubble and wayside grazing, roughage, and some fodder can provide for little more than maintenance. Even so, because of their large numbers, particularly in India, Pakistan, and Thailand, these animals absorb a very large proportion of the total feed supplies in their countries and it is difficult to provide them with the improved feeding that could have a marked effect on their productivity in beef and milk output and also on their capacity for draft work.

Because of the continuing predominance of traditional patterns of production, the output of meat and milk has not kept pace with demand in a number of the higher income countries of the region, including the Republic of Korea, Malaysia, and the Philippines. In order to maintain the growth in consumption these countries have had to import substantial quantities of meat and milk products in recent years. Poor production management, scarcity of technical knowledge, the uneven genetic qualities of the livestock and shortage of investment capital are all factors which have restricted the rate of expansion in the production of livestock products. But undoubtedly, the main constraint has been the inadequate supply of feedstuffs. The failure to improve the output of grassland, roughage, and fodder crops has impeded the development of the dominant ruminant sector, while the slow progress in the production of domestic concentrate feeds, and in the use of by–products, have forced countries expanding their pork and poultry industries to become more dependent on imported feedstuffs. This trend is evident in a number of developing countries, such as the Republic of Korea, Malaysia, the Philippines, and developed countries like Japan. The recent development of integrated crop/livestock/fish farming in some parts of Southeast Asia is, however, evidence of efforts to reduce dependence on imported feed supplies.

FEEDSTUFFS RESOURCES AND CONSUMPTION

Planning the development of the feed/livestock sectors in the region is handicapped by the incompleteness of the information about feed resources. While it is possible to indicate the order of magnitude of some of the major sources of roughages, such as cereal straws and rice hulls, and some of the main by–products of cereal milling, only scattered data in a few countries are available for fodder crops. Information is especially scanty about the feed contribution of grassland, wayside grazing, of many forage crops and household waste and of the non–conventional by–products of agro–industrial processing. The best documented area is that of concentrate feeds where data on the use of the major types of concentrate feeds in the various countries provide a reasonable picture of the regional consumption pattern.

Sources of roughage for ruminants

About 800 million hectares of land in the region, 25 percent of it in China, 20 percent in other developing countries and 55 percent in the developed countries, are classified as permanent pasture. These provide a major part of the ruminant intake of roughages in the region.[1] A further 900 million hectares of unclassified land, mostly desert or wasteland, provide some sparse grazing. Australia and New Zealand have large areas of well–managed grassland, but elsewhere the carrying capacity of most pasture land is very low because of unfavorable climate or over–grazing. In time, much of it could be improved by reseeding, the use of fertilizers, irrigation, and proper grazing management, though this however, is likely to be a slow and costly long–term development. Apart from grazing, the bulk of the roughage intake of ruminant animals consists of straw and stubble, special fodder crops, and the by–products of crop production.

The output of rice straw in the developing countries of the region is tentatively estimated at 220 to 250 million tons a year. To this should be added a further 100 to 120 million tons of straw from wheat, barley, and oats. Substantial quantities are fed, mainly to buffalo, in Bangladesh and South India, but over the region as a whole, much is burned (especially in areas where double cropping of rice is practiced), used as fuel or as mulch in paddy fields or simply wasted because of the cost of its collection and transport. Fed by itself, straw provides only a low grade maintenance diet, suitable chiefly for buffalo, but in some areas, particularly sugar–producing districts, it is a growing custom to treat straw with molasses to provide a more nourishing and palatable ration for other ruminants also.

The paddy harvest also yields about 40 million tons of rice hulls a year. Most of these are used as fuel or wasted, but in some countries they are, after treatment with ammonia, used as feed, primarily as a source of fiber in beef cattle feed–lot rations. The ammonia treatment is only economically feasible where hulls are concentrated in large quantities at big commercial mills. The cost of collection is a deterrent to the expansion of this practice on a local basis, though in developed countries, Australia for instance, rice hull cubes are increasingly used in ruminant feeding.

Since the output of straw and hulls is a function of cereals production and can be expected to increase only in line with cereal milling, most of the increase in the energy value of roughage in the medium–term future is likely to come from fodder crops grown especially for feeding. The potential requirements of fodder crops are great, but the rate at which production will expand will depend on the attractiveness of the prices offered to producers and on the competition for land from other crops. As long as there are shortages of food grains, land may not be available for fodder crops. But as the yields of grain crops are raised, the pressure to extend the area of food grain crops may ease. There may thus be changes in land use patterns and considerable diversification of crop production in coming years, with fodder crops playing a more important role. For example, the Indian Draft Five–Year Plan 1978–83 states that "to meet the large gap between the requirements and availability of fodder and feeds, the production of high–yielding varieties of fodder crops as part of an integrated program of crop husbandry in a mixed farming system will be given priority." The output of fodder in 1975 in three countries of the region where it is already of considerable importance

[1] It has been estimated that in 1974 in the Republic of Korea, natural grasses accounted for 54 percent of all feedstuffs supplies and 62 percent of the roughage intake (FAO/IBRD: Cooperative Program Livestock Development Projects, 1974).

(India, Pakistan and the Republic of Korea) has been estimated at 42 million tons.[1]

Trends in the supply and demand for concentrate feeds

More information is available about the supply and consumption of the main concentrate feeds. From food and feed utilization balance sheets prepared by FAO for most countries in the region, it is possible to build up a regional picture of the energy contribution of the main types of concentrate feedstuffs (Table 3).[2] Cereals are by far the main type of concentrate feed in the region, providing in 1972–74, 45 percent of the metabolizable energy[3] obtained from feed and almost a third of the protein. By-products of cereal milling accounted for about 25 percent of the energy and 33 percent of the protein, while oil-cakes and meals accounted for 11 percent of the energy and 33 percent of the protein. The remaining energy and protein was obtained chiefly from milk consumed by the suckling young of cows and buffalo.

In developing countries of the region, cereals provided for about 40 percent of the total concentrate feed energy while milling by–products contributed 33 percent. But a very high proportion of the cereals were fed in China where they were more important as a source of energy than milling by–products. In the other developing countries, by contrast, the feed use of cereals was low and the energy contribution of milling by–products was three times as great. In the developed countries of the region, cereals were by far the main source of energy from concentrate feed, contributing 68 percent of the caloric intake compared with 12 percent obtained from milling by–products. Cereals also provided a large part of the protein intake, though in recent years the consumption of oil cakes and meals in Japan has increased greatly.

[1] FAO: Agriculture Toward 2000, (Rome 1979), p. 100.

[2] Data on the production and feed use of roots, tubers, and pulses for the region are shown in Appendix Tables 5 and 6. Information on the use of certain other concentrate feeds, such as molasses, are available for a few countries, but the data are too fragmentary to be included in regional aggregates.

[3] Metabolizable energy (ME) is the gross energy of feed minus energy lost in feces, urine, and gaseous products of digestion.

TABLE 3 Consumption of Main Concentrate Feedstuffs, 1972–74

	Metabolizable Energy				Crude Protein			
	Cereals	Milling by–products	Oilcakes and meals	Total[a]	Cereals	Milling by–products	Oilcakes and meals	Total[a]
	. . . million megacalories . . .				. . . million metric tons . . .			
World	1,331	210	170	2,027	52	13	29	105
Asia and the Far East Region	144	83	36	323	6	6	6	19
Developing	100	85	29	258	4	5	5	15
India	3	18	8	33	----	1	1	3
Korea Rep.	2	2	----	4	----	----	----	----
Malaysia	1	1	----	2	----	----	----	----
Pakistan	0	2	2	4	----	----	----	----
Philippines	1	2	----	4	----	----	----	----
Thailand	2	2	----	5	----	----	----	----
Developed	44	8	7	65	2	----	1	4
Australia	8	1	9	12	0	----	----	1
Japan	35	6	7	52	1	----	1	3

— Less than 0.5 million

[a] Including other concentrate feedstuffs, and milk.

Trends in the Feed Use of Cereals

Traditionally, very little grain has been available for feeding to animals in most of the developing countries of the region. Only one percent of the rice and less than two percent of the wheat consumed was used for feed in 1975–77, and most of this consisted of broken and low quality grains not suitable for human food. In the case of coarse grains, the share going for feed was just under 25 percent, but this figure is put into a proper perspective by the fact that almost 90 percent of the coarse grains are fed in China, where in the past substantial amounts of barley and millet, and in recent years large quantities of maize, are believed to have been fed to its huge swine herd of over 300 million head and to a flock of 1,400 million chickens. In the other developing countries, the feed use of coarse grains represented eight percent of total utilization.

Nevertheless, over the past two decades feed grain use in China has been growing very slowly, and it is in the developing market economies that the main expansion has occurred as governments and livestock producers have sought to satisfy the rising demand for protein foods. Since the early 1960s, this group of countries has shown the highest growth rate in cereal feed use of any region in the world. Starting from a low base of 2.5 million tons a year in the early 1960s, their feed use expanded by 6.3 percent a year during the decade to 1972–74 and is projected to continue to grow at almost the same pace over the period to 1985. With the help of sharply rising imports (except Thailand) the consumption of coarse grains—two thirds of the total – has expanded even faster, rising by eight percent a year during the decade to 1972–74 and is projected to expand almost as rapidly over the period to 1985 (Table 4).

During the earlier decade, cereal feed use expanded at an explosive rate of 20 percent a year in the Republic of Korea and Thailand and by 14 percent a year in Malaysia, largely reflecting the fast expansion of the pork industry in the Republic of Korea and of the poultry sectors in all three countries. The growth in feed use in these countries is expected to continue at between 7 and 10 percent a year into the 1980s, while consumption in the Philippines could accelerate to almost 12 percent a year. Grain feed use in India has been growing at almost 4 percent a year and is projected to continue at almost this rate in the 1980s. But in view of trade reports indicating a faster growth in egg production than is revealed by the

TABLE 4 The Feed Use of Cereals

	Feed Use			Growth Rates	
	1962–64	1972–74	Projected 1985 (Basic)	1962–64 to 1972–74	1972–74 to 1985 (projected)
	. . . million tons . . .			. . . percent per annum . . .	
Asia and the Far East Region					
Total cereals	33.8	49.3	78.8	3.8	4.0
Coarse grains	30.2	43.0	69.9	3.6	5.0
Developing					
Total cereals	26.8	33.4	56.1	2.2	4.4
Coarse grains	24.6	30.5	50.0	2.2	6.1
Developing market					
Total cereals	2.5	4.6	9.5	6.3	6.2
Coarse grains	1.3	2.8	6.9	8.0	7.8
Developed					
Total cereals	7.0	15.9	22.7	7.4	3.0
Coarse grains	5.6	12.5	19.9	8.4	4.0

official statistics, poultry feed requirements could rise considerably faster than the projected grain feed use growth rate.

Japan is the largest user of feed grains in the region after China and its feed use growth rate (10 percent a year) was among the highest of all developed countries in the 1960s, when meat, milk, and egg production soared from a low base. The increase to 1985 is projected at a more modest rate of 3.3 percent a year. In Australia, with its large areas of pasture land and a predominantly ruminant animal population, the level of grain feeding is moderate. But in the late 1960s when the poultry and the beef feed–lot industries expanded rapidly, the feed use of cereals rose rapidly to account for over half of the total cereals consumed in the country. The fall in the ratio of livestock/grain prices from 1972 brought a swift reversion to grassland feeding of cattle and in consequence grain feed use fell by 24 percent between 1972–74 and 1975–77. However, there was a sharp recovery in grain feeding in 1978 and 1979, due especially to a strong demand for pork and poultry meat.

The Feed Use of Milling By–products

As noted above, by–products from the milling of cereals for human consumption are an important source of feed energy in the region accounting for almost 30 percent of the total energy obtained from concentrate feed. In 1975–77 the output of cereal brans amounted to 4.1 million tons, 90 percent of it produced in the developing countries (Appendix Table 7). Rice bran is the most important type accounting for over half of the total, with wheat bran accounting for 30 percent and that from coarse grains for 16 percent. Since bran production is determined by the level of cereal food milling, its output does not vary greatly from year to year. It is expected to increase in the 1980s by 2 to 3 percent a year, in line with the projected growth in the demand for cereals for food. As the production of other feedstuffs is expected to increase more rapidly, brans are foreseen to become gradually less important in the feedstuffs patterns of the region's developing countries in the 1980s.

Trends in the Supply and Demand for Oilcakes and Meals

While the long–term upward trend in the consumption of oilcakes and meals in the developing countries of the region was checked during the world food crisis of the early 1970s, the improved economic outlook in a number of countries in recent years has given a renewed impetus to demand. Between 1972–74 and 1978, the regional consumption expanded by 5.3 percent a year, reflecting a growth rate of 7.8 percent a year in the developed countries due to the continuing strong demand in Japan and of 4.4 percent a year in the developing countries (Table 5). The latter figure was depressed by the small growth in India and an actual decline in use in Pakistan, the two major consuming countries. In a number of other developing countries consumption rose much faster than the regional average, soaring to 16 percent a year in Malaysia, 23 percent a year in the Philippines, and 24 percent a year in the Republic of Korea (Appendix Table 8).

The region is an important producing area of many kinds of oilcakes and meals, including those of groundnuts, sunflowerseed, copra, and palm kernel, and several countries – India, Pakistan, the Philippines, and Thailand – are significant exporters. But output trends in recent years have been affected by the constraints to the production of some major oilseeds in some countries, notably of groundnuts of India and of cottonseed in Pakistan, the chief oilseed crops in these countries. The main difficulties have been competition for land from other crops, inadequate fertilization and low returns for producers. The lagging production has restricted the growth in export availabilities in these major exporting countries in recent years.

In some other countries, buoyant demand and the implementation of development programs have induced a rapid growth in the production of some oilseed crops, for example, palm kernel in Indonesia and Malaysia and coconuts in Indonesia and the Philippines. But in general, the output of oilcakes and meals has not been increasing as fast as consumption so that regional imports have been rising rapidly, particularly into those countries, such as the Republic of Korea and Malaysia which are not themselves big producers of oilcakes and meals. Most of these imports have come from outside the region, in part because many of the oilcakes and meals produced in the region – those from cottonseed, copra, and palm kernel for example – are low in protein and though suitable for consumption by ruminants are less appropriate for pork and poultry. Thus despite the growing regional market, oilcakes and meals produced in the region have continued to be exported to countries outside the region, while high protein feeds, especially soybean cake and meal, have been imported in growing quantities.

The Feed Use of Roots and Tubers and Pulses

Among the high energy feedstuffs in the region, roots and tubers are prominent. The best available estimates of utilization indicate that some 38 million tons, 26 percent of total production, were fed to animals in 1972–74 (Appendix Table 6). Feed use expanded by 4.2 percent a year between 1972–74 and 1978 and is expected to increase

TABLE 5 Trends in Production, Imports and Consumption of Oilcakes and Meals

	Production		Net Imports		Consumption	
	1972–74 to 1978	1972–74 to 1985 (proj.)	1972–74 to 1978	1972–74 to 1985 (proj.)	1972–74 to 1978	1972–74 to 1985 (proj.)
			. . . percent per annum . . .			
Asia and the Far East Region	1.9	3.0	23.0	7.4	5.3	3.6
Developing	2.0	3.3	– 5.4[a]	2.6[a]	4.4	3.3
Developed	0.9	–0.3[a]	6.8	6.0	7.8	5.9

[a] Net exports.

at least in line with production over the period to 1985. The two main products used as feed are sweet pototoes, which are grown and consumed mainly in China, and cassava, which is produced very largely in the developing market economies of the region, particularly Thailand, India, the Philippines, and Malaysia.

The production of cassava in the region increased by about 4 percent a year during 1972–74 and the rate of growth has increased up to 4.5 percent a year in recent years. Output has increased much more rapidly in some coun–tries, notably in Thailand, where production has responded to strong import demand from Western Europe, and in the Philippines and Vietnam, where the local markets absorb all production.

Since most cassava is grown mainly for local food use, or for export, feed use tends to be poorly documented. The best current estimates indicate that about 2.6 million tons of cassava in root equivalent (10 percent of total supplies) were fed to animals in the region in 1972–74. The main countries using cassava as feed are India, Indonesia, and Thailand, though feed use is also expand–ing in Malaysia and the Philippines. Future growth in feed use will depend on the extent to which dried cassava chips continue to be substituted for imported feed raw materials in compound manufacturing and for low quality forage at the farm level. Feed use is projected to grow by between 1.2 and 2.4 percent a year over the period to 1985.

About 27 million tons of pulses, including beans, peas, chickpeas, and lentils, are produced in the region, 90 percent of them in China and India (Appendix Table 5). Information on their use as feed is fragmentary, but it is estimated that at least 10 percent of the total output is fed to animals. The feed share is well above the regional average in China, but below it in other countries. Future feed use of pulses in the market economies is expected to keep pace with the projected production growth rate of 3.2 percent a year.

Non–Conventional Feedstuffs

Throughout the region there is an enormous quantity of farm and agricultural processing by–products that could be used for feed. These non–conventional feeds include husks from oilseeds crushed in the region, molasses, sugar cane tops, and fruit pulps and wastes (particularly of citrus, pineapple, and bananas). To these may be added tree leaves, cassava leaves, and the vines of sweet potatoes which can serve as a green fodder. Some of these by–products are currently exported though the economic returns might be greater if they were used domestically to increase livestock production.

There is need to consider new sources of roughage for ruminants. Reference has been made to the pre–treatment of straw to make it more palatable and nutritious. Proposals for pelleting straw and treating it with acids and alkalis should be explored further, as should the capacity of ruminants to utilize cellulose in the rumen fermentation process. Schemes for establishing pastures and growing forage crops under tree crops, especially under coconuts, young rubber, and oil palm, could be developed in several countries. More information is needed about the range and the usefulness of crop by–products.[1]

[1] A study of non–conventional feedstuffs is currently being undertaken by FAO.

Compound Feed Industry

The compound feed industry is well established in the major livestock producing countries of the region, notably the Republic of Korea, Malaysia, the Philippines, Thailand, and Japan. But in general, the activities of the industry are poorly documented and output data are available for relatively few countries. In a number of countries the industry tends to be controlled by a few big millers, but there are also many small local millers and in addition there is a good deal of on–farm mixing, with farmers buying raw material ingredients of their choice and mixing them to their own requirements.

The most rapid increase in compound feed manufacturing is taking place in the Republic of Korea. In the early 1960s bran from the food milling industry was the major source of livestock feed, but in the later years of the decade, joint financing arrangements between the United States and the Korean government helped to establish feed milling enterprises and, with the rising GNP of the early 1970s strengthening the demand for protein foods, the output of compound feed rose rapidly to 1.7 million tons in 1977 and 2.6 million tons in 1978. Output is expected to grow by 12 percent a year in the 1980s, rising to 6.6 million tons in 1985 and 11.1 million tons in 1991. To achieve this rate of expansion, the government, in addition to encouraging new investment in large milling concerns, has advised small and medium–sized millers to modernize their mills and to raise their output capacity to at least 200 tons a day.

A 1977 survey of feedmills in Malaysia showed that firms employing more than 20 workers produced 416,000 tons of compound feed that year. Over 60 percent of this represented poultry feed, the output of pork feed having declined sharply as many large pork enterprises turned towards self–mixing. There are, however, still many small milling firms, employing fewer than 20 workers, and those, together with on–farm mixing, probably account for over 50 percent of the mixed feed output. The commercial feed industry in Thailand is expanding rapidly, and is estimated to have produced 800,000 tons in 1977, out of a total feed production of about 3 million tons. Most of the on–farm mixed feed is prepared for pork consumption, but 55 percent of the commercial feed is destined for broilers and laying hens, and 35 percent for pork. In the Philippines there were 56 commercial feed millers in 1973, but 11 mills produced 60 percent of the total of 80,000 tons of compound feed. This represented 30 percent of the total feed requirements. India has a well–established compound feed mixing and manufacturing industry producing mixed feeds mainly for milk animals and poultry. Emphasis is being placed on increasing the use of local crops, crop residues, and straws, and on reducing the amount of cereals and oil–seeds in ruminant feeds.[1]

Japan, however, remains by far the biggest compound feed producer in the region. After expanding rapidly in the 1960s, output fell back during the recession of 1973–76, but recovered by 15 percent in 1977 and expanded by a further 6 percent to reach 20.6 million tons in 1978.

Technological development in compound feed manufacture within the region has in general been based on the utilization of large quantities of cereals in mixed feed. Rapid growth of compound feed production has thus been accompanied by a rise in imports of feed grains. The rapid growth in formula feed production in the Republic of Korea has been based on the absorption of 60 to 63 percent of feed grains into the ration. Malaysia imports about 80 percent of all ingredients, almost two–thirds of them feed grains, used in commercial feeds. It is estimated that almost 40 percent of the mixed feeds in Thailand consists of feed grains. In Japan the share of cereals in feed ingredients is still two–thirds.

The compound feed industry may have a positive role to play in the rational development of the feed/livestock sector in the countries of the region by making efficient use of scarce resources. But there is a need to examine the scope for adapting compound milling technology and to train appropriate management skills to utilize a larger proportion to the varied but underused domestic feed–stuffs, including both conventional and non–conventional processing by–products.

The Present Pattern of Trade and the Scope for Enlarging Intra–regional Trade in Feedstuffs

The region is an important trading area for concentrate feedstuffs, containing as it does a number of countries which are substantial importers of feedstuffs and a few which are significant exporters. Regional imports of coarse grains tripled during the 1960s and in recent years they have been rising at a rate of almost 7 percent a year to a total of 25 million tons in 1978 (Table 6). Most of these grains are used as animal feed. Two–thirds of the imports are taken by Japan, but the intake of the developing countries, particularly the Republic of Korea and Malaysia, has been rising faster than that of Japan in recent years and is expected to form an increasing share of the total in the future (Appendix Table 4). Imports of oilcakes and meals have been expanding even more rapidly – nearly 14 percent a year in recent years – and totalled nearly 3 million tons of protein equivalent

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[1] Report of the WFP/FAO Government of India Mission on India Project 618 (Operation Flood, Phase I), "Milk Marketing and Dairy Development."

TABLE 6 Trade in Coarse Grains and Oilcakes and Meals in the Asia and the Far East Region

	Coarse Grains		Oilcakes and Meals[a]	
	1972-74	1978	1972-74	1978
	. . . million metric tons . . .			
Net Imports[b]				
Region	17.8	24.7	1.5	2.9
Developing	5.1	7.2	0.3	0.9
Developed	12.8	17.5	1.2	2.0
Net Exports[c]				
Region	4.9	4.4	0.8	0.8
Developing	2.7	2.1	0.8	0.8
Developed	2.2	2.3	------	------

[a] Protein equivalent.

[b] Net imports of net importing countries.

[c] Net exports of net exporting countries.

in 1978. As in the case of coarse grains, Japan is by far the major market for protein feedstuffs, but the share taken by the developing countries has increased rapidly in a few years, from a fifth of the total in 1972–74 to a third in 1978 (Appendix Table 8).

The feedstuffs exports of the region amount to 4–5 million tons of coarse grains and a little under one million tons of oilcakes and meals (Table 6). Exports of coarse grains have shown little growth in recent years chiefly owing to fluctuations in the harvests of the two major grain exporting countries – Australia and Thailand. In 1977–78, for example, exports of coarse grains declined by over one–third following poor 1977 harvests of maize in Thailand and barley in Australia. Exports of oilcakes and meals have also been stagnant in recent years chiefly because of lagging production in major oilseed producing countries, India and Pakistan.

Intra–regional trade in feedstuffs amounts to 2 to 3 million tons of coarse grains and about 70,000 tons of oilcakes and meals a year. Thailand and Australia normally ship over 80 percent of their exports of coarse grains to markets within the region. In 1977 and 1978, 2.1 million tons of their total exports of 3.2 million tons went to countries in the region. However, because of limited export availabilities, the volume of exports of the two countries has not increased in recent years. Although shipments to Japan were sharply reduced in 1977 and 1978, it remains by far the main market, accounting for almost half of the combined shipments of the two exporters (Table 7). Since the early seventies, China too, has been a substantial and, until Thailand had to cease shipments in 1977 and 1978, a growing market for coarse grains. Shipments to other developing countries of the region particularly Malaysia, the Philippines and until 1977–78 the Republic of Korea, have been increasing rapidly. As yet, however, they account for only 12 percent of the total shipments of the two exporters.

The four main exporters of oilcakes and meals in the region – India, Pakistan, the Philippines and Thailand – ship about 20 percent of their combined exports to countries in the region. But only in the case of Thailand do intra–regional shipments play a major role in the export trade. Japan, which was the predominant market in the early seventies, has become less important in recent years, while developing country markets have become more significant, particularly for India and Thailand.

Intra–regional trade is less significant for importers than for exporters. The deficit countries of the region normally obtain over 80 percent of their imports of coarse grains and more than 90 percent of those of oilcakes and meals from outside the region. The major source both of coarse grains, oilcakes and meals is the United States, though irregular supplementary supplies are obtained from Canada, Argentina and Brazil.

The small share of intra–regional trade in total imports (2.3 million out of 22.8 million tons in the case of coarse grains in 1977/78 and 0.1 million out of 2.5 million tons for oilcakes and meals in 1977) suggests that there is a large potential for increasing intra–regional trade. But a number of constraints have hampered the expansion of this trade in the past. The most serious problem is that of ensuring a larger and regular volume of supplies in exporting countries. In the case of coarse grains, climatic conditions in both Thailand and Australia tend to cause sharp fluctuations in yields and output from one year to another. In years of bad harvests these countries are not able to ensure the regularity of shipments required by importers in the region, such as Japan and the Republic of Korea, which as a result, have tended to turn increasingly to North America for imports of maize and sorghum.

Intra– regional trade in oilcakes and meals has also been held back by limited supplies in the major exporting countries, India and Pakistan, as a result of the lagging production of groundnuts in India and cottonseed in Pakistan. There are further reasons for the low intra–trade level. As noted earlier, the low protein content of many oilcakes and meals produced in the region, makes them unsuitable for use in the swine and poultry sectors, where demand is strongest. They, therefore, tend to be exported outside the region while other higher protein cakes and meals are imported. There is also a tendency for exports to follow traditional trading routes because of long standing business arrangements, for balance of

TABLE 7 Asia and the Far East Region: Intra–Regional Trade in Coarse Grains and Oilcakes and Meals

IMPORTING REGIONS & COUNTRIES	EXPORTING COUNTRIES							
	AUSTRALIA		THAILAND		TOTAL RAFE COUNTRIES[a]		WORLD	
Coarse Grains	1971/72 to 1973/74 av.	1977/78	1971/72 to 1973/74 av.	1977/78	1971/72 to 1973/74 av.	1977/78	1971/72 to 1973/74 av.	1977/78
	..... 000 metric tons							
Asia and the Far East Region	1,600	1,440	1,540	680	3,140	2,120	17,260	22,797
Developing	250	255	765	357	1,015	612	5,110	5,890
Korea Rep.	100	17	19	-----	119	17	890	2,035
Malaysia	3	6	106	148	109	154	195	293
Philippines	1	2	27	71	28	73	125	137
China	130	226	444	-------	574	226	995	2,918
Developed	1,350	1,185	775	323	2,125	1,508	12,150	16,907
Japan	1,313	1,185	771	323	2,084	1,508	12,133	16,904
World	2,024	1,957	1,810	1,287	3,834	3,244	64,700	81,500

Oil Cakes and Meals (Protein equivalent)	INDIA[b]		PAKISTAN[c]		PHILIPPINES[d]		THAILAND[e]		TOTAL RAFE		WORLD	
	1972-74 av.	1977	1972-74 av.	1977	1972-74 av.	1977	1972-74 av.	1977	1972-74 av.	1977	1972-74 av.	1977
	..... 000 metric tons											
Asia and the Far East Region	68	65	3	n.a.	4	-----	11	5	86	70	1517	2522
Developing	3	47	1	n.a.	-----	-----	11	15	15	62	332	730
Korea Rep.	-----	-----	-----	n.a.	-----	-----	-----	-----	-----	-----	29	59
Malaysia	1	3	-----	n.a.	-----	-----	3	2	4	5	18	38
Philippines	1	2	-----	n.a.	-----	-----	-----	-----	1	2	-----	-----
China	-----	18	-----	n.a.	-----	-----	4	4	4	22	200	367
Developed	64	18	3	n.a.	4	-----	1	6	72	24	1190	1808
Japan	64	18	3	n.a.	4	-----	1	6	72	24	1160	1792
World	357	390	26	2	46	88	16	20	445	500	11160	15477

[a] Australia and Thailand, Korea DPR also exports about 0.2 million tons of maize a year.

[b] Groundnut meal.

[c] Cottonseed cake.

[d] Copra.

[e] Oilcakes and meals, excluding fishmeal.

n.a. = not available

payment reasons, and in order to maintain exports to finance imports of manufactured and capital goods from developed countries. The greater part of India's exports of groundnut cake and meal and virtually all of Pakistan's shipments of cottonseed and the Philippines' of copra are directed to western and eastern European ports.

In addition, the pattern of technological development has not encouraged the growth of intra–trade in some instances. The transfer of technology, particularly in the compound feed manufacturing sector, often creates a dependence on feed raw materials from developed country sources. The large compound feed industry in Japan and the rapidly growing one in the Republic of Korea are based largely on the utilization of large quantities of maize and sorghum as well as soybean products from North America.

If intra–regional trade in feedstuffs is to expand, governments will probably have to adopt specific policies in this direction. While more emphasis is being placed in current development plans than in earlier ones on the need to encourage the production of coarse grains and fodder crops, it will also be necessary to provide concrete support in the form of infrastructure, technical knowledge, management training and financial incentives to current and potential producers to step up the production of feedstuffs, including more high protein oilseed crops in countries with export potential. The extension of bilateral trading arrangements between individual exporting and importing countries could also make a contribution to intra–regional trade by providing a basis for long–term production planning. Where high protein feed raw materials have to be imported, consideration must be given as to whether they are available or can be grown within the region.

CONCLUSIONS AND POLICY ISSUES

Overview – Current Situation and Outlook

The consumption of animal products in Asia and the Far East region is low by world standards. Most of the supplies are consumed in the three developed countries of the region and in China. In the developing market economies, animal products in 1972–74 provided only six percent of the per capita calorie and 15 percent of the protein intake. However, from a low base, the total demand for livestock products has been rising fast in recent years, reflecting population growth, rising incomes, and consumers' growing desire for more varied diets. Between 1972–74 and 1978 consumption of meat, eggs, and milk products in the developing countries of the region rose by 3.8, 3.7, and 2.2 percent a year, respectively. Recent FAO projections indicate that between 1972–74 and 1985 demand could grow by 3.0 percent a year for meat, 3.3 percent for eggs, and 2.8 percent for milk products.

Production of eggs is, in general, keeping pace with demand, but in spite of having a large population of buffalo and cattle, many of the developing countries are greatly deficient in meat and milk products. The projected future rates of growth in the output of these products are lower than those of demand and so indicate that the deficits could increase in coming years if present trends and policies continue. Even the current low average levels of consumption have been sustained only through a sharp increase in the imports of meat and dairy products at a heavy cost in foreign exchange.

Moreover, even the moderate increase in the output of livestock products has resulted in a marked rise in the demand for concentrate feedstuffs. This trend is expected to continue in the 1980's. The demand for cereals for feed use in the developing countries of the region is projected to grow by 4.4 percent a year over the period 1972–74 to 1985, and that of oilcakes and meals by 3.3 percent a year. But the production of coarse grains in those countries is expected to expand by only 2.4 percent a year, and while the output of oilcakes and meals is projected (on the basis of 1975 unchanged prices) to match the growth in demand, the latter has in fact greatly outpaced production in recent years and has already exceeded the 1985 projected level. The gap between demand and production is therefore likely to increase in the 1980's.

The implications are that imports of feedstuffs will also rise. Net imports of coarse grains into the developing countries increased by 7.4 percent a year between 1972–74 and 1978, even though India eliminated its need for imports during the period. On present trends, demand can be expected to continue to grow by at least seven percent a year into the 1980's. In addition to the likely growth in the requirements of the developing countries, the import demand of Japan, which is already the world's biggest single importer of coarse grains, is expected to contine to expand by four percent a year. Imports of oilcakes and meals have been expanding even faster than those of coarse grains. The intake of the developing countries almost trebled between 1972–74 and 1978 and has already far exceeded the level projected for 1985 on the basis of past trends. Imports into the developed countries have also been expanding at a rate well above that projected over the period to 1985.

Unless there are determined efforts to achieve a higher rate of growth in the domestic production of feedstuffs, the prospects are that the livestock industries in a number of countries will become increasingly dependent on imported feedstuffs. The resulting balance of payments burdens could well be an additional constraint to the rapid expansion of livestock production in those countries.

Problems and Development Issues

While the primary responsibility of the governments of the region's developing countries has been to ensure an adequate supply of staple foods, they have increasingly accepted the need for increasing the supply of protein foods, particularly livestock products, as a means of improving general nutritional standards. The intensity of demand for livestock products varies with the level of economic development and the distribution of incomes within countries. Most livestock products in the region are consumed in the developed and the higher income developing countries, and by a small segment of the population in the poorer countries. But as more countries advance in their economic development, rising incomes will enable an increase in consumption of these products throughout the region. Confronted with rising demand for livestock products, governments have several policy options:

1) to import more meat and dairy products;

2) to increase domestic production of livestock products with the aid of imported feedstuffs;

3) to increase domestic livestock production based on the expansion of domestic grain feeds and the more efficient use of national feed resources and agricultural and industrial by -products.

In the short–term, governments may to some extent follow all three policies simultaneously. But neither the first nor the second option can be pursued indefinitely because of the cost in foreign exchange which would be excessive for most countries. The main exception would be those like Japan, with a strong exporting base to pay for mounting imports. In the longer–term, for balance of payments reasons as well as for purposes of ensuring food security and obtaining the development benefits which follow from increasing livestock production by small and medium–sized farms, the third course is clearly the most attractive and is likely to be followed by more and more governments as national resources permit. Countries which have the capacity to produce surpluses of certain feedstuffs face the additional policy decision of determining the comparative advantage of exporting feedstuffs relative to increasing domestic animal production more rapidly, with the prospects of eventually becoming net exporters of livestock products.

Raising domestic production to meet the rising demand for protein will entail much greater emphasis being given to the development of the livestock sector than in the past. It may involve important changes in the organization of livestock production and in the provision and use of feedstuffs. A first requisite is that there should be closer coordination of livestock and cropping programs. Because plans for expanding livestock production may in some circumstances come into conflict with food production policies (as shown, for example, by the feed use of grains that could be consumed by humans or the planting of fodder crops on land that could be used for food crops), it will be essential to achieve the integration of livestock and crop production on a national and local basis to ensure the best pattern of land use, a balanced rotation of crops and the efficient utilization of crop by–products.

In view of the pressure on land resources in the developing countries of the region, the expansion of livestock production will depend greatly on improving grasslands and raising animal productivity, particularly of ruminants. Because of the large numbers of low–producing bovine animals which are used primarily for draft purposes, especially in Southeast Asia, it will be necessary to develop management policies for large ruminants and to give increased attention to the development of animals which can fill a multi–purpose role. Draft power will still be required but improved meat and milk production must be obtained from smaller numbers of genetically improved animals, fed adequate rations from improved grassland and specially grown fodder. Improved animal breeding and management could thus be of key importance.

While the rationalization of meat production from ruminants will be slow, modern methods of swine and poultry production can be transferred quickly from developed to developing countries. Though most governments state that their policies and programs are oriented towards small farmers, the new technology has too often been established in large scale commercial enterprises near urban centers making inefficient use of local resources and contributing little to rural development in their areas. It is important that governments implement policies to encourage small holder production of milk, eggs, pork and poultry meat, based as far as possible on locally grown feeds, and ensure that livestock industries are an integral part of overall rural development. This will require appropriate price policies to encourage the production of coarse grains (where feasible) and fodder crops which ensure reasonable returns for livestock products. Price policies will also need to be complemented by other incentives for feedstuffs production including the provision of technical assistance, improved storage, transport and extension services and improved credit facilities.

In addition to improving grassland and where appropriate encouraging the production of coarse grains, oilcakes and meals, the feedstuffs resources of most countries can be augmented by paying closer attention to the recovery and utilization of all milling by–products that have been wasted or greatly under–used in the past. These could make an important contribution, especially to swine and poultry feeding and production. Future work on feedstuffs in the region should contain a plan to bring together and make available to farmers all the information possible about the potential resources of nonconventional feedstuffs and their relative value and usefulness.

The establishment of compound feed manufacturing industries in the region, which puts the proper emphasis on balanced rations, has already played a considerable role in the improved feeding of swine and poultry in most countries of the region. These industries have, however, tended to follow a pattern of using a high proportion of concentrates, particularly feedgrains, in their feed mixtures. The requirements of these industries have thus contributed heavily to the increase in the imports of feed concentrates and raw materials in recent years. It is therefore necessary to examine the possibility of developing a compound feed technology that could absorb more locally available crops and processing by–products and waste.

A feature of feedstuffs development in the region is the declining share of intra–regional trade in feedstuffs and feed raw materials in total utilization. Due to fluctuating export supplies in the grain exporting countries of the region, and the availability of large supplies of coarse grains in the United States which are often offered on concessional terms, the proportion of intra–regional trade in coarse grains declined from 18 percent of total imports in the early 1970's to nine percent in 1978. Intra–regional trade in oilcakes and meals has been even more restricted because of slow production growth and rising domestic demand in the region's surplus producing countries and because most shipments have continued to flow to traditional markets in western and eastern Europe. As a result, importing countries have relied to an increasing extent on imported feed raw materials particularly soybeans and soybean meal, chiefly from North America. In the interests of regional food security, to minimize transport costs and to stimulate economic development deriving from increased trade within the region, governments may wish to consider ways of encouraging bilateral and multilateral arrangements for increasing trade in feedstuffs within the region. An indepth study of the potentialities of intra– regional trade and of practical policies for increasing it should receive attention in future work programs on feedstuffs within the region.

Policy decisions in the developing countries of the region are often inhibited by insufficient information about present and potential feed resources, both conventional and non–conventional. In particular, information is inadequate about the feed contribution of grasslands, wayside grazing, other roughages, fodder crops and many agro–industrial by–products and household waste. Because of the need for reliable statistical and agricultural data as a foundation for policy making and planning, more information needs to be collected on the range of available feedstuffs in each country and on their uses and feed values in varying circumstances and under different farming systems.

Research and experimentation is needed to provide up to date knowledge of input/output relationships for different animals and livestock systems and for evolving a feasible technology for small farmers in the region.

Governments should also recognize the need for clearer information on their policies and programs for feedstuffs development and on their plans to involve small farmers in the development of livestock production both to raise the income of these often neglected groups and to increase the total food supply in their countries.

APPENDIX I

ASIA AND THE FAR EAST REGION

The countries included in the Asia and Far East region are as follows:

DEVELOPING

Bangladesh
Bhutan
Brunei
Burma
China
Fiji
Hong Kong
India
Indonesia
Kampuchea D.R.
Korea D. P. R.
Korea Rep.
Lao
Malaysia
Maldives
Mongolia
Nepal
Pacific Islands
Pakistan
Papua N. Guinea
Philippines
Solomon Islands
Sri Lanka
Thailand
Vietnam

DEVELOPED

Australia
Japan
New Zealand

APPENDIX TABLE 1 Livestock and Poultry Numbers

	1972–74 (average)				1978			
	Buffalo	Cattle	Swine	Chickens	Buffalo	Cattle	Swine	Chickens
				..... million				
Asia and the Far East Region	122.3	360.0	316.7	2,131.6	127.5	369.7	345.3	2,419.6
Developing	122.3	318.2	305.6	1,843.2	127.5	327.2	333.8	2,070.3
China	29.9	62.6	235.4	1,231.4	30.6	65.6	288.3	1,372.7
India	58.5	178.4	7.3	139.2	61.0	181.7	8.8	144.2
Korea, Rep. of	----	1.3	1.3	24.5	----	1.5	1.5	30.2
Malaysia	0.3	0.3	0.9	40.4	0.3	0.4	1.1	47.5
Pakistan	9.8	14.2	0.1	25.1	11.1	14.9	0.1	42.1
Philippines	4.9	2.0	8.5	49.4	5.3	1.8	9.7	58.9
Thailand	5.6	4.4	4.1	58.7	5.5	4.7	3.1	56.3
Developed	----	41.8	11.1	288.4	----	42.5	11.5	349.3
Australia	----	29.1	3.0	39.7	----	29.4	2.2	42.8
Japan	---	3.6	7.6	242.2	----	4.0	8.8	300.0

APPENDIX TABLE 2 Output of Meat,[a] Milk[b], and Eggs

	Meat			Milk			Eggs		
	1972-74 average	1978	Proj. 1985 (Basic)	1972-74 average	1978	Proj. 1985 (Basic)	1972-74 average	1978	Proj. 1985 (Basic)
				..... 000 metric tons					
Asia and the Far East Region	26,908	32,488	38,373	58,830	62,625	74,797	6,688	7,751	9,271
Developing	21,501	25,738	30,564	41,094	45,127	55,397	4,615	5,530	6,810
China	14,930	17,280	21,000	5,164	5,191	6,950	3,461	4,063	----
India	709	748	915	23,531	24,987	31,990	81	85	94
Korea, Rep. of	215	246	403	102	291	550	157	224	251
Malaysia	128	147	222	28	31	30	89	112	142
Pakistan	427	629	638	9,263	9,970	12,800	40	72	145
Philippines	602	681	1,084	30	33	40	160	190	250
Thailand	455	455	625	10	11	24	158	195	221
Developed	5,407	6,750	7,809	17,736	17,498	18,800	2,073	2,221	2,461
Australia	2,408	3,148	3,088	6,937	5,329	5,300	205	205	206
Japan	1,975	2,479	3,445	4,905	6,100	6,900	1,806	1,960	2,198

[a] Four main types of meat (beef and veal, sheep and goat meat, pork, poultry meat.

[b] Total milk.

APPENDIX TABLE 3 Trade in Meat and Milk Products

		Meat[a]			Milk Products[b]		
		1972-74 average	1978	Proj. 1985 (Basic)	1972-74 average	1978	Proj. 1985 (Basic)
		000 metric tons					
Asia and the Far East Region	imp.	594	1,024	1,050	3,127	4,900	5,640
	exp.	1,948	2,397	2,571	5,709	4,510	5,639
<u>Developing</u>	imp.	284	566	548	2,386	3,495	4,302
	exp.	321	408	365	24	79	55
India		+ 6	+ 4	– 16	297	439	618
Korea, Rep. of		+ 1	+ 74	+ 17	22	8	22
Malaysia		+ 20	+ 24	+ 14	403	525	583
Pakistan		– 1	----	+ 2	77	282	466
Philippines		+ 2	+ 14	+ 18	491	739	800
Thailand		– 10	– 16	– 11	234	267	290
<u>Developed</u>	imp.	310	458	502	741	1,405	1,338
	exp.	1,627	1,989	2,206	5,685	4,431	5,584
Australia		–960	–1,384	–1,315	–1,752	1,154	– 904
Japan		+ 310	+ 452	+ 502	+ 741	1,405	+1,338

[a] Four main types of meat (beef and veal, sheep and goatmeat, pork, poultry meat).

[b] In milk equivalent

+ Net imports

–Net imports

APPENDIX TABLE 4 Production and Net Imports of Coarse Grains and Total Cereals

	Production[a]				Net imports[b]			
	1972-74 average	1975-77 average	1978	Proj. 1985 (Basic)	1972-74 average	1975-77 average	1978	Proj. 1985 (Basic)
				..... 000 metric tons				
ASIA and the FAR EAST REGION								
Coarse grains	116,564	129,848	136,150	154,938	17,832	19,352	24,682	32,237
Total cereals	391,149	436,986	475,556	530,675	43,944	46,914	54,003	64,943
CHINA								
Coarse grains	75,430	70,130	86,000	95,480	1,160	2,400	4,300	4,200
Total cereals	232,666	240,900	268,400	302,910	6,260	7,100	12,560	9,320
DEVELOPING								
Coarse grains	111,356	123,951	128,350	147,782	5,053	4,595	7,219	12,115
Total cereals	364,616	407,989	436,436	498,013	25,860	26,364	31,046	38,427
INDIA								
Coarse grains	25,847	29,972	30,309	33,210	627	198	----	2,226
Total cereals	92,298	100,835	114,313	124,496	2,955	5,153	− 765	4,914
KOREA, Rep. of								
Coarse grains	1,584	1,552	1,519	2,103	921	1,232	1,981	2,269
Total cereals	5,750	6,403	7,560	7,474	3,108	3,373	3,671	4,839
MALAYSIA								
Coarse grains	16	28	35	54	258	355	456	886
Total cereals	1,293	1,286	1,067	1,808	942	970	1,428	1,786
PAKISTAN								
Coarse grains	1,479	1,514	1,529	1,800	− 3	1	− 12	374
Total cereals	11,150	12,574	12,846	16,893	1,107	934	1,355	1,844
PHILIPPINES								
Coarse grains	2,229	2,834	2,874	3,976	136	143	126	663
Total cereals	5,467	6,752	2,874	3,976	1,056	857	892	1,594
THAILAND								
Coarse grains	2,232	2,577	3,150	3,453	− 1,996	− 2,168	− 1,917	− 2,330
Total cereals	11,291	12,232	12,366	16,589	88	96	124	145
DEVELOPED								
Coarse grains	5,208	5,897	7,800	7,156	12,779	14,757	17,463	20,122
Total cereals	26,533	28,997	39,120	32,662	18,084	20,550	22,957	26,516
AUSTRALIA								
Coarse grains	4,415	5,051	6,854	6,270	− 2,149	− 3,152	− 2,055	− 3,330
Total cereals	14,586	16,923	25,546	20,288	− 8,740	− 10,102	− 1,340	− 1,400
JAPAN								
Coarse grains	354	275	382	283	12,777	14,741	17,463	20,122
Total cereals	11,181	11,791	12,653	11,399	18,044	20,445	22,951	26,463

[a]Including rice in terms of milled.

[b]Aggregates of net imports of wheat, rice and coarse grains of net importing countries, including wheat flour in wheat equivalent.

APPENDIX TABLE 5 Production of Roots, Tubers and Pulses

	Roots and tubers								
	Cassava			Total roots and tubers			Pulses		
	1972-74 average	1975-77 average	1978	1972-74 average	1975-77 average	1978	1972-74 average	1975-77 average	1978
				..... 000 metric tons					
Asia and the Far East Region	26,366	30,381	37,857	153,275	161,231	164,186	23,523	25,685	27,028
Developing	26,366	30,381	37,857	146,639	154,801	157,848	23,168	25,372	26,735
India	6,273	6,481	6,493	12,951	15,098	16,341	10,380	11,622	11,806
Korea, Rep. of	----	----	----	2,132	2,499	1,982	37	52	58
Malaysia	325	349	364	456	495	500	----	----	----
Pakistan	----	------	----	385	466	455	767	778	826
Philippines	511	679	1,707	1,435	1,944	2,790	28	47	51
Thailand	5,869	8,367	13,000	8,445	11,620	13,383	224	175	211
Developed	----	----	----	6,636	6,430	6,338	355	313	293
Australia	----	------	----	734	725	737	59	101	63
Japan	----	----	----	5,670	5,453	5,351	239	157	165

APPENDIX TABLE 6 Feed Use of Cereals, Roots, Tubers, and Pulses

	All cereals			Roots and tubers		Pulses	
	1972-74 average	1975-77 average	Proj. 1985 (Basic)	1972-74 average	1975-77 average	1972-74 average	1975-77 average
				. . . . 000 metric tons			
Asia and the Far East region	49,348	50,981	78,800	35,721	40,409	2,946	3,184
Developing	33,439	35,111	56,100	34,894	39,913	2,870	3,111
India	1,192	1,335	1,880	----	----	925	1,019
Korea, Rep. of	612	1,058	1,807	152	516	----	----
Malaysia	387	414	919	100	99	----	----
Pakistan	79	80	305	----	----	140	150
Philippines	410	499	1,539	75	85	----	----
Thailand	749	824	1,859	----	----	---	----
Developed	15,909	15,870	22,700	827	496	76	73
Australia	2,799	2,126	2,800	32	1	38	47
Japan	12,701	13,242	18,782	781	487	34	22

APPENDIX TABLE 7 Production of Milling By–products – Bran

	1972-74 average				1975-77 average			
	Wheat bran	Rice bran	Coarse grains bran	All cereal bran	Wheat bran	Rice bran	Coarse grains bran	All cereals bran
				..... 000 metric tons				
Asia and the Far East region	12,450	21,540	6,534	40,524	13,612	23,651	7,098	44,361
Developing	10,989	20,428	6,054	37,471	12,049	22,419	6,491	40,959
India	2,177	4,668	1,157	8,002	2,168	5,116	1,254	8,538
Korea, Rep. of	313	426	12	751	307	538	11	856
Malaysia	97	151	1	249	98	150	2	250
Pakistan	609	263	94	966	715	308	97	1,120
Philippines	128	371	474	973	148	452	597	1,197
Thailand	21	1,133	9	1,163	21	1,252	11	1,284
Developed	1,461	1,112	480	3,053	1,563	1,232	607	3,402
Australia	421	29	16	466	436	39	17	492
Japan	991	1,083	464	2,538	1,076	1,193	590	2,859

APPENDIX TABLE 8 Production and Trade in Oilcakes and Meals (Protein Equivalent)

	Production					Trade[a]			
	1972-74 average	1975-77 average	1978	Proj. 1985 (Basic)		1972-74 average	1975-77 average	1978	Proj. 1985 (Basic)
					...000 metric tons				
Asia and the Far East Region	5,788	6,187	6,355	8,210	Imports	1,517	2,326	2,875	2,908
					Exports	768	1,040	788	1,138
Developing	5,203	5,600	5,743	7,643	Imports	332	697	937	541
					Exports	768	1,032	788	1,138
India	1,665	1,806	1,826	2,504		−487	−568	−590	−867
Korea, Rep. of	12	18	19	24		+ 29	+ 39	+113	+ 89
Malaysia	38	46	58	90		+ 18	+ 36	+ 80	+ 42
Pakistan	275	218	216	368		− 39	− 26	− 38	+ 24
Philippines	123	173	191	242		− 79	− 83	−113	−114
Thailand	95	120	132	152		− 35	− 34	− 33	− 49
Developed	585	587	612	567	Imports	1,185	1,648	1,961	2,367
					Exports	----	----	----	----
Australia	59	54	83	102		+ 29	+ 17	+ 21	+ 8
Japan	523	530	526	435		+1,155	+1,629	+1,938	+2,356

[a] (−) net exports; (+) net imports.

FAO PROGRAMS ON THE DEVELOPMENT OF FEED RESOURCES

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INTRODUCTION

Increasing grain prices and rising pressures on land from an ever–increasing world population have resulted in a re–assessment of feed resources for the livestock sector. Not only are new feeds required which do not compete with man's own food needs, but the feeds required must be consistent with traditionally available productivity. The information about present and potential feed resources, both the conventional and especially the non–conventional ones, is inadequate to make the most efficient use of them. Nor does the available information give a firm basis for feed policy decisions.

The program on feed resources of the Animal Production and Health Division is devoted to finding more information on locally available feeds by region and by country and to finding feed systems which make the best possible use of available feed resources. The following programs and activities have a special reference to the region of Asia and the Pacific.

FAO TECHNICAL CONSULTATION ON NEW FEED RESOURCES

An inventory of feed resources in terms of quantity and quality is the first step towards more efficient and controlled use of feed resources in a particular country or region. An important event in this respect was the FAO Technical Consultation on New Feed Resources held in November 1976, in Rome. The existing scientific knowledge on potential nutrient resources was reviewed and ways and means of processing and incorporating them into animal diets were thoroughly discussed. Since then, several activities have been initiated as a follow–up to the recommendations made at that meeting.

INVENTORY STUDIES ON FEED RESOURCES

There are two studies which have a special reference to the region of Asia and the Far East.

An inventory of non–conventional feed resources A case study setting up a methodology, to be carried out in Sri Lanka. The basic objectives are 1) to make an inventory by agricultural regions of the real quantities and qualities of available by–products along with their prices, the trends of their availability and the way they are at present utilized, 2) to identify the constraints which limit their use, and 3) to propose basic elements for further practical project formulation. A similar study is already under way in Senegal in West Africa.

Study on the non–conventional feed resources in APHCA countries The outline of this study will be presented by Dr. Devendra, who is carrying out the study.

USE OF LOW QUALITY ROUGHAGES

Following the FAO Technical Consultation on new feed resources, a detailed study was carried out by Dr. Jackson, India, on the technical and economical feasibility of different methods used in the treatment and utilization of straw. Based on the recommendation made in his report, a project has been developed for Asia and the Far East entitled "Regional Program for the Use of Treated Straw in Animal Feeding." The potential participants are: Bangladesh, India, Malaysia, Pakistan and Sri Lanka. Eight institutes in these countries will be involved in comparing the most feasible methods of straw treatment and conducting feeding experiments on the effectiveness of the use of treated straw in feeding systems. The second phase will be the demonstration of the most suitable methods and feeding practices for the small farmers. The project is waiting for final approval. In addition, a regional training course , financed by UNDP, in

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

India will be conducted on the subject "Straw Treatment and Use of Treated Straw in Animal Feeding." The countries in Asia and in the Far East are expected to send participants to the training course.

UTILIZATION OF AGRO–INDUSTRIAL BY–PRODUCTS

Pilot projects have been developed in some West–African countries to study the more effective use of agricultural by–products in animal feeding. The program should be widened to cover other regions and countries. A need exists to develop similar field operations in APHCA countries based on the greater utilization of local agro–industrial by–products in combination with other non–conventional as well as conventional feeds.

RECYCLING OF ANIMAL WASTE

Recycling of animal wastes is of special interest to the densely populated areas of Asia and the Far East. As a result, a UNDP/FAO animal waste utilization project in the Republic of Singapore concerned with the treatment of pig wastes has been developed.

Additionally, a comprehensive report has been worked out by a consultant, Dr. Muller, on the techniques and methods currently available for the chemical, physical, and biological treatment of animal wastes to improve their nutritive value. The technical and economical feasibility of various processes has been tested, and recommendations have been made on the practical applications of available techniques as well as recommendations on further research that may be required. The report is to be printed during the first half of 1980.

INTERCOUNTRY COOPERATIVE RESEARCH PROGRAM ON THE WATER BUFFALO

The long term objective of the Water Buffalo Research Program is to use this animal more effectively at a small farm level than has been possible in the past. The available feed resources and the efficiency of feed utilization in buffalo with particular reference to crop residues and agro–industrial by–products will be investigated. A project formulation mission will be visiting the countries which may participate: Egypt, India, the Philippines, Sri Lanka, and Thailand, using the information gathered to prepare a detailed work plan.

The feed resources program as briefly described above, has been focused on the new or so far under–utilized feed resources. However, we cannot restrict our work to non–conventional feeds. All possible feed resources should be considered. More work is needed to improve pasture production and the use of fodder crops. Better coordination of livestock and cropping programs would be an important means of making better use of available feed resources in the APHCA region.

Country Papers

Studies on Feed and Feeding of Livestock and Poultry with emphasis on

1) Feed Industry
2) Livestock Industry
3) Government Regulations and Assistance

LIVESTOCK AND POULTRY PRODUCTION IN HONG KONG

Country Paper

INTRODUCTION

Hong Kong, on the southeast coast of China, covers 405 square miles. Cool dry weather prevails from September to April, otherwise the Territory is hot and humid. The mean annual rainfall of 2,169 mm (85 inches) is mostly recorded during summer months. Typhoons can be experienced from May to September.

The topography is rugged and the soils are generally thin, acidic and low in nutrients. Only some 42 square miles can be classified as arable land, out of which some 17,150 acres are farmed. Rice cultivation has now been gradually replaced by intensive vegetable production with an almost continuous cropping of 10,100 acres. No forage crop for animal feedstuff is grown in Hong Kong, except small plots of sweet potatoes, the vines of which are commonly fed to swine.

There is insufficient land for extensive grazing in Hong Kong and swine and poultry are the principal animals raised for food. The swine and poultry industry grew rapidly in Hong Kong from a population of 371,400 swine and 3,836,000 chickens in 1969 to 586,900 swine and 6,349,000 chickens in 1979. Local swine production was valued at HK$357 million in 1979 (US$73,000,000), and accounted for 25 percent of the total consumption of pork by a population of about 5 million. Production of the poultry industry, including pigeons and quail, is worth some HK$361 million a year (US$74,000,000), and contributes about 65 percent of the total local consumption.

POULTRY PRODUCTION AND MARKETING

The local poultry industry is engaged mainly in the production of live broilers of the South China breeds. The meat of these breeds has a distinct flavor and taste, is tender, and is preferred by the Chinese in Hong Kong. Crossbreds with exotic breeds and local chickens are also commonly seen on local poultry farms. The average bird takes approximately 110–115 days to reach maturity (2.1 kg in weight). The size of poultry farms has increased over the last 10 years from less than 1,000 to an average of 5,000 birds per farm, but poultry farms of over 50,000 birds per farm produce the bulk of total production. Small farms are operated on a family basis and are maintained at a low investment level. Large-scale operations are characterized by a high degree of mechanization, a high level of management and production efficiency, and a lower per unit production cost.

The poultry farmers sell their chickens in two different channels as described below:

Middlemen

A poultry middleman comes to a farm to select and pick up the live birds at a pre-arranged price. The middleman re-sells the poultry to retailers and/or restaurants. The average gross profit margin received by a middleman varies from 15 percent to 25 percent. The retailers then sell the live chickens to the end-users with a gross profit margin from 20 percent to 25 percent. End-users in Hong Kong live where they prefer to have the birds killed and dressed by retailers at the time of purchase. The consumers believe that freshly killed birds have a better flavor.

Wholesalers

The larger farms usually prefer to deliver the live birds to a wholesaler. The wholesaler is paid a commission (4–5 percent) when the birds are sold to the consumer. The selling price is usually determined by the law of supply and demand on that particular day. These wholesalers will sell the birds directly to the retailers or restaurants. Generally, this system increases the financial returns to the producers. However, in both cases, the farmers will receive cash as soon as their products are sold.

SWINE PRODUCTION AND MARKETING

The local swine industry has become sophisticated and intensive in recent years due partly to the influence of the agriculturally advanced countries and partly to the competitive nature of the business. Approximately 90 percent of the existing national swine herds represent crossbreeding

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of local sows with exotic breeds; the remaining 10 percent are pure lines of introduced stock. Large White, Landrace, Duroc and Hampshire breeds are most popular at present. The locally produced pigs have achieved better carcass quality and are bringing higher prices for their producers than pork coming from China. The average size herd is about 100 head, and there is a steady and definite trend towards larger farms.

All pigs are sold at local markets for the supply of fresh meat. These pigs can be sold in various live–weights from suckling pigs (used as roasters) to mature animals, averaging 100 kilos. The pigs are sold for cash by two different systems, by middlemen or wholesalers similar to the marketing of poultry products. All pigs must be slaughtered in Government abattoirs and examined by Health Inspectors.

CONSUMPTION OF FEEDSTUFFS

Almost all feedstuffs are imported from countries such as China, Thailand, Indonesia, United States of America, Canada, New Zealand, Australia, and Argentina. In 1979, the quantity of feedstuff imported amounted to 700,000 metric tons. The breakdown of items is shown in Table 1. A greater portion of feed ingredients are grains especially maize. The major sources of protein are fish meal, meat and bone meal, and a wide variety of agricultural by–products. Most farmers mix their own feeds using either their own formulas or by formulas supplied by the Agriculture and Fisheries Department or by mixing grains with a protein, vitamin, and mineral supplement. This feeding system accounts for about 80 percent of the feed consumed, and the balance (20 percent) is made up of complete formulated feeds imported or manufactured locally. The food conversion efficiency is shown below:

Poultry	3.0 – 3.50
Swine	3.25 – 3.75

Production efficiency is variable depending on: feed quality, feed formulation, balancing the nutrient content of the ration with animal size and management program, and the health status of the herd. Since feed constitutes about 60 percent of the total cost of production, a small improvement in feed utilization will result in a large reduction in per unit cost.

FEED MANUFACTURING INDUSTRY

The local feed manufacturing industry is relatively new and sophisticated. Two modernized feed plants and several smaller feed mills were established in the 1970s.

TABLE 1 Feedstuffs Imported to Hong Kong in 1979

Item	Metric Ton
Maize, unmilled	279,932
Wheat and maslin[a], unmilled	134,293
Sorghum, unmilled	20,756
Oats, unmilled	1,165
Barley, unmilled	999
Millet, unmilled	165
Other cereals, unmilled	82
Rye, unmilled	3
Fish meal	7,426
Feedstuff, prepared	104,460
Wheat bran	95,400
Oil–seed cake and meal	25,126
Rice bran	5,786
Pollard and by–product	9,478
Meat or offals meal	3,041
Copra–oil cake	97
Vegetable product	19,470
Cereal straw and husks	1,155
Fodder roots, hay etc.	8,489
Feed waste	519
Mineral feed	109
TOTAL	717,951

[a] Mixture of grains, especially wheat and rye.

Keen competition between local manufacturers and feed importers keeps the prices of formulated feeds very close to those of self–mix feeds. Also, there have been improvements in the quality of feeds manufactured and it is expected that more and more farms will be switching over to formulated feeds in the 1980s, especially when the cost for farm labor becomes more expensive. The present production capacity of local feed manufacturers is about 6,000 metric tons per month. Some are upgrading this capacity with the addition of new equipment. This will increase total production by 50 percent in 1980.

SALE OF FEEDS

Most feeds are delivered directly to farms by dealers. Although most feed producers have increased their discount rates for Cash Sales from 1 percent to 3 percent, still about 90 percent of the sales are on credit basis with a credit period of 30 to 45 days. Bad debts increase when swine and poultry prices are affected by excessively high imports. Thus, feed dealers have become more cautious about extending credit to farmers, and this adversely affects the feed market. The outlook for 1980 depends on whether the market prices for swine and poultry can catch up with the increasing cost of feed.

SERVICES OFFERED BY FEED PRODUCERS

Farm services provided by feed producers have been very important. Most feed manufacturers and dealers provide veterinary services to help the farmers solve animal disease problems on a free–of–charge basis. Seminars are being held to discuss management, nutrition, disease prevention, and other problems. Experimental studies are being run to define the nutritional requirements for the local breeds under local conditions. The feed manufacturing industry in Hong Kong is making rapid advances in meeting the challenges facing the poultry and livestock industry.

GOVERNMENT REGULATIONS

The Hong Kong government favors a general policy of free trade. There are at present, no legislative controls over feedstuff quality. With most feed ingredients sold by retailers, there is no declaration of nutrient composition, such as the levels of moisture and crude protein. No legal action has been taken against feed adulteration. Occassionally, fish meal or meat meal has been mixed with non–nutritive materials. Popular brands of concentrate feeds may also be sold under forged labels. Farmers may not be able to detect this because there are so many factors that may lower production performance. The only constraint imposed upon feedstuffs is related to health standards imposed to safe–guard the general public or local primary producers.

GOVERNMENT ASSISTANCE

The Hong Kong government, through its Agriculture and Fisheries Department, helps farmers achieve a better socio–economic standing through increased productivity and by the introduction of new and improved production techniques, equipment, and methods of management. It backs these services with adequate credit and marketing facilities. Agricultural development staffs work in close collaboration with livestock and poultry specialists to appraise farmers, as soon as possible, of technology advances and the results of local adaptive research. The development staff likewise acts as a vehicle for identifying and transmitting local farming problems to specialists for investigation and resolution.

Technical advice on feeds and feeding is provided to farmers through individual, small group, and mass approach methods. Individualized methods include farm visits which number 100,000 a year. Group approach methods include courses of instruction, demonstrations, discussion groups, and organized farm visits. Mass media approaches include agricultural broadcasts and publications.

The government also provides a feed analysis service for farmers, purchasers, or feed mills to ensure feed quality and to prevent feed adulteration. Facilities are available for determining the moisture, crude protein, fat, crude fiber, ash, nitrogen free extract content, and the free fatty acid (rancidity) of oil bearing materials. Least–cost formulations, using linear programming, are issued on regular basis to primary producers. This has meant that the medium to large scale farmers who normally have their feed mixed on farms can benefit by reducing production cost without significant alteration of nutritive value an palatability of feedstuffs. This service has proven helpful when seasonal agricultural set–back in exporting countries cause price fluctuations.

To meet farm credit needs, financial assistance is made available from funds administered by the Agriculture and Fisheries Department. A total of $10 million is loaned to farmers each year as supervised credit at little or no interest. Over half of the loans are issued to livestock farmers for the purchase of feedstuffs. This is a very successful loan program.

Two farmer organizations in Hong Kong are concerned with the development of swine and poultry industries. One is the Federation of Pig Raising Cooperative Societies which has a membership of 25 cooperative societies. Their main activities are to help individual farm members obtain government credit and undertake bulk purchase of feedstuffs and improved breeding stock. The other is the New Territories Chicken Breeders' Association, whose objective is to promote the poultry industry in Hong Kong. The agricultural development staff maintains close contact with these farmers' associations and gives vital assistance.

OUTLOOK

With an increasing population in Hong Kong and a rise in per capita income, there will be an increasing demand for fresh poultry and pork. Based on the present trends, local farmers will continue to expand their poultry and swine industries to meet these demands. However, the following problems may impede this growth: the rising costs of feedstuffs, labor, and other input items; the competition of swine and poultry markets from imports; and the environmental pollution problems caused by the improper disposal of poultry and swine manure.

LIVESTOCK AND POULTRY PRODUCTION IN IRAN

Country Paper

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GEOGRAPHIC LOCATION AND STATUS OF AGRICULTURE

My country, because of its geographical and topographical location, is considered to be in one of the arid or semi–arid regions of the world. The presence of lofty mountains and the varying climatic conditions as well as large tracts of plains and coastal areas have, however, enabled my country to produce a wide variety of crops. We have the warm humid areas along our coast, burning deserts, and snowbound regions, which provide a variety of climates for the production of almost any kind of crop. Sometimes the difference in temperature between the hottest and coldest areas reaches 50 degrees centigrade. This situation, obviously, affects the sowing and raising of crops at different points in different seasons. For example, in the month of March, when some regions of the country are still frozen under a blanket of snow, in other areas crops are being harvested, and in others it is time to begin spring cultivation. The average rainfall in Iran is about 240 millimeters, fluctuating between 50 millimeters for some areas and 2,000 millimeters for others per year.

The population's dependence on agriculture is so great that most of the population is concentrated along the banks of rivers, springs or *Qanats* (underground water channels) where water for growing crops is readily available. It would not be out of place to point out that in the Persian language there are a large number of words *"abad"* or *"abadi"* which eloquently speak of vegetation and the presence of water. The antonym of these is *"Biyaban"* or wilderness or desolate areas.

Generally speaking, despite varied climatic conditions which Iran offers to its population and which are conducive to the production of tropical as well as torrid crops, the state of dairy farming is somewhat imbalanced in the overall agricultural economy of the country. The origins of this are found in the mismanagement by agricultural planners and the faulty agricultural policies of the past years. Our country has not been able to achieve self–sufficiency in many basic farm products such as wheat, barley, corn, meat, fats, rice, cereals, nor some kinds of fruits and vegetables although between 1973 and 1976 the agricultural growth of Iran has averaged 323 percent.

During the course of the past year, since the success of the Iran Revolution, a series of measures have been adopted on a multilateral front aimed at improving agriculture nationally, and it is hoped that following these infrastructural development activities and the introduction of long–term as well as crash programs, that Iran's reliance on foreign markets will be reduced gradually.

Iran is also forced to strive hard to become fully self–sufficient in food production in view of the fact that today food is being used extensively as a political weapon and overshadows all economic and social activity on a global scale. My country plans to overcome an acute shortage of water, a scattered rural population, as well as other physical problems through a rapid development of infrastructural facilities and the extension of welfare services through the appropriation of an ever–increasing volume of funds for these purposes. This would ultimately revive the almost–destroyed national agriculture and achieve a relative independence in certain commonly consumed items. Other national programs and a plan for industrial development have been simultaneously undertaken. These efforts include the Crusade for Reconstruction, the dispatch of teams to the rural areas to increase production and a general mobilization to improve agriculture.

Dairy farming and cattle breeding, in keeping with the overall unsuitable and faulty planning of the past, have suffered a great deal and are unable to meet the local needs. As a result of the unreasonable policies pursued in the past years, a major portion of the pasture lands have been destroyed. Consequently, the country faces a considerable shortage of animal products and has to use billions of rials to import these goods to meet the local demand.

Keeping this introduction in mind, allow me to outline briefly the nature of the duties and operations of the Agricultural Cooperative Bank of Iran in relationship to the

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agriculture and dairy farming problems. The Agricultural Cooperative Bank, which has been in existance for about 26 years, attends chiefly to the financial needs of the cooperative societies and unions, agricultural joint stock companies, farmers, and persons engaged in farming who have not yet had the opportunity to join rural cooperatives. Therefore, a major portion of the bank's operations involve loans to farmers, small land–owners, horticulturists, dairy farmers, cattle breeders, poultry farmers, honey and silkworm cultivators, fishermen, and owners of rural industries. It also attends to the financial needs of companies and institutions which are engaged in the production, conversion, or distribution of agricultural goods.

The bank's loans and credits are extended to cooperative and non–cooperative agencies in the form of long, medium, or short–term loans, or in the overdraft of accounts to cover current and essential agricultural expenditures. So far, the interest charged amounts to 4 percent from cooperative societies, 3 percent from cooperative unions, 6 percent from individual members of the cooperative societies, and 8 percent from non–members of a cooperative society. Interest chargeable on overdrafts is 10 percent. However, at the beginning of the current Iranian year (March, 1979), interest has been abolished completely from the national banking and monetary system in accordance with Islamic principles, and the bank charges only 1 percent by way of commission. Such a system is unique indeed anywhere in the world. The duration of medium–term loans is 10 years and that of long–term ones, 15 years.

During the 26 years that the bank has been in existance, it has granted more than 354 billion rials (about 5.5 billion U.S. dollars) which has been used by the farmers to meet the current agricultural expenditures, irrigation, planting of orchards and plant nurseries, dairy cattle and poultry breeding, construction of buildings and rural facilities, and other similar institutions. It has also granted loans totaling 65 billion rials, or about 18 percent of the bank's total loans expressly for purposes of dairy farming and cattle breeding and the acquisition of fodder for cattle. The "supervised projects", on the basis of which loans are granted to farmers on the approval of experts within the framework of the bank's technical supervision, were started in 1348 (1969), and since then more than 61 billion rials have been extended in the form of collective, joint or individual loans under the supervision of the bank to assist dairy farming and cattle breeding.

In the field of dairy farming and cattle breeding in Iran, it might be said that despite the implementation of 1,314 different projects by the Agricultural Cooperative Bank at a cost of 40 billion rials and allocation of other billions of money in the production of red meat and products, the difficulty in obtaining fodder and cattle feed, the lack of supervision and quarantine controls, and the existance of a series of crippling laws as well as a tendency to make investments in non–productive fields, led to the creation of a situation where, despite the presence of all the necessary factors and a suitable economic atmosphere, our agriculture and dairy farming is faced with acute difficulties.

Although a number of dairy farms are operating in various parts of the country, particularly around the big cities, the above–mentioned difficulties on the one hand and a sharp increase in the demand for animal products on the other have made it difficult to meet local needs.

According to available statistics, the added value of the dairy sector in 1358 (1979) was 150 billion rials on the basis of constant prices, which represents 35 percent of the total value of the whole agricultural sector of the economy.

In light of this, it might be stated that the current food shortages in Iran, particularly in the field of dairy products, are due mainly to insufficient veterinary services and technical facilities, lack of attention to the need for improvement of the cattle breed, defective training programs, particularly in the field of preventive techniques of cattle diseases, concentration of production units around big cities, a disproportion in the price of animal products as compared to the finished cost and a lack of attention to the traditional means of cattle breeding.

Attention is now being paid to correct these shortcomings simultaneously with the introduction of basic and far–reaching reforms. Particular attention is being paid to agricultural planning.

Allocation of free grants both in the form of cash and technical assistance, a revival of the traditional cattle–breeding methods, encouragement to grow more fodder crops, improvement of the breed of Iranian cattle, and assistance to veterinary and technical institutions, resurgence of rural industries, improvement of pasture lands, and a series of other measures are now under way.

Obviously, in this connection we welcome and are willing to adopt the experience of other people and so we consider the current seminar to be highly useful and informative to us.

In the way of food industries, we have in our country today only a few factories producing canned fruits and fruit juices, a few biscuit factories, milk pasteurization plants, flour mills, plants to produce luncheon meats, and a small number of bone and fish meal plants. It is, therefore, evident that this country, which is virtually sprawling over a sea of oil, having a vast expanse of land and varied climatic conditions, suffers badly from an acute shortage of food and dairy products.

The increasing imports of food products in recent years are silent but at the same time eloquent testimonies to this sad state of affairs. But before organizing our agri–culture and dairy farming, we believe, we must first of all be aware of existing realities. I seek your pardon for dealing at length with our agricultural problems, but I am doing so in the hope that we can benefit from your expert opinions and views.

During the past few years, some steps have been taken to improve things, but these are by no means sufficient.

In the field of production and in certain fields of food industries, corrective measures have been taken, but in the fields of marketing of food products, little attention has been paid to standards, quality control, and supply.

At present, we have some well–equipped dairy farms around Teheran and a few other major cities with large stocks of cattle and poultry. Most of these projects have been accomplished with the help of the Agricultural Cooperative Bank. But it must be pointed out that with the establishment of large agro-industrial complexes, the traditional agriculture and cattle breeding programs were abandoned in a most undesirable manner.

A policy of rapid industrialization without an effort to provide incentives to the agriculturally–based rural populations led to a mass migration to the cities. Un–fortunately, those who remained in the villages are faced with many problems.

The shift to imports rather than indigenous production aimed at achieving self–sufficiency in food has resulted in the loss of interest of farmers in their profession and the few modern agro–industries and dairy and poultry farms are in no way able to meet the national demands.

In addition to this, we are now passing through a revolu–tion which has generated a large number of other socio–economic problems. The need for the revival of agriculture even by employing the traditional methods and expansion of dairy farming on the village level with the help of the villagers themselves seems to be of utmost importance if we are to achieve a satisfactory level of production.

However, this does not mean that attention should not be paid to the expansion of the existing or establishment of new agro– industries. With encouragement to the local farmers, cattle and poultry breeders, it is essential that they should be guided to employ modern techniques. We believe that we cannot find solutions to our problems unless we study closely where we went wrong in the past.

We realize at the same time that we cannot do away with imports immediately because our agricultural and dairy problems can be solved only through the introduction of basic and far–reaching reform in the production system at the village level. At the moment, our other major problems also include marketing of food products, establish–ing service institutions and training of technical staff in various fields.

These in turn, require the introduction of an efficient economic management of the existing possibilities for a better use of our potential. In the light of this very brief outline of our problems, we shall certainly appreciate the views of experts attending this seminar, so that in the light of their experiences, we may be able to implement programs which would yield better and quicker results.

Now, I would like to give a brief outline of the existing rules and regulations governing cattle and poultry breeders, ending with an outline of the bank's rules for the extension of loans. I have also attached a report on the imports of meat, eggs, milk, meat powder and fish meal and oilseeds together with the names of the exporting countries.

General Regulations Governing Issue of Permits for Dairy Farms and Affiliated Plans

Individuals and organizations, whether real or legal entities, or government or private companies who desire to establish dairy farms (breeding, fattening or maintenance of domestic animals, bees, fish or laboratory and skin animals), or who desire to establish cattle breeding complexes or factories (chicken hatching, animal feed production or cold storage facilities for keeping animal protein) must submit the following documents:

- The original and a photocopy of the land title in their names or an officially registered lease from the owner for at least seven years.
- A lot or parcel map indicating the address.
- A map showing the number of the main plot of land or secondary plots as registered by Property Registration Department.
- A map of the village where the land is located showing its location after the approval of the Village Development Association and the local House of Justice.
- Holders of permits for the establishment of a dairy farm or the affiliated factories are required to create the installations according to approved plans and in the designated area. Before creation of such facilities as

required under the license, they are not entitled to transfer the land to anyone else.

- The nature and the number of cattle and the final capacity of each dairy farm, as well as food industrial plants, the area of the land, and the construction area shall be mentioned in the license.

- The license shall be valid for two years.
- The applicants must appoint a person responsible for running the dairy farms and are also required to provide health facilities including appointment of doctors.

- After the license is issued, the Veterinary Department shall inform the local Governor General's office or the local municipality or other department of the Ministry of Water and Power to supply water and power to the dairy farm or affiliated factories.

- The license holder of the dairy farm or affiliated factories has no right whatsoever to build constructions or establish installations other than those mentioned in the license. In this connection, he will be required to furnish the necessary guarantees, the specimen of which is available with the Veterinary Department. Any breach of this provision shall be dealt with in accordance with the provisions of the guarantee.
- Before they are commissioned into service, the applicants shall contact the Veterinary Department immediately on completion of the buildings and installations of the factories so that experts can inspect these facilities, and if they are constructed in accordance with the approved plans, the expert consulted shall issue permission for its commissioning under the law.

- The license holder is required to take all the actions necessary for the construction or installation within the prescribed period of time. If a license holder, at the end of the duration of the license period has not taken any actions and has no justifiable reason, his license will be deemed to have been cancelled from that date, and the local Governor General's office, the local municipality and other departments will be informed accordingly.

- Where this manual does not cover the number of cattle, the distance of the proposed dairy farm or affiliated plant from the nearest dairy farm, the city limit or the satellite town, the village or the area of land and other documents required are not available, no license will be issued.

- Holders of temporary licenses for dairy farms will be allowed to expand their facilities provided they possess adequate land in proportion with the number of additional cattle.

- Dairy farms which have only temporary permits will not be allowed to expand.

- The holders of dairy farm licenses are required to enforce technical and health orders received by them from the experts of the Veterinary Department and to take the necessary actions to remove existing defects within the prescribed period of time.

- Cancellation of a dary farmers license will rest with the Veterinary Department.

Regulations Governing Cow Dairies

- The number of pure-bred milk cows in the newly established commercial dairy farms should not be less than one hundred.

- The minimum land required for the establishment of the smallest dairy unit (one hundred) is determined as follows, and the size of bigger dairies should be calculated accordingly:

  Land needed for the construction of building and establishment of installations must be 1.5 hectares, and land required for the cultivation of fodder crops must be at least 20 hectares.

Note: The application for the establishment or expansion of dairy cow herds must receive certificates from the local Agriculture Department showing availability of sufficient quanti , of water for cultivation of fodder crops or a certificate from the provincial Department of Protection of Water Resources showing that a well may be drilled to ensure a sufficient supply of water for the said crops. In the absence of these certificates, the Veterinary Department will be entitled to make its own inquiry from provincial authorities.

- The minimum distance between each newly established cow dairy from other dairy establishments, the city limits, and the satellite towns should be between 150 meters and 1 kilometer.

- Installations required for one hundred pure-bred milk cows varies between 1680 square meters and 1830 square meters of covered area and 1960 square meters open area. For each cow, an area of 16.6 to 17.2 square meters covered and uncovered area, respectively, is needed.

- Temporary licenses for dairies are issued for a minimum of 20 head of pure–breds, 30 head of cross–bred, and 40 head of local bred cows.

Regulations Governing Establishment of Sheep Farms

- When sheep are moved from place to place during winter and summer seasons (in the rural areas) the following regulations shall apply.

- The number of milk producing and breeding sheep in newly established sheep farms shall not be less than 250 head.

- The minimum land required for the establishment of the smallest sheep farm (250 milk producing and breeding sheep) shall be determined in the following manner and shall serve as the basis for calculations for larger farms.

  The land needed for the construction of building and the establishment of installation for one unit of sheep farm with 250 heads of sheep is 2500 square meters, and the area required for raising fodder crops shall be at least five hectares. In other words, for each 50 head of sheep at least one hectare of land is required to produce fodder crops. Therefore, applicants desiring to give ready fodder to sheep for four or five months in a year (depending upon regional conditions) and to use pastures for the rest of the year, must have at least half a hectare of land for every five head of sheep for the production of cultivated fodder crops.

- The minimum distance between sheep farms and the city or village limits should be between 150 meters and/or 1 kilometer.

- Each sheep must have 1 square meter covered area, 2 square meters open area. Storage and milking space should be at least 5 square meters.

- For farmers able to maintain at least fifty head of sheep in hygienic condition, temporary permits are issued.

Poultry Breeding

Since the minimum number of birds and the minimum area required depends on breeding and maintainance conditions, these regulations can be summarized as follows:

- Breeding of chickens for meat purposes requires a fully automatic coop for at least fifteen thousand birds. One square meter of floor space must be provided for each 15 birds and the coops should be at least 25 meters apart.

- Maintainance of chickens for meat purposes shall be in open coops of ten thousand each. One square meter of floor space must be provided for each ten chickens and the coops should be separated from each other by at least 12 meters.

- It is compulsory to house turkeys and ducks in closed and fully automatic coops of two thousand birds. One square meter of floor space must be provided for each four birds. The minimum distance between coops should be 25 meters.

- Breeder hens must be housed in closed, fully automatic coops of three layers for thirty–five thousand birds. One square meter of floor space must be provided for each 24 birds.

- Breeder hens must be housed in closed and fully automatic coops for at least 10,000 birds providing one square meter of floor space for each eight birds.

- Breeder hens must be housed in open coops for at least 8,000 birds providing one square meter of floor space for each seven birds.

- Breeder hens must be housed in closed, fully automatic, three layer coops for fifteen thousand birds providing one square meter of floor space for each eight birds. In a system without racks, 12,000 birds with seven birds per square meter of floor space is acceptable.

Temporary Permits

- When chickens are raised for meat purposes, there must be a minimum of 2,000 birds in each phase.

- Pure bred breeder hens used for producing hatching eggs must have a minimum of 6,000 birds in each phase.

- Chickens used for producing hatching eggs must have a minimum of 2,000 birds in each phase.

- Broad hens must have a minimum of 2,000 birds in each phase.

REGULATIONS GOVERNING CREDIT AND BANKING

As stated above, the Agricultural Cooperative Bank of Iran and the Agricultural Development Bank were amalgamated following the Iranian Revolution and operate under the name of the Agricultural Bank of Iran. It is charged with the task of channeling all financial assistance in various forms to the operators of dairy, poultry and animal feed projects.

Long–Term Loans

These loans are granted for the implementation of basic projects in the field of dairy and poultry farming to cover the cost of installations, water and power supply, machinery and equipment, acquisition of cattle and feed, and all other current expenditures essential for full and complete implementation of the projects.

The repayment duration of these loans is between eight and ten years, with the first installment beginning in the second or third year. The interest charge on these loans is six percent to members of the cooperative societies and eight percent to non–members plus one percent for bank commission on the total amount. Under the new system, interest is to be eliminated completely and only a very nominal service charge will be levied from those who receive loans. The exact amount of this charge has not yet been determined.

Medium–Term Loans

These loans are intended to be used for maintenance of facilities; purchase of equipment; purchase of milk cows, buffalo, sheep, pure– bred chickens for hatching purposes. It must be repaid within two to five years and the rate of interest is the same as for long– term loans.

Short–Term Loans

These loans are extended for the purchase of sheep and calves for fattening purposes, chicken for meat, and cattle and poultry feed as well as some current expenditures.

It might also be mentioned here that the bank also extends overdraft consideration to dairy and other farmers, which can be withdrawn from time to time at an interest rate of 12 percent. Of course, this privilege is available only to farmers who have established a reputable credit rating with the bank. Unlike other loans which are earmarked for specific purposes designated by the bank, there is no supervision over the expenditure of the amount over–drawn from the current accounts.

Conditions for Loans for Dairy and Poultry Farming

The applicants for government loans and credits must fulfill the following conditions:

- Possession of valid permit for a dairy or a poultry farm in accordance with the laws mentioned above.

- Ability to mortgage property which must be judged by the bank's evaluators to be twice the amount of the loan. This property can be an urban house, farm property, buildings, or orchards.

However, sometimes loans are granted on the personal guar–antee of the applicant or some other reliable person to the extent of 1 million rials (about 100,000 pesos).

- Ability to pay one percent of the total amount of the loan as a service charge at the time of making applica–tion for the loan. If the amount of the loan approved is less than that applied for, the bank refunds the balance of the 1 percent service charge (after deducting its 1 percent) to the applicant.

- Proof to relevant government departments that there is no claim against the land on which the project is to be implemented or which has been offered by way of mortgage.

Before the loan is made to the applicant, a bank official visits the site and inspects it from the point of view of location, availability of health facilities, capacity, etc. He will also substantiate the need for which the loan is intended and makes his report to the province branch or to the head office (determined by the amount of money involved), and a final decision is made by these authorities.

The approved loan is put into a special account, and the recipient is allowed to draw from it gradually as funds are needed under the supervision of the bank. Therefore, at every stage it is ensured that the loan is spent for the purpose for which it has been extended.

Non–Cash Assistance to Dairy and Poultry Farmers

The non–cash assistance such as giving tractors, fodder material, water and power, etc., is also governed by similar rules and regulations. The needs of the applicants are carefully assessed by the bank and quotas are determined for each farmer according to these needs.

LIVESTOCK AND POULTRY PRODUCTION IN MALAYSIA

Country Paper

THE ANIMAL FEED INDUSTRY

Domestic Availability and Utilization of Feedgrains and Other Feedstuffs

Agricultural crops, by–products and agro–industrial wastes including those by–products from the processing of imported raw materials some of which are extensively utilized are available in Malaysia. Tapioca, forage grasses, rice bran, wheat middlings, brewer's grains and yeast, sago waste, palm kernel meal, coconut cake, fish meal, and molasses fall into this category.

Large quantities of some feed materials that have potential use as animal feeds are also available. Presently, the use of these materials in animal diets is limited. Additional research is needed to determine better feeding programs to utilize these materials. These include pineapple waste, paddy straw, palm oil sludge, palm press fiber, sugar cane tops and bagasse, poultry manure, rubber seed meal, and cocoa pods and shells.

Land development in Malaysia has always been oriented toward rubber and oil palm production. As such, the country produces few or no feedgrains for the animal feed industry. There is no national policy on feed crop production. Because of this, feed crops like maize, soybean, groundnuts and sorghum have been used in existing agricultural programs in the following manner:

- as a catch crop associated with rubber cultivation,
- as an off–season crop in single–cropped paddy areas, and
- as an "Interim" crop at the initial stages of new land development for rubber and oil palm projects.

There are over 10,000 hectares of land in Malaysia planted with maize, soybean, and groundnuts, and nearly 30,000 hectares under tapioca cultivation. The production of these crops is intended as a food source for human consumption and apart from tapioca chips and waste, negligible amounts of these feed crops are being used in the animal feedmilling industry.

The lack of an aggressive feed crop production program in the country is attributed to several factors, such as:

- low income returns per hectare of feed crops as compared to rubber, oil palm, cocoa, or coffee (this element of comparative advantage is a deterrent in the large–scale plantings of feed crops)
- limitation of suitable land for food crop production
- agronomic factors, such as low yields, etc. and,
- competitive use for human consumption.

Sources of fodder available for ruminant feeding are first, from natural or traditional grazing resources such as waste land, roadsides, fringes of single–crop paddy areas, under rubber, coconuts, and oil palm trees on large estates; second, the establishment of pastures and grasslands; and third, by–products from crop production, such as paddy straw, rice hulls, etc.

The major source of fodder for ruminants may result from good management of well established artificial grasslands used for the production of high quality forage. There are eight cattle ranches run by the National Livestock Development Authority. These ranches contain over 12,000 hectares of land cleared and planted with suitable grasses and legumes. A grass meal plant used for pelleting guinea grass was established in 1975.

Large tracts of virgin land are available but are unsuitable for pasture development due to several reasons. Some of these are the local topography, the soil and location barriers, and the high input cost of clearing. These conditions make the potential returns marginal and unattractive to investors.

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

Until recently, pasture production in Malaysia has been almost entirely based on N-fertilized grass pastures. However, legume–based pastures which need relatively small amounts of fertilizer requirements could become an increasingly popular source of feed for meeting the nutritional needs of ruminants.

Agricultural by–products and agro–industrial wastes, used extensively in this country for animal feeds, include rice bran, coconut cake, palm kernel cake, fish meal, milled bran and pollard, and molasses. Local production of these feed materials in 1977 is given in Table 1.

TABLE 1 The Production of Products Usable as Animal Feedstuffs (Peninsular Malaysia)

Product	1977 (metric tons)
Coconut cake	41,512
Rice bran and polishings	65,353
Tapioca refuse	107,175
Milled bran and pollard	115,789
Fish meal	11,928
Palm kernel cake	183,700[a]
TOTAL	525,457

Source: Department of Statistics, Malaysia

[a]Extracted from "Utilization of Feedingstuffs from the Oil Palm", by C. Devendra, 1977. Proceedings on Feedingstuff for Livestock in South–East Asia Malaysian Society of Animal Production in Serdang, Selangor.

Note: Molasses, limestone, sago refuse, and oyster shell are also being produced but in small quantities. As statistics about this are conflicting, they are not being added to the above list.

While the locally produced rice bran and coconut cake are extensively used by local feedmillers, much of the country's total requirements for these products are still being met through imports (Tables 2, 3, and 4). However, it is expected that the local production of rice bran, palm oil, palm kernel meal, and coconut cake will increase in the coming years, due to the expanding production of paddy rice and the increased cultivation of oil palm and coconuts.

Agricultural by–products and industrial wastes, not presently used extensively for animal feeds include oil palm by–products, such as palm press fiber and palm oil sludge or effluent, paddy straw and rice hulls, pineapple wastes, sugarcane by–products (cane tops and bagasse), rubber seed meal, animal by–products (e.g. meat and bone meal, blood meal, poultry litter), and cocoa pods and shells. Considerable quantities of these by–products

TABLE 2 Imports of Animal Feedstuffs into Peninsular Malaysia, 1977

Commodity	1977 Quantity (metric tons)	1977 Malaysian Ringgit (000)
Maize	391,794	122,496.3
Rice bran	110,780	25,005.6
Other brans	1,677	444.1
Rice broken	----	----
Soybean oil cake	81,966	49,499.4
Coconut oil cake	12,046	2,847.9
Groundnut (Peanut) oil cake	20,257	9,837.6
Gingelly (sesame) oil cake	1,822	677.1
Other vegetable oil cakes	----	----
Palm kernel cake	5	1.2
Fish meal	17,284	8,364.1
Prawn dust, etc.	134	28.6
Meat meal	9,305	6,439.7
Meat offals (meal and flours)	30	20.4
Skimmed milk	6,031	5,944.6
Tapioca refuse	3,686	430.4
Sago refuse	----	----
Cereal and fodder, straws, husks, ears, etc.	23,124	1,066.8
Other vegetable products/ oil/cakes beat pulp/forage	33,276	23,258.2
TOTAL	713,218	263,362

Source: Ministry of Agriculture

are available, but currently many of these products are wasted or used as fuel. Factors underlying the inadequate utilization of these by–products as feeds are:

- limited appreciation of their potential value,
- seasonal supply,
- no effective guidelines for their use have been established, and
- lack of research on the utilization of these products in animal feeding systems.

The potential of these by–products as a feed source for animal feeding, particularly for the ruminant sector, is enormous, considering the vast quantities available. The efficient utilization of agricultural by–products and agro–industrial wastes as animal feeds would reduce the dependence of Malaysian farmers on imported products. However, their large scale utilization in animal feeding still awaits greater research and the development of appropriate technology.

TABLE 3 Imports of Animal Feedstuffs into Sabah, 1975

Type	1975 Quantity (metric tons)	1975 Value C.I.F. ($)
Cereal straw and husks unprepared or chopped	0.05	115
Fodder roots hay and similar forage products	83.96	28,217
Maize ears of grain and maize leaves	85.04	39,935
Other vegetable products for animal feed N.E. S.[a]	4,363.60	2,257,038
Rice bran	1,676.04	477,336
Other brans, sharps, etc. of sifting or legumes	1,751.05	892,431
Coconut oil cake	53.44	17,765
Groundnuts (peanut) oil cake	21.79	12,356
Soybean oil cake	133.35	76,906
Oil cake and other residues of vegetable oil excluding dregs	13.42	3,676
Prawn dust	12.93	6,176
Fish meal	122.89	107,257
Meat meal	38.74	23.368
Greaves	0.48	111
Flour and meals of meat and offals	0.29	652
Flour meals of fish, crustacean, etc.	7.50	5,599
Coffee husks and skins	----	----
Cocoa shells, husks, skins and waste	----	----
Tapioca refuse	7.02	2,306
Other beet pulp, bagasse, dregs, and waste residue	15.83	8,440
Sweetened forage and other preps. for animal feed	34,948.66	19,687,979
TOTAL	43,336.08	23,647,663

[a] N. E. S. – Not elsewhere specified

Source: Department of Statistics
Agricultural Station of Sabah, 1975

TRADE IN ANIMAL FEEDGRAINS AND FEEDSTUFFS

Imports

To meet domestic requirements, Malaysia imports about 50 to 55 percent of the total annual feedstuffs needed.

The figures for volume and value of imports of animal feedstuffs into Peninsular Malaysia, Sabah, and Sarawak are given in Tables 2, 3, and 4, respectively. The quantity of animal feedstuffs imported into Peninsular Malaysia has been steadily increasing at a rate of 10 percent annually. In 1977, some 713,000 metric tons of animal feedstuffs, valued at over $260 million Malaysian Ringgit (or $120 million US) were imported. Of the total feedstuffs imported, maize is the most important (about 50 to 55 percent), followed by rice bran (16 percent), and soybean meal (11 percent). From 1971 to 1977, there has been a marked increase in the import of protein concentrate feeds. The importation of soybean meal increased by 400 percent and fish meal imports doubled.

Substantial quantities of maize are imported from Thailand (65 percent of total maize imports) and also from Argentina. Australia is the major supplier of cereal straw, husks, and meat meal. Fodder, hay, roots and forage products are imported largely from China, which also supplies substantial amounts of other vegetable products for animal feeds. Rice bran is imported from Burma, India, and Indonesia. Thailand and Indonesia supply over 75

TABLE 4 Imports of Animal Feeds Into Sarawak, 1977

Item	1977 Quantity (metric tons)	1977 Malaysian Ringgit ($)
Rice bran	7,190.32	1,773,105
Cereal veg., bran, pollard, sharps, etc.	5,216.70	2,050,047
Copra cake	2,276.88	777,923
Other oilseed cake[a]	6,054.52	3,919,426
Maize[b]	29,344.26	10,680,336
Meat and fish meal	1,932.26	1,866,378
Sweetened forage and other animal feed preparations (compound feeds)	36,790.36	20,760,592
Animal feeds N.E.S.[c]	2,647.84	916,081
TOTAL	91,453.34	42,743,888

[a]Includes oil cake of other residues of vegetable oils excluding oil cake of groundnuts (peanuts); of soybeans; and of gingelly (sesame).

[b]Includes maize unmilled and maize for animal feeding.

[c]Includes fodder roots hay and similar forage products; maize ears of grain and maize leaves and other vegetables products for animel feed N.E.S.

Note: N.E.S. – Not Elsewhere Specified; 1977 figures are preliminary

Source: Department of Statistics
Agricultural Statistics of Sarawak, 1977.

percent of the coconut oil requirements. Nearly 23 percent of the supply of soybeans comes from Brazil, Good protein sources of fish meal are imported from Thailand each year.

Of the total animal feedstuffs imported in 1977, about 49 percent of the volume came from the ASEAN countries. Most feedstuffs imported into Sabah and Sarawak come from Peninsular Malaysia and Singapore.

Exports

As with imports, the volume of exports has been growing steadily over the years. From Table 5 it can be seen that 213,000 metric tons of feedstuffs were exported. "Exports" to Sabah and Sarawak totaled about 18 percent of all exports of feedstuffs from Peninsular Malaysia, and 20 percent went to Singapore, where they were diverted to other countries. The major export item over the past two years has been palm kernel cake. This amounted to nearly 78 percent of total exports in 1977. The Netherlands is the biggest market for palm kernel cake, while Germany ranks second. Another item of growing interest in terms of exports is sweetened forage and other vegetable products. These are primarily exported to Sarawak and Sabah. The volume of exported animal feedstuffs totaled about $64,000 Malaysian Ringgit (or $30,000 US) in 1977.

TABLE 5 Exports of Animal Feedstuffs from Peninsular Malaysia (1977)

Feed Item	1977 Quantity (metric tons)	1977 Malaysian Ringgit $ (000)
Maize (unmilled for animal feeding)	548	120.1
Rice bran	----	----
Other brans	4,218	1,440.1
Rice broken	----	----
Soybean oil cake	----	----
Coconut oil cake	*	*
Groundnut (peanut) oil cake	28	11.5
Gingelly (sesame) oil cake	----	----
Palm kernel cake	166,784	45,394.6
Fish meal	3,670	1,058.8
Prawn dust, etc.	1,536	284.7
Meat meal	----	----
Meat offals (meal and flour)	40	15.4
Skimmed milk	64	72.8
Tapioca refuse	65	13.2
Cereal and fodder, straws, husks, ears, etc.	484	65.3
Other vegetable products/oil cakes, beet pulp/forage	28,798	15,118.3
Sago refuse	6,855	172.3
Other vegetable oil cakes	124	64.6
TOTAL	213,214	63,831.7

*Insignificant

Source: Statistical Digest 1975 Ministry of Agriculture.
Import Export Trade in Food and Agricultural Products, Peninsular Malaysia 1977, Ministry of Agriculture

THE ANIMAL FEEDMILLING INDUSTRY

Background

The rapid development in the livestock industry, particularly in the swine and poultry sectors, over the past 20 years has been due in part to the complementary establishment and growth of the animal feedmilling industry. The feedmilling industry has grown most rapidly in the past ten years to an estimated annual turnover of some $250 million Malaysian Ringgit (or $115 million US) today.

The amount of capital commitment that has been invested into the feedmilling industry proper over the years is estimated at over $60 million Malaysian Ringgit. About 1800 people work in feedmilling operations throughout the country.

Production

There are about 59 commercial feedmills in Peninsular Malaysia (or a total of 65, inclusive of those in Sabah and Sarawak). Also, there are at least an additional 100 smaller operations throughout the country whose production figures are not available. Industry sources indicate an overall production capacity from these 59 feedmills at just under one million metric tons annually. Of this capacity, nearly 80 percent is attributed to 27 large feedmills having production capacities of 1000 metric tons or more per month, based on two shifts.

The total production capacity of feedmills in 1978 is estimated at 980,000 metric tons per annum (based on 2 shifts) and the production of compounded feeds is 445,000 metric tons as indicated by the Department of Statistics. Thus, the average operating level of feedmills is at 45 percent of full production capacity. However, bigger feedmills (with 5000 metric tons per month capacity) achieve higher utilization rates, 70 percent or more, compared to the small feedmills.

Of the 59 feedmills, only 19 mills are members of the Malaysian Feedmillers' Association, and they account for approximately 60 percent of the total national commercial feed sales. Figures from the Department of Statistics reveal that prepared animal feedstuffs manufactured by feedmills for pig and poultry average only 44 percent of the total amount available for domestic utilization for the period between 1970 to 1976 (Tables 6 and 7). This shows that self–mixing plays a large role in the feedmilling industry. The trend towards self–mixing on farms has in fact risen in recent years because the quality of compound feeds is not consistent due to the absence of government quality controls.

TABLE 6 Production of Prepared Poultry and Swine Feeds in Peninsular Malaysia

Year	Poultry Feeds (metric tons)	Swine Feeds (metric tons)	Total (metric tons)
1968	97,880	100,780	198,660
1969	104,780	125,280	230,060
1970	121,350	152,080	273,430
1971	127,825	158,926	286,731
1972	123,427	144,049	268,376
1973	162,099	130,152	292,251
1974	139,102	113,156	252,258
1975	191,900	123,156	315,056
1976	241,311	148,476	389,787
1977	272,311	113,851	386,162
1978	314,713	130,135	444,848

Source: Annual Industrial Statistics
Department of Statistics, Malaysia.

Plant expansion programs have recently been undertaken by some feedmillers. This will increase the feedmilling industry's production capacity by 23,000 metric tons annually.

Level of Technology

Feed manufacturing facilities range from modern milling equipment in a few of the larger mills to outdated, even primitive mill equipment at many of the small mixing plants serving a few farmers. The latter group has minimal investment in a simple two ton per hour mixer which enables the farmer to produce feed for his own use, some sales and custom mixing for his neighbors. The biggest feedmillers use computers in deriving and formulating the most profitable diets involving several variables. One feedmiller is using linear programming techniques to carry out feed formulations on a periodic basis. Apart from a handful of these large feedmills that utilize computers for ration formulation, including punch card control systems, most of the feedmills possess only simple equipment consisting of hammer mills and vertical batch mixers with proportioning, conveying, and bagging executed manually. In recent years there has been a trend toward the installation of pelleting machinery among large feedmill operators.

Credit Service

One of the outstanding features of the animal feedmilling industry is the provision of credit services that are made available to poultry and swine producers. According to industry sources, credit extended to farmers for purchasing feeds is reported to be in excess of $80 million (MR).

TABLE 7 Local Production, Net Imports and Availability of Animal Feedstuffs for Domestic Utilization: Peninsular Malaysia, 1971–1977

Year	Quantity of animal feedstuffs (metric tons) Imports	Exports	Net Imports	Production of locally produced feedstuffs (metric tons)	Total availability of locally produced feedstuffs (metric tons)	Percent of the total utilization of local feedstuffs
1971	413,877	39,857	374,020	347,231	621,251	56
1972	420,416	83,433	336,983	398,531	735,514	54
1973	382,208	107,094	275,114	408,867	683,981	60
1974	455,960	102,246	353,714	403,181	756,895	53
1975	541,974	185,100	356,874	410,297	767,171	53
1976	534,855	157,569	377,286	486,546	863,832	56
1977	713,218	213,214	500,004	525,457	1,025,461	51

Generally credit services are also available to dealers or agents in varying proportions. The financial strength of big mills in giving farmers long term credit enables them to get a higher price for their products. The credit limits for each client are awarded on an individual basis.

Credit terms normally range between 30 to 60 days for poultry feeds, between 120 and 180 days for swine feeds, and 30 to 45 days for raw feed materials. Length of time for credit varies with each marketing or distributing outlet. With direct sales to farmers, the time period is normally long. With retailing outlets a short time period is given, and for the agent, dealer, or wholesaler, a medium time period is generally approved. Good marketing strategy and credit control enables big mills to generate high volume at less than one percent loss in bad debts. Small mills suffer from small market coverage, selling only to neighboring farms and incur a loss in bad debts of 6 to 10 percent due to poor credit management.

MARKETING

Procurement of Raw Feed Materials

While some large feedmill operators import their own raw feed materials, others obtain their supply of raw materials through affiliated feedmill companies stationed in Singapore. This has been the traditional practice due to the fact that Singapore has better port and handling facilities and has access to a wide communications network for purchasing feed commodities. Some small feedmillers and self–mixers purchase their raw materials from other dealers or agents in Singapore or locally. Generally, most feedmills maintain inventories to meet their requirements for two or more months. Locally produced materials are not normally purchased directly by the feed mills but are supplied by contractors.

Bulk handling and storage facilities of raw materials at ports are lacking, although the installation of new port facilities for bulk handling, including storage and transport facilities for several feed grains, is being seriously considered by one or more Port Commissions in the country.

To date, bulk feed distribution systems for transporting of feed to and storage at the producers premises is lacking, although new technological innovation and automation at the farm level have induced several producers and some large feedmilling operators to consider the adoption of such systems as a means to reduce feed costs.

Pricing

There is no government legislation which controls the pricing of finished feeds in Malaysia. Every feedmiller competes freely and prices are allowed to fluctuate. Individual feedmillers adjust prices from time to time to reflect changes in raw material costs. A mark–up of one percent over bank interest rates is assessed those extended credit. Additional mark–ups or discounts depend on the credit standing of the buyer and his rapport with the dealer or agent.

Marketing Channels

The distribution of prepared animal feeds is normally conducted through three channels:

(1) Direct sales (to farmers)
(2) Wholesalers (dealers/or agents)
(3) Retailers

The simplest distribution system is one represented by the small on–farm mixer with the simple mixing equipment who sells small amounts to neighboring farms. This type of marketing is to a large extent conducted by small feed–millers. Large feedmilling operations have a distribution network operated by distributors or wholesalers who service the producers themselves as well as retailers. Where proximity permits, the mill may service retailers directly. Very few big mills engage in direct sales to producers and, when they do, these are limited to selected big producers. About 60 percent to 80 percent of the finished feeds from big feedmills is handled through the wholesale network, where selected middlemen operate as dealers or agents in each region. Small retailers in village areas, such as sundry shops, normally service small backyard poultry producers whose requirements for commercially prepared feeds are estimated at about 80,000 metric tons annually.

The wholesale network incurs a small amount of bad debts. They are rich, well established trading houses and, in most cases, act as the sole distribution source in each region. They are the main outlets for big mills in different regions. They require only short to medium credit terms.

Sundry or provision outlets are an important retail outlet for poultry feeds. They incur few bad debts and have short credit terms.

The distribution of finished feeds is almost entirely in paper bags or fiber sacks. Products from feed mills are generally sold in 50 kg. bags. The majority of feedmills appear to concentrate their sales in the region where they are located.

The distribution network of finished feeds in Malaysia is diagrammatically represented below:

MARKETING CHANNELS

	BIG FEEDMILLS	SMALL FEEDMILLS
DIRECT SALES TO PRODUCERS	Low percent to selected and big producers only	High percent (70 to 80 percent) to farmers in the vicinity
DISTRIBUTORS OR WHOLESALERS	60 to 80 percent to selected and regular middlemen (dealer or agent) in each region	Low percent (10 percent) to small middlemen and distributors
RETAILERS	Low percent. Second impor– tant and outlet– reliable provision or sundry shops	15 to 20 percent. Fair amount to sundry shop in near vicinity

Market Potential

Domestic production, net imports, and total availability for domestic utilization of animal feedstuffs is shown in Table 7. In 1977, about 1.03 million metric tons of animal feeds were consumed by the livestock sector.

Several bold and dynamic developmental livestock programs for intensifying production are anticipated in the next ten years. The goal is to make the country more self–sufficient in dairy and beef production, and to main– tain the self–sufficient status of swine and poultry. New programs will be implemented.

In line with the rapid growth in the livestock industry, demand for animal feeds will increase proportionately. However, much of this demand will be geared largely toward meeting increases from both the poultry and swine sectors. Although the development in the dairy sector will cause an increasing demand for calf and dairy cattle concentrate feeds in the next ten years, this de– mand is considered to be relatively insignificant in the overall national demand for mixed feeds. It has been calculated (Table 8) that by 1990, feed requirements for the swine and poultry sectors will exceed 2 million metric tons. Thus, the market potential of prepared feeds for the livestock sector is tremendous and is an important one in the realization of production targets for livestock.

TABLE 8 Total Projected Demands of Animal Feeds for Poultry and Swine

	Feed Requirements (metric tons)			
Year	For Pork Production	For Poultry Meat Production	For Egg Production	Total
1978	385,340	205,900	414,960	1,006,200
1979	399,700	223,000	430,500	1,053,200
1980	414,600	241,500	460,320	1,116,420
1981	430,070	261,600	492,240	1,183,910
1982	446,000	283,400	526,260	1,255,660
1983	462,730	306,800	562,380	1,331,910
1984	479,500	333,000	601,020	1,413,820
1985	497,740	359,800	642,600	1,500,140
1986	516,260	389,700	687,120	1,593,080
1987	435,490	422,000	734,580	1,692,070
1988	555,360	457,000	784,980	1,797,340
1989	576,040	495,000	839,160	1,910,200
1990	597,160	535,900	897,120	2,030,180

The following parameters were used in the calculations:

1) Assuming commercial pork production at 85 percent and feed conversion ratio at 4.0:1.

2) Assuming population of breeding sows is based on 11.7 percent of the total number of swine available for slaughter and consumption, and boar to breeding sow ratio at 1:20. A carcass weight factor of 0.0499 metric ton is used. Feed consumption is at 0.9 metric ton per sow or boar per year.

3) Assuming that approximately 25 percent of the total overall poultry meat production is derived from poultry not consuming prepared mixed feeds.

4) Assuming the national average feed conversion for broiler at 2.6:1.

5) Assuming a production of 220 eggs/hen/year (national average)

6) Assuming an average feed consumption per bird of 115 g/hen/day or 42 kg/hen/year.

THE LIVESTOCK INDUSTRY

Present Status

Peninsular Malaysia is achieving a considerable and increasing degree of self–sufficiency in livestock and livestock products. Currently, it produces 100 per–cent of the requirements for poultry meat and eggs, 65 percent of beef, 20 percent of mutton (goat meat) and 5 percent of milk requirements. It is self–sufficient in swine products.

In 1977, the value of livestock production is estimated at more than $900 million Malaysian Ringgit with the poultry and swine sectors contributing about 70 percent of this total. The rate of growth of livestock production is estimated at 6 to 7 percent annually.

The swine and poultry industries are advanced and well established in Peninsular Malaysia. Although per capita egg and poultry meat consumption has more than doubled between 1960 and 1976, production has kept pace with demand. In comparison, the development of the ruminant sector has been slow, although in recent years much effort has been directed at establishing a dairy industry through massive importation of crossbreds and upgrading of local cattle.

The relatively stable demand and the reasonable price of livestock products over the last fifteen years have con–tributed significantly to the growth of the industry.

Poultry meat and eggs are consumed by a comparatively large proportion of the population in Sabah. The swine sector in the state has benefited greatly from the intro–duction of improved breeds of swine and is currently self–sufficient in swine products. To date, the production of beef is more than 90 percent of domestic requirements. Sabah imports 75 percent of its goat meat and mutton requirements.

Sarawak is about 90 percent and 100 percent self–sufficient in its poultry meat and egg requirements, respect–ively. It also produces all its pork requirements and is presently 20 percent self–sufficient in beef. The contribu–tion of local milk production for consumption is negligible. Goat meat and mutton production in this state is very small although supplying about 70 percent of its domestic requirements.

The livestock population in Malaysia for 1977 is given in Table 9 and consists of 317,000 buffalo, 469,000 cattle, 360,000 goats, 53,000 sheep, 1.5 million swine, and 24 million poultry throughout the country. A large propor–tion of the livestock population is located in Peninsular Malaysia.

TABLE 9 The Population of Farm Animals in Malaysia, 1977

Species	Peninsular Malaysia	Sarawak	Sabah[a]	Total
Cattle	428,300	10,300	30,400	469,000
Buffalo	212,800	7,200	97,400	317,400
Goats	332,300	10,300	17,200	359,800
Sheep	51,500	Negligible	1,100	52,600
Swine	1,186,400	172,700	151,200	1,510,300
Poultry	19.2×10^6	1.76×10^6	2.16×10^6	24.12×10^6

[a]Estimated for 1977 from 1975 figures, assuming a four percent annual increase.

Livestock Policy and Programs

The country, in its efforts to eradicate poverty and restructure society through the realization of the New Economic Policy, basically has three broad policy objectives for livestock development:

- To develop the production of livestock and its products to meet national requirements and export demands.
- To create employment opportunities.
- To raise the income level of farmers, particularly the small producers.

To attain these goals, developmental strategies and aggressive programs have been formulated and implemented under the present Third Malaysia Plan.

One of the important strategies adopted is to establish dairy and beef industries in the country and upgrade the quality of local cattle through a massive (10,000 head yearly) importation of crossbred breeding cattle from overseas. For the systematic development of the dairy industry, several milk collection centers, inducing smallholder participation have been established. This program provides a package deal that includes extension services, milk collection and marketing outlets, feed and credit services, artificial insemination (A.I.) and veterinary services for rural farmers. An extensive cattle A.I. service has been planned to enhance the quality of local cattle through the use of imported, deep–frozen semen from developed countries. Several large commercial dairy units have also been implemented by the National Livestock Development Authority, where sources of animals for beef fattening programs are an off–shoot, or "by–product."

As with the dairy program, smallholder poultry programs have been implemented in various parts of the country to encourage participation of smallholders in poultry keeping to help supplement their monthly income.

The poultry industry has been well established by the commercial sector and it is anticipated that future development of this sector will essentially be one of consolidation to increase productivity and move towards integration. The development of the swine industry, likewise has been one of rapid expansion in the last two decades. Small and large commercial units exist throughout the country and in the next ten years, there should be evidence of increased efficiency through better management and husbandry methods. Future local requirements for pork will be met through increased expansion of swine farming units.

LOCAL PRODUCTION AND PROJECTED DEMANDS

Poultry Meat and Eggs

The poultry industry in general can be said to be well established in Peninsular Malaysia and meets the country's total requirements for poultry meat and eggs. Local production of poultry meat in 1978 was estimated at 104,000 metric tons. Projected estimates indicate that domestic requirements will rise to 317,540 metric tons in 1990, representing an annual increase of 15 to 16 percent. Local egg production in 1978 was 2175 million eggs and demand for domestic consumption is expected to reach 5212 million by 1990.

Further development of the poultry industry will be one of rapid expansion and it is anticipated that the projected demands will be met through local production.

Pork

As with the poultry sector, the swine industry in the country is stable and well developed. The country is self–sufficient in pork requirements. Pork production was estimated at 57,000 metric tons in 1978, and it is projected to reach 143,600 metric tons by 1990.

Beef and Dairy

The total cattle population is estimated to grow at a rate of 5 percent for oxen and 1 percent for buffalo. There has been a decline in buffalo numbers in recent years due to the introduction of mechanization in double crop paddy areas. Slaughter of cattle amounted to over 77,000 head in 1977, 40 percent of those were buffalo. In 1977, the beef sector produced more than 12,000 metric tons of meat. Annual milk production is currently estimated at 23 million liters.

While future ruminant production and development as a whole will take on a less dramatic role as compared to the poultry and swine sectors, the beef industry in Peninsular Malaysia is expected to increase its current self–sufficiency status from 65 percent to about 80 percent by 1990. Dairy development will expand steadily and milk production will increase from present consumption levels of 396 million liters to 539 million liters.

Goat Meat and Mutton

The goat and sheep industry is a rather small and insignificant one. Current meat production, largely from goats is small and is estimated at over 800 metric tons. Much of the domestic goat meat and mutton requirements are met mainly through imports of chilled or frozen lamb from Australia and New Zealand.

Further development of the goat and sheep sectors will be centered on the annual importation of 2000 breeding animals to augment the existing goat population and improve breed quality. Live sheep imports for slaughter will be continued to meet domestic demands. Local goat meat and mutton requirements for Malaysia is expected to reach over 8100 metric tons by 1990. The demand projection of various livestock products for the country for 1990 is given in Table 10.

Credit

Credit plays an important component in livestock production. For both the smallholder and commercial enterpreneur, credit availability in the form of short, medium, or long term loans with low interest rates (at 8½ to 9 percent) is available through the Agricultural Bank and also other commercial banks. In recent years, in an attempt to stimulate greater smallholder participation in agriculture in the rural areas, commercial banks were urged to provide "soft–term" loans (with easy payment terms).

Subsidies, as opposed to credit, are also provided by government institutions. The Veterinary Department executes several forms of subsidy programs for livestock raisers. Direct financial assistance is avoided in subsidy programs, and assistance is provided in the form of infrastructure establishment, and/or purchase of stock, etc.

Marketing of Livestock Products

The overall development of the poultry and livestock industries are closely dependent upon the general efficiency of the marketing system, which will influence prices received by producers and also ensure the supply of livestock products at competitive prices to consumers.

In a country with several major community groups and religions, the demand for and supply of meat depend upon the religious customs and acceptance of the population. Beef is mainly consumed by the Malays and shunned by the Chinese. Indians prefer goat meat and mutton. Malays do not consume pork and nearly all the pork produced is consumed by the Chinese populace. Poultry meat is generally accepted by all groups.

While there has been some measure of progress in recent years, notably in the slaughtering of cattle and swine, and in some urban retail establishments, the livestock marketing system in the country is largely characterized by a lack of sophistication, small fixed capital, and rudimentary facilities. In spite of these limitations, it offers an efficient and valuable service.

The major portion of the livestock produced in Malaysia is accounted for at the fresh market with relatively negligible percentages going into processing. In recent years, however, there has been a subtle displacement towards chilled and processed livestock products.

In 1973, an Act was passed that charged the National Livestock Development Authority as being the statutory and only official agency responsible for the promotion of efficient and effective marketing of livestock and livestock products, including poultry and fodder. It has powers to regulate marketing through licensing at all levels, including retailing and processing. Although still in its infancy, it has initiated centralized and orderly slaughtering of swine and cattle in the urban and suburban areas through the establishment of modern, hygienic and regional slaughter houses or abattoirs.

TABLE 10 The Projected Demand of Livestock Production in Malaysia in 1990

		Total domestic requirements in 1990			
Commodity	Unit	Peninsular Malaysia	Sabah	Sarawak	Total
Beef	Metric tons	31,344	3,700	5,336	40,380
Milk	Million liters	539	n.a.	n.a.	539
Poultry meat	Metric tons	274,864	34,312.5	8,363	317,540
Eggs	(No) million	4,700	223.4	288.7	5,212.1
Pork	Metric tons	106,340	22,364	14,909	143,613
Mutton	Metric tons	8,014	93	n.a.	8,107

Source: Veterinary Division, Ministry of Agriculture

Generally, it can be said that there are two types of marketing patterns for livestock and livestock products, especially in the poultry sector, that can be found in the country. These are direct marketing and chain marketing. Direct marketing, or door–to–door sale of produce, is generally engaged in by small producers in the rural areas. Chain marketing consists of wholesalers, middlemen, and retailers, and such a marketing system is used by the commercial farming sector.

Until recently, milk marketing has been insignificant and restricted to door–to–door sales by milk vendors who own small dairy herds in the suburban areas. Under the Third Malaysia Plan, a concerted effort has been made by the Veterinary Department to establish a dairy industry through the implementation of a program on milk collecting centers, particularly among smallholders. Milk marketing from the centers is handled by the Department and has contributed to the orderly and effective disposal of milk in those areas where the scheme has been implemented.

The present marketing system appears fairly efficient in light of the apparent lack of sophistication. However, improvement is apparent in market intelligence, alternative market outlets, and price stability due to government intervention.

GOVERNMENT REGULATION AND ASSISTANCE

Quality Control

Presently, there is no Animal Feeds Act or Regulation pertaining to animal feed quality. Some small measure of control is exercised through the Price Control Order of 1974, and the Trade Description Act of 1972.

The Price Control Order of 1974, stipulates that manufacturers, importers, producers, or wholesalers must affix labels to include the ingredients and quantity or proportion of the ingredients in bagged animal feeds.

Currently, nearly all feedmills affix labels to the bags of animal feeds. However, the degree of identification of the various items under nutrient composition varies with individual feedmill operators.

The Trade Description Act of 1972, simply stipulates that the description given must comply to the contents per se. While direct government intervention into the quality control of compounded feeds has so far been minimal and restricted to the requirement for the proper labeling of feed products, proper nutrient specifications have been left to the responsibility of the Standards and Industrial Research Institute of Malaysia (S.I.R.I.M.), a quasi–government institution. Draft standards on various commodities, including animal feeds, have been executed through several technical sub–committees which consist of representatives from the interested government agencies, quasi–governmental institutions, and the private sector. Their sole responsibility is to draft specification standards. To date, specifications for a glossary of terms for animal feedstuffs and specifications for specific feed ingredients such as bloodmeal, groundnut meal, tapioca chips, mineral mixtures used as supplements, and finished feed products for poultry, swine, and cattle have been published and released. While standards and specifications pertaining to animal feedstuffs also exist, compliance, however, is at present on a voluntary basis. Local feedmills are gradually adopting these standards.

The absence of any legislation on animal feed description and quality in the country has been a growing concern among many farmers and also among larger feedmill operators. An Animal Feeds Act and other regulations have recently been drafted and are presently under active consideration.

Tariffs

There are no regulations pertaining to the use of selected crops or feedstuffs as animal feeds. The extent to which the selected feeds and their products are being used in the various outlets is determined primarily by the availability of the product, market prices, and other competitive factors.

Nine major feed items are given tax exemption for feedmills, producers, and importers for use in animal feeding and these are, maize, soybean meal, groundnut cake, sorghum, meat and bone meal, maize germ, rape seed meal, sesame cake, and whey powder.

As a measure toward protecting local industries and promoting greater utilization of locally produced feedstuffs, tax exemption is not given for rice bran, fish meal, copra cake, tapioca chips and refuse, wheat bran (pollard) and grain, groundnuts, rolled oats, maize flour or flakes, and leaves, linseed oil meal, and limestone. All these feed items are subject to a five percent surtax

For feedmills and producers, a three percent tax exemption is given for some specific antibiotics, drugs, medicines, minerals, vitamins and amino–acids, together with other feed items such as blood and bone meal/dust, cod liver oil, skim milk powder, barley and cotton seed waste.

A tariff of five percent is also levied on imported prepared feeds. However, very little is imported at the present time. Also, there is a 5% export duty imposed on prepared or finished feeds.

Existing Incentives

Several investment incentives are offered to the animal feedmilling industry. Animal feed manufacturing projects are eligible for the Accelerated Depreciation Allowances under the Income Tax Act of 1967, and for all the incentives under the Investment Incentives Act of 1968 which include; pioneer status, labor utilization relief, locational incentive, investment tax credit, export incentive, and increased capital allowances. In addition to the above, companies are also eligible to be considered for tariff protection and concessions.

Other Assistances

Government aid to selected feed crop production takes the form of subsidies to small farmers, the provision of farm credit, extension services, marketing, and processing services.

In an effort to stimulate smallholder participation with the objective of raising rural farm income, subsidies are given to participants who have a minimum of one half acre to a maximum of five acres of land. The subsidy is in the form of improved planting materials, agricultural chemicals, essential equipment, and land improvement. Subsidies totaling $150 to $200 Malaysian Ringgit per acre are provided to feed crops such as maize, soybean, sorghum, tapioca, and groundnut, under the Agricultural Inputs and Diversification Program.

The Farmers' Organization Authority within the Ministry of Agriculture, and the Agricultural Bank provide both short and long–term credit and loans to farmers with easy repayment periods and low interest rates.

Marketing of the produce is primarily undertaken by the Farmers' Association and Cooperative, and the Federal Agricultural Marketing Authority. The latter supervises and coordinates such activities as purchase, assembling, transport, processing, grading, etc.

REGIONAL COOPERATION AND ASSISTANCE

Several countries within the region are striving toward the development of viable livestock industries in their countries. Their livestock development programs are focused on the small farmers and landless agricultural laborers. Regional cooperation and assistance have enhanced these efforts.

The following are possible areas of regional cooperation and assistance for further discussion at this workshop:

- A regional program to coordinate the research being conducted on feed resources and feeding systems. Establish a center within the region, to effectively catalyse development and strengthening of coordinated research, both nationally and/or regionally in the areas of feeding systems, new feed resources, etc. The basic activity would be to bring together results of existing research studies where feeding systems have been developed for the effective utilization of agricultural by–products such as paddy straw, sugarcane tops, etc., in animal diets and to provide for an accelerated effort in developing programs where none exist. In this way, the latest technology emanating from such a center may be rapidly disseminated and adapted to other countries in the region.
- Quality Control: standardization of nutritive terms and guarantees of important nutrients contained in the feed resources produced and exchanged among countries within the region.
- The interchange of information among countries within each region on specific areas such as the utilization of feed resources and technological development.
- Provision of market analysts on feed commodities (forecast in production and availability of feedgrains and feedstuffs) within the countries for the promotion of effective trade.

FEED INDUSTRY IN SRI LANKA

Country Paper

A. S. B. Rajaguru and Asoka Siriwardene[1]

BACKGROUND

Sri Lanka has a land area of 6.4 million hectares and a population of 14 million growing at the rate of 1.9 percent per annum. About 80 percent of the population live and work in the rural areas. The economy is largely dependent on agriculture. Of a total labor force of 4.1 million, 52 percent are employed in crop production. Agriculture contributes 33 percent of the Gross National Product.

The livestock industry accounts for about 7 percent of the gross value of agricultural production. The livestock population, based on the last Census of Agriculture (1971), comprises 989,000 cattle, 387,000 buffalo, 284,000 goats, 17,000 sheep, 42,000 swine, and 3.7 million poultry. Development of the livestock industry has been given high priority by the government because of the urgent need to raise the nutritional standards of the people. The levels of consumption of animal protein foods is very low. The per capita consumption of animal products in 1978 was as follows:

Product	Per Capita Consumption
Milk	1.5 oz per day
Beef	3.5 lb per year
Pork	0.35 lb per year
Poultry meat	0.5 lb per year
Goat meat	0.17 lb per year
Eggs	19.0 per year

The current development plans foresee substantial increases in production, particularly of dairy and poultry products.

THE DAIRY INDUSTRY

At the present time, 60 percent of the nation's milk requirement is produced in the country; the balance is imported. The bulk of the milk produced locally comes from the central mountains region, where climatic conditions are favorable for temperate breeds of cattle. Three breeds, namely, Friesian, Ayrshire, and Jersey and their crosses form the bulk of the cattle population in this region and the levels of production range from 8 to 12 liters per day. The low country comprises the dry zone and the coconut growing region, which carry 53 and 25 percent of the cattle population, respectively. However, together these two zones contribute only 25 percent of the total quantity of milk marketed. The reason for this is that the cattle in this region are either low producing indigenous stock or stock up–graded with Zebu–type milking breeds. This region, nevertheless, has considerable potential for improvement in the form of land availability and natural grasslands. The development plans of the government aim to improve the milk production potential of the indigenous cattle through a program of cross–breeding, improvement of milk collection, and marketing facilities.

Milk is marketed both in its fresh form and as processed milk. The National Milk Board collects approximately 50 percent of the milk produced in the country, which amounts to 250,000 liters per day.

THE POULTRY INDUSTRY

The layer population in 1978 was estimated to be 1.0 million under intensive management and 1.4 million under non–intensive management. Generally, no commercial feed is fed to the latter category. The former category is almost entirely maintained on deep litter and fed compounded feeds. The replacement stock is supplied both by the government sector and the private sector. The government hatcheries provide about 50 percent of the required stock. The average production is 220 eggs per year and the industry provides all the required eggs for local consumption.

The broiler industry operates on a relatively small scale, producing about 50 percent of the requirements of chicken meat. The total broiler meat production amounts to around 2000 tons each year. The average feed conversion efficiency is 3.5:1.0 for dressed broiler meat.

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THE SWINE INDUSTRY

Commercial swine production in Sri Lanka is of relatively recent origin and, therefore, has not developed to the same extent as the cattle and poultry industries. This is also due to the fact that feed costs are high in relation to the sale price of swine products. About 80 percent of the swine population are small indigenous types maintained in backyards as scavengers, or fed swill and refuse. Imported breeds are, however, maintained by the commercial breeders who rely more on farm mixed feeds and swill rather than on commercial feeds.

FEED RESOURCES

The livestock and poultry industry in Sri Lanka is sustained almost entirely on local feed resources. Cost of feed material is considerably lower than cost of imported feed, and thus the use of imported material becomes uneconomical. The only items of feed material that are imported are animal protein feeds, vitamin/mineral premixes and feed additives. In recent times, with the intensification of animal husbandry development, the local feed resources are being fully utilized. The situation at the present time is that demand for feed is so great that every possible effort is being made to make maximum use of all available material.

In the past, dairy farmers paid little attention to pasture establishment and its utilization. Milk production was heavily dependent on concentrate feeds. With increasing demands for concentrate feeds by poultry producers, feeding practices of dairy farmers are receiving close scrutiny. A concentrated effort is now being made to change dairy farmers from feeding excessive amounts of concentrate feeds and to encourage them to make better use of improved pasture forage.

Table 1 gives the quantities of the major feed materials available in the country. Coconut meal, rice bran and wheat bran form the bulk of the available resources and these three ingredients form the basis of all compounded feeds.

TABLE 1 Raw Material Availability in 1979

Item	Tons Per Year
Maize	10,000
Coconut meal	45,000
Wheat bran	20,000
Rice bran	20,000
Gingelly meal	5,000
Rubber seed meal	2,000
Kapok seed meal	2,000
Soybean meal	500
TOTAL	104,500

Maize is a seasonal crop grown in small holdings. The annual production varies considerably depending on the rainfall pattern. The crop in 1979 was poor because of extensive damage caused by a cyclone. Production in other years range from 15,000 to 20,000 tons.

Coconut meal is available in three forms; as *chekku poonac*, meal from low pressure expellers, and that from high pressure expellers. The *chekku* process is a primitive procedure whereby copra is crushed in a mortar and pestle type of mechanism powered by bullocks. Oil extraction is inefficient and the resultant meal contains around 15 percent oil. Most of the mechanized mills are equipped with low pressure expellers which produce a meal with an oil content of 7 to 8 percent, whereas meal from high pressure expeller mills contains only 3 to 4 percent. One major problem with coconut meal containing high levels of oil is its poor keeping quality. Rancidity and mold growth develop readily under the prevalent hot, humid environmental conditions.

Rice bran is variable in quality depending on the efficiency of the milling process. Two types of rice mills are used in Sri Lanka. The most common is the old huller type which removes both the bran and the hull in one operation. The resulting bran contains high fiber, ranging from 13 to 20 percent. This bran is designated Rice Bran No. 2. The newer cone type rice mill, on the other hand, polishes in two stages, the first removes the hull and the second the bran. The bran has less than 12 percent fiber and about 13 percent crude protein. Rice bran also has a high oil content (13 to 14 percent) and thus is susceptible to deterioration during prolonged storage. No facilities are as yet available for de-oiling bran.

Wheat bran is available from the State Flour Milling Corporation which produces a high quality bran. This consists of a mixture of bran (pollard) and wheat germ. The quality is very consistent and thus is preferable to rice bran.

Gingelly (Sesame) meal is mostly produced by the *chekku* process. To facilitate milling, a quantity of chopped straw is generally fed in with the seed. The result is that the meal has relatively less protein and more fiber. The expeller processed meal contains about 40 percent crude protein.

Rubber seed meal has been shown to be a very good substitute for coconut meal when produced from decorticated seed. However, practical difficulties have arisen in milling due to the gummy nature of the rubber seed kernels. To overcome this problem, millers have resorted to milling a mixture of 50 percent decorticated seed with 50 percent undecorticated seed. The meal produced has high fiber and low protein (12 to 15 percent). Feeding is hazardous due to the presence of sharp–edged shell material.

Kapok seed meal has come into use as a livestock feed during the last 4 years. The meal has 20 to 30 percent crude protein and has shown promise as a satisfactory protein supplement. Unfortunately, it is now evident that toxic factors are present in kapok seed meal which have produced growth depression when fed at low levels and mortality at levels above 30 percent in the feed. Eggs from hens fed as little as 3 percent kapok seed meal developed pink colored egg whites and viscous yolks when stored under refrigeration. The presence of cyclopropenoid compounds in kapok seed is said to bring about this change in eggs. Kapok seed meal use has been discontinued in swine and poultry feeds.

FEED INDUSTRY

Approximately 80 percent of the compounded feeds marketed in Sri Lanka are produced by two state–owned provender mills. Together, these two mills produce the quantities of feed listed in Table 2 below.

TABLE 2 Feed Output in Ton's Per Year

Item	Tons
Chick mash	5,000
Grower mash	6,000
Layer mash	57,000
Breeder mash	2,000
Broiler starter mash	2,500
Broiler finisher mash	3,500
Cattle feed	18,000
Swine feeds	500
TOTAL	94,500

Feed manufactured by the State–owned mills are marketed at subsidized rates as an incentive to development. The feeds are issued on a quota basis both to direct users and retail agencies. These quotas are determined on the basis of demand and stock numbers. There is, however, a ceiling on the quota allowed, to encourage small farm operations so as to give the industry a broad base.

The role of the private sector is thus limited to the supply of feed to large commercial farms and those who receive inadequate quotas by the State. As may be expected, heavy demands are made for feeds produced by the State sector, not only because of the subsidy, but because these feeds are consistent in quality. A proportion of the large commercial farms also resort to custom mixing to maintain quality of feeds.

The composition of some conventional and non–conventional feedstuffs available in Sri Lanka are given in Table 3.

PROBLEMS RELATING TO FEED STANDARDS

The inadequacy of feed supplies is perhaps the major constraint on livestock development. Efforts are being made to evaluate a variety of agro–industrial waste products as potential feed. Some of the products being investigated are manioc (tapioca) leaf meal, tea refuse, fish silage, alkali treated straw, and sugar cane waste products. Although future prospects are encouraging, the present shortage of feed has slowed down the pace of development.

Adulteration of feeds is inevitable in a situation where feed is in short supply. The problem exists with raw materials as well as with mixed feeds. At the present time, although feed standards exist, implementation of a quality control measure is not possible because of inadequate government regulations. Statutory provisions are to be made in the near future to overcome this problem.

Deterioration in feed quality both during processing and storage is a serious problem. Maintenance of buffer stocks of feed material is necessitated by seasonal fluctuations in availability. Deterioration in feed quality occurs readily in feeds stored in the tropics. Production of mycotoxins in stored feeds and the extent of damage to livestock remains to be investigated.

It is evident that considerable loss of production in poultry occurrs due to the deterioration of vitamins contained in premixes. All vitamin/trace mineral premixes are imported. Often such premixes are held in storage for periods ranging from 4 to 9 months. These premixes do not appear to retain potency of vitamins beyond 3 months of storage.

GOVERNMENT REGULATIONS

As mentioned earlier, no legal safeguards exist for the maintenance of feed quality. Statutory provisions are to be made in the near future to regulate, supervise and control the manufacture, importation, and sale of animal feed. The proposed regulations will provide for the licensing of all manufacturers, importers, and vendors, the fixing of minimum standards, and quality control. Manufacturers will be required to state on packages the nature and composition of the feed marketed together with the maximum levels of any deleterious substances.

TABLE 3 Composition of Some Conventional and Non–Conventional Feedstuffs in Sri Lanka

Feedstuff	International feed number	Dry matter (%)	Crude protein (%)	Fat (%)	Crude fiber (%)	Ash (%)
Sugarcane, bagasse, dehy or sun–cured	1–04–686	92.1	2.32	0.03	53.11	1.99
Coconut, meats, meal manually extd (*Chekku*)	5–21–283	90.1	19.18	15.27	15.34	7.94
Coconut, meats, meal mech extd	5–01–572	92.8	20.4	8.6	12.0	6.9
Coconut, meats, meal solv extd	5–01–573	92.5	21.2	1.8	15.0	5.6
Fish, meal mech extd	5–01–977	92.9	37.18	–	–	42.41
Sesame, seeds, meal mech extd (Gingelly)	5–04–220	92.8	47.42	5.10	5.52	12.51
Shad, nicaraguan, leaves, dehy (Gliricidia)	1–11–665	92.4	20.2	3.9	13.0	10.7
Kapok, seeds, meal mech extd	5–21–137	88.2	27.0	8.2	23.0	6.3
Maize, grain	4–02–879	89.8	10.7	3.8	2.36	1.98
Cassava, common, leaves, dehy (Manioc)	1–10–768	92.0	22.3	8.74	16.84	8.98
Cassava, common, starch process residue, dehy (Manioc)	4–11–974	88.4	2.6	1.56	10.35	2.31
Rice, bran, 6–12% fiber	4–26–378	89.3	13.4	14.6	8.7	8.9
Rice, bran, more than 12% fiber	4–26–201	89.7	8.9	6.5	19.1	19.6
Rice, grain	4–03–939	91.8	10.36	1.62	1.56	3.28
Rubbertree, para, seeds without hulls, meal mech extd	5–03–959	89.6	23.62	10.93	9.86	5.89
Wheat, bran	4–05–190	92.0	14.1	4.9	9.1	4.7

GOVERNMENT REGULATIONS AND ASSISTANCE IN THAILAND

Country Paper

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GOVERNMENT REGULATIONS

The feed Quality Control Act was enacted in 1963 and revised in 1978. It is administered by the Department of Livestock Development, Ministry of Agriculture and Cooperatives, to regulate and control the manufacture, importation, and sale of animal feed. This act prevents the fraudulent sale and adulteration of feed offered in the marketplace.

Animal feeds covered under this act are defined as:

Single feed ingredient. These ingredients include soybean oil meal, peanut oil meal, and fish meal.

Mixed concentrates. These are mixtures of feed ingredients containing a high amount of protein, vitamins, and minerals intended to be used as a complete feed after the addition of energy providing materials such as cereal grains and their by-products.

Complete feeds. These are mixtures of feed ingredients that will furnish the nutritive requirements of a certain type or species of animals, e.g. complete layer mash.

The Minister of Agriculture is empowered to issue ministerial regulations. These are:

- Requiring persons licensed to manufacture and sell animal feed to register the type and trade name of the feed.

- Establishing standards and quality control for animal feeds manufactured in terms of crude protein, crude fat, crude fiber, and moisture content.

- Authorizing the use of various substances or chemicals to preserve the quality of animal feed.

- Providing specifications on the use and nature of boxes, parcels, or containers used for animal feeds.

- Requiring the use of labels indicating brand names, net weight, and chemical composition.

- Prescribing the conditions for the use and sale of damaged animal feed and adulterated animal feed.

No one shall be allowed to manufacture animal feed for sale or to trade animal feed without first obtaining a license from the competent authority.

It shall be unlawful for any person to engage in the manufacture or sale of animal feed without having first registered a discription of the feed by name and chemical composition.

No change in the brand of a registered feed shall be made without a written notification to the proper authorities. The Director General is empowered to cancel the registration of any feed that does not conform with the provisions of this act.

No commercial feeds shall be registered:

- If the brand name thereof is identical, or will likely be confused with a brand name that has already been applied to a registered feed.

- If the specific name of each and every ingredient of the mixture is not clearly stated; or

- If the feed does not conform to the provisions of this act.

Every package containing feed shall be labeled as follows:

- Each label shall be in Thai, must be legible, clear, and distinct in its meaning.

- Labels of a single ingredient shall show clearly:
  Net weight
  Name and address of manufacturer
  Brand or trade name

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

Name of article
Minimum crude protein
Maximum fat
Maximum fiber
Maximum moisture
Registration number

- Labels of feed mixtures shall show clearly:
  Net weight
  Name and address of manufacturer
  Brand or trade name
  Nutritive purpose
  Minimum crude protein
  Maximum fiber
  Minimum fat
  Maximum moisture
  A list of ingredients used
  Registration number

In the implementation of this act, the government authorities may enter the premises of any licensed business in order to inspect the animal feed, equipment, and other documents, and to take small amounts of the available animal feeds as samples for chemical analysis.

The methods of analysis as published in the Official Methods of Analysis of the Association of Official Agricultural Chemists shall be used in making the analysis.

Results of analysis will be recorded in the files of the Department of Livestock Development and confidential copies furnished the manufacturer.

The sale of damaged feed or adulterated feed is prohibited.

The number of feed manufacturers, retailers, and animal feeds registered in 1978 and 1979 are shown in Table 1.

TABLE 1 Number of Feed Manufacturers, Retailers, and Animal Feeds Registered

Item	1978	1979
Manufacturers	30	30
Retailers	1,038	1,700
Animal feeds	968	1,350
Mixed concentrates	387	495
chicken	174	214
swine	137	186
duck	76	95
Complete feeds	581	855
chicken	337	455
swine	215	332
duck	29	54
cattle	0	14

GOVERNMENT SERVICE

Aside from the license fee ($7.50 for the manufacturer and $5.00 for the retailer), no registration fee or inspection fee shall be levied.

INVESTMENT PROMOTION

The animal feed manufacturers can get promotional support from the Board of Investment under the following conditions:

- A capital investment must not be less than 10 million Baht (0.5 million US dollars) excluding cost of land and working capital.
- No less than 60 percent of the registered capital must be owned by Thais.
- Factory must be located outside Bangkok Metropolis.

Under the investment promotion program some incentives are:

- An exemption or a 50 percent reduction of import duties and business taxes on imported machinery.
- Reduction of import duties and business taxes of up to 90 percent on imported raw materials and other feed ingredients.

ANIMAL INDUSTRY IN THAILAND (FEED END–USERS)

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SUMMARY

In the past decade, the livestock industry in Thailand has become more commercialized. In particular, the poultry industry has changed from a "backyard" type of operation to a modern and efficient industry. The swine industry has also become more commercialized. The government is currently putting a great emphasis on upgrading the cattle industry.

The major objective of a livestock industry is to produce food for people in the most efficient way possible. In order to accomplish this objective, both the government sector and the private sector must analyze the problems that still exist in the livestock industry and try to solve the problems in the most sensible way.

INTRODUCTION

Most of the animal feed produced by the commercial feedmills in Thailand is used by the poultry and swine industries. Less than one percent is used by the cattle industry.

Table 1 classifies the poultry and swine industries by size of the production unit and the percentage contribution of each group to each particular industry. The production units are grouped into large, medium, and small by the number of animals at each farm.

Table 2 lists the approximate number of commercial broilers, eggs, and swine produced in 1979.

MARKETING

Broilers Approximately 70 percent of the broilers produced are sold directly by farmers to processors. Approximately 20 percent are sold under guarantee buy back price to the feed dealers, commercial feed companies and processors. The remaining 10 percent are pre–sold under contract to feed dealers and processors.

Eggs The majority of farmers sell eggs to egg whole–salers. A small number of farmers sell directly to the retailer in the market place.

Swine All of the commercial swine produced are sold directly to processors.

TABLE 1 Classification of the Poultry and Swine Industries by Size and Contribution (in percent) of Each Group to the Total Production of the Industry

Group	Industry	Number of Animals	Percent Contri-bution
Large	Broiler	Over 30,000	20
	Layer	Over 10,000	15
	Duck layer	Over 5,000	10
	Swine (sow)	Over 200	15
Medium	Broiler	10,000–30,000	55
	Layer	3,000–10,000	25
	Duck layer	1,500– 5,000	35
	Swine (sow)	50– 200	35
Small	Broiler	Under 10,000	25
	Layer	Under 3,000	60
	Duck layer	Under 1,500	55
	Swine (sow)	Under 50	50

TABLE 2 Approximate Production of Broilers, Eggs, and Swine in 1979

Item	Thousands per year
Broilers (1.65 kg. live wt.)	115,900
Eggs (hen) (dozen)	131,235
Eggs (duck) (dozen)	75,000
Swine (120 kg. live wt.)	4,380

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PRODUCTION COST

The production costs for medium size farms are as follows:

Production cost per kilo broiler — Estimated production cost for broilers in 1980 based on $235 per ton feed cost, 30 cents each chick cost and a feed conversion ratio of 2:1 are as follows:

Cost of Producing a 1.65 Kilo Broiler	U.S. Dollar
Feed (1.65 x 2.00 x 23.5)	$ .775
Chick	.30
Medication	.05
Litter	.015
Utility	.015
Labor	.02
Depreciation	.03
Total production cost	$1.205
Present market price/kilo for live broiler	.83
Cost of production of broiler/kilo	.731
Growers' profit/kilo	$ .099

Production cost per dozen eggs — Estimated production cost per dozen eggs in 1979, based on $180 per ton feed cost and hen house production of 230 eggs per hen.

Cost Per Dozen Eggs	U.S. Dollars
Feed cost (2.28 kilo per doz.)	.41
Pullet cost	.10
Medication	.01
Labor	.01
Depreciation	.01
Utility	.005
Miscellaneous	.005
SUBTOTAL	$ .55
(less) sales of spent hens	.05
Average price/dozen	.60
Production cost/dozen	.50
Grower profit/dozen	$ .10

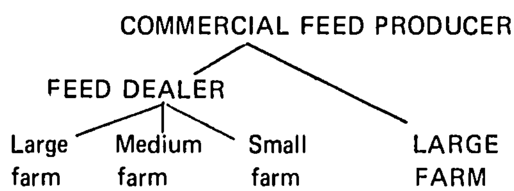
Today, all of the commercial broilers in Thailand are raised in open side broiler houses. Eighty percent of the layers are raised in wire or wooden cages.

Production cost per swine — Production cost for commercial swine in 1979, based on an average feed cost of $180 per ton and feeder swine cost of $30 (12 kg live wt.).

Cost of Production up to 120 kilo live wt.	U. S. Dollars
Feeder swine cost	$ 30.00
Feed cost (360 kilo x $180/ton)	64.80
Medication	2.50
Labor	1.50
Utility	0.60
Depreciation	3.00
Total Cost of Production of 120 kilo swine	$102.40
Total cost of production per kilo	.85
Average market price per kilo (live wt.)	.93
Growers' profit/kilo	$ .08

Large and medium size swine operations raise swine in houses with concrete floors.

CREDIT SYSTEM



Feed Credit

Since feed is the major cost item in the production of meat and eggs, the feed dealers play an important role in financing the medium and small size farms. The majority of medium and small farms rely on the dealers for feed credit. The large farms that purchase feed directly from the commercial feed producers can obtain feed credit from their suppliers. The credit terms from the feed dealers and the feed producers run from 15 to 45 days.

Building Credit

Medium and large operations can obtain loans from commercial banks. The small farmers have a very difficult time in obtaining bank loans. Therefore, they have to rely heavily on feed dealers to extend more feed credit, or accumulate sufficient funds from their existing operation to expand.

The International Network of Feed Information Centers (INFIC) System

A review of the history and organization of INFIC, an explanation of the procedures used in describing feeds, and a discussion on the merits of an INFIC Center in Southeast Asia

USAID SUPPORT TO ANIMAL PRODUCTION IN DEVELOPING COUNTRIES

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I wish to commend all who have arranged this occasion and thank those who are sponsoring this workshop in conjunction with Utah State University. I am pleased to have this opportunity to make a few opening remarks on the livestock program of the United States Agency for International Development, commonly know as USAID or more simply, AID. I shall make a few remarks on AID's objectives, some of its functions, and its interests in the subjects to be discussed here.

AID's activities are directed primarily toward assisting the poorest citizens of the Developing Countries. Many of these people live in rural areas and are farmers; they make their living by growing crops and/or livestock. These low-income farmers may be involved in only one type of agriculture production, such as rice or they may receive their income from a combination of several activities like producing garden vegetables, dairy cattle, and coconuts. The basic objective of AID-agriculture is to promote programs which will improve the conditions of the low-income farmers through increasing the quantity and improving the quality of food products they produce. AID sponsored programs are implemented in food and livestock production to supplement projects underway or to "plug the gaps" in agriculture activities not adequately covered by other programs. AID sponsored programs are never generated to take the place of "on-going" programs of the developing countries. Instead, they are designed to assist country programs, using the project approach as the package through which that assistance is provided.

Within AID there are several bureaus, offices, and divisions. One of these units is called the Development Support Bureau (DBS) which is made up of the Office of Agriculture, Human Nutrition, Rural Development, Science and Technology, Energy, Health and others. This Bureau is centrally funded and serves to provide support to the four regional bureaus which in turn relate to the field missions in countries which are designated to receive AID support. For example, the Asia Bureau has the coordinating function for the AID Missions in South-east Asia. Within the Office of Agriculture, we have various subject matter divisions such as Crops, Soils and Water, Economics, Fisheries, Livestock, and Agribusiness.

What is the role of the Livestock Division in AID programs? We support the development, promotion, implementation and evaluation of projects designed to increase the production of livestock and their products by the small livestock producers of developing countries. The goals and objectives of our projects are to expand the annual income of the producers and raise their standard of living.

All of these projects require planning, budgeting, evaluating, technical inputs, advisory assistance, monitoring, and could be concerned with animal health, nutrition, reproduction, range management, sociology, economics, marketing, and by-product usage. Currently, the Livestock Division supports seven different livestock projects, some of which are worldwide in scope and others are country or regionally specific. The division also assists in livestock projects which are supported by country missions and has the responsibility for overseeing the first Title XII Collaborative Research Support Program (CRSP) which relates to small ruminants. Indonesia has been selected as one of the four primary sites. Research there will involve several aspects of goat production as related to the small farmer. Other title XII projects envisioned for the future include animal health, small farming systems, which will include a livestock component, large ruminants and water buffalo.

I have mentioned "sponsorship", "support" and areas of speciality but just how is the transfer of assistance to the

[1] Presented paper and Chief of Division
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target recipient or audience, as it is often called, accomplished? AID contracts for the services and assistance of organizations, an individual, or a consortium of institutions. In many cases, State and private universities are the sources of the technical assistance, but technical service contracts are also awarded to USDA and other government agencies, the international agricultural centers, private firms, and individual consultants. These contracts are either for a short term, like a few months, to deliver a particular product (reports, etc.) or for longer terms of two to five years for developing a "many phase program" or for improving a system in a host country. The contracts between AID and the contractor define the work that is to be done, the time it will take, any training to be accomplished, the responsibilities of the recipient country and the costs involved. Then, it is the responsibility of the contractor to establish the working relationship with agencies and individuals in the host country. In other words, the contractor must involve the host country administrators, technicians, farmers, and scientists – people like yourselves – in the project operations. Generally, the stronger the relationship between the contractor and host country, the better the results of the program. Some of the host country personnel may receive training in the United States or a formal type of training on the project site. This will depend upon the kind of project. The training portion of a project is extremely important because when AID contracts terminate, the personnel of the host country are usually on their own; they must assume the responsibility for continuing the program and hopefully build onto the program that was initiated. We hope that the accomplishments of successful projects will be used to further developments long after the departure of the contractors. Some of AID's projects in agriculture are designed to provide laboratory services, field support, and to make possible publications of manuals and teaching aids, the presentation of seminars and short courses, and the sponsorship of workshops like this one.

Now I would like to discuss two AID supported projects which are being emphasized in this region of the world. These two projects were really "born" in Latin America when the University of Florida and Utah State University cooperated in designing a project to improve the nutritional level and feeding efficiency of livestock. How did such a project get started?

Initial observations indicated that the production potential for livestock in Latin America was not being achieved. In fact, the local production of livestock products was falling further and further behind human population increases. One of the major constraints affecting livestock production was in the realm of animal feeding and nutrition. Not much was known about the nutrient content and/or the identification of locally available feedstuffs. Consequently, the project was designed to acquire nutritional information on livestock so that more efficient feeding programs could be developed for the various regions of Latin America.

Several approaches were employed to accomplish this task. In 1971, AID and the University of Florida signed a contract to compile and disseminate information on the nutrient composition of feedstuffs available for livestock feeds in Latin America. The University of Florida scientists coordinated the collection of information of feedstuffs from 21 countries and 60 laboratories in Latin America. These values were coded and then sent to Utah State University where they were summarized and prepared for publication. The University of Florida successfully completed this project in 1974 and distributed the publication entitled, "Latin American Tables of Feed Composition." Under this contract, the publication and distribution of other related booklets and manuals concerning the identification of feedstuffs and laboratory procedures were accomplished.

As an outgrowth of these joint efforts, AID contracted with Utah State University in 1974 to develop a worldwide project to establish regional feed information centers (International Network of Feed Information Centers [INFIC]) in the developing countries. The role of the Centers was to compile and disseminate feed composition information in order to facilitate the efficient formulation of livestock diets (rations). The technical assistance aspects of the contract have been provided by the International Feedstuffs Institute (IFI) at Utah State University which engages in activities relating to both developing and developed countries. The actual locations and functions of these INFICs will be discussed in some of the following presentations by Mr. Kearl and Dr. Harris.

At the completion of the University of Florida contract in 1974, a new contract was awarded in 1975 to identify, demonstrate, and develop beneficial mineral supplementation for grazing ruminants in Latin America. (Actual title was "Development of Efficient Mineral Supplementation Regimes for Grazing in the Tropics." Initially, the project leaders reviewed the available literature on minerals related to pastures and livestock in Latin America. Then they summarized and published the results. This was followed by demonstration projects with livestock owners who would loan their cattle for use in mineral studies. In all cases, scientists and technicians of host country agencies were deeply involved in the studies which the University of Florida coordinated. The success of this project in Latin America has stimulated the extension of the scope of the project to include national and international institutions in host countries in other parts of the world. Consequently, the University of Florida is now giving attention to the mineral problems in Indonesia, Malaysia, Philippines, Thailand, and a few countries in Africa. You will hear more about these activities from Dr. McDowell who will be speaking later this morning.

Although the activities of the Utah and Florida contracts are different they are also related. The overall objective of the current projects are to provide technical assistance that will have applicability, on a broad basis, in the development of efficient feeding systems. The ultimate goal of these projects and the programs that emerge from them is the development of year around feeding systems for cattle, sheep, goats, and buffalo, using grasslands that are not suitable for cultivated crops and crop residues and other feedstuffs that are not suitable for human consumption. Particular attention is given to native rangelands, seeded and fallow pastures, and combinations of crop residues and cultivated forages on smallholder crops/livestock farms. A major focus of the program is identifying and correcting nutrient deficiencies in pastures, forages and other feedstuffs. The University of Florida minerals nutrition project is designed to assist in mineral deficiences or toxicities of grazed forages while the Utah State University project is centered on the compilation of feed composition information for use in the development of efficient feeding programs. Both projects complement each other and are providing needed information which when applied by people like you and your colleagues will move livestock production upward in your countries and in your own individual feeding situations.

The challenge before us at this workshop is to learn more about the International Network of Feed Information Centers, take advantage of the presence of Drs. Harris, McDowell, and Kearl, and share your ideas with each other following this conference. I am hopeful that you will consider ways in which you might support the concept of a feed information center in this region of the world.

Ultimately, of course, the challenge before all of us is to continue to build on the information base already established and to expand that base further as we do research and learn more about feed composition, nutrient digestibilities and livestock requirements. Obviously, the collection of information and storing it in a data bank is only the first step. The utilization of information by the farmer, through assistance of the extension person or someone who can transfer the information into increased animal productivity and efficiency is the bottom line and must be the final objective. No project, no data bank, no feed table, no research laboratory will do this. It will be accomplished by people like you, armed with knowledge and its application to today's problems and who have the desire to do research and the ability to train others, that will bring about the improvement in livestock production that is needed to better the farmer's lot and provide animal products so desperately needed to feed the world's hungry and malnourished.

AID is pleased to provide support for this worldwide activity through Utah State University and the University of Florida and to cooperate with the Animal Production and Health Commission of Asia (APHCA). Again, you are to be complimented for your interest in and desire to take part in this seminar. I wish you well as you proceed with today's program.

AN INTERNATIONAL SYSTEM FOR COOPERATION ON FEED DATA COLLECTION AND DOCUMENTATION[1]

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SUMMARY

The aim of INFIC is to combine (by using the computer) world data on the composition and nutritive value of products that are or may be used as feeds, and to provide abstracts of, and references to, other information about feeds. As an essential prerequisite of successful exchanges between existing data stores and for organizing future input into a common data base, agreement has been established on a multilingual international feed vocabulary, on information coding, data structure, and computer programming. Efforts are being made to establish regional centers in developing countries where feed composition information can be collected, documented and retrieved.

The output of the common data base may take many forms depending on the needs of users. These may include conventional feed composition tables, replies to specific inquiries, or on–line data. The output of the system is also immediately applicable in computer programming operations that formulate most–profitable diets.

INFIC can uniquely service advisers in developing countries; it also incorporates services of proven value for the technically advanced countries.

To become fully successful, INFIC requires the collaboration of all laboratories that produce or hold information on feeds, particularly in developing countries, and continued support from funding agencies.

Key Words: network, feed centers, feed databanks, feed nomenclature, feed vocabulary, feed abstracts.

[1] A report on Project 079, Journal Series No. 2613. This research was partly financed by the United States Agency for International Development under contract number AID/TA-C-1159 entitled, "Increasing Livestock Production Through Improved Nutrition Information."

[2] Associate Director, International Feedstuffs Institute and Assistant Professor, Animal, Dairy, and Veterinary Sciences Department; Director, International Feedstuffs Institute and Professor, Animal, Dairy, and Veterinary Sciences Department, respectively.

INTRODUCTION

The degree of development achieved by a country largely depends upon the extent and utilization of its resources. Relatively little can be done to increase supplies of natural resources, but there are innumerable ways to improve their utilization. The natural and cultivated forage that can be utilized by wild and domestic livestock is a most important factor in the production of animal products, but this resource is often mismanaged. Primary attention must be given to assisting national and regional organizations to achieve efficient use of their resources.

Developed countries, however, lack basic data on the chemical, physical, and biological values of their feeds. Cereal grains and other products suitable for human foods are generally not available for use in animal diets in developing countries. Instead, forages and by–products from the production of human foods are the primary feeds, and these require individualized analyses.

Because environmental factors affect the chemical and physical properties of plant species, applications of nutritional principles have to take into account the conditions prevailing in a given region. These factors point to an urgent need to generate data through applied nutrition research in all countries.

The utilization value of feeds in terms of their economic value and the nutritional requirements of animals must be precisely known before profitable animal diets can be formulated. A major problem in present feed evaluation is the scarcity of reliable data. A world databank should contain nutritional information about all feeds used in formulating animal diets. In addition, that information should express feed energy values in terms compatible with those describing the energy requirements of animals.

Efficient and effective data exchange among countries and regions requires an international feed vocabulary to accurately describe materials used as animal feeds, and standard

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methods for chemical and biological analyses of feeds. These requisites must be fulfilled before data can be processed and entered into databanks that can service all countries.

BACKGROUND

In the early nineteenth century, scientists were able to begin classifying feeds according to their chemical composition. The earliest recorded feed tables are those of Thaer (1809) who classified hays according to their content of acid and alkali soluble material. Later, Boussingault (1843) published a table of "hay equivalents" that compared feeds on the basis of their nitrogen content.

Wolff (1874) and Lehmann (1899) expressed feed values in terms of digestible nutrients. These concepts took into consideration differences between feeds in nutrient losses during digestion. This work was expanded by Kellner (1905) in Germany and Armsby (1903) in the United States who, working independently, observed and catagorized differences between feeds in the amount of energy lost during metabolism.

The work of Wolff (1874) was expanded in the United States by Atwater (1874). His methods were modified by Henry and Morrison (1910) and became known as the total digestible nutrient (TDN) system. The concepts of digestible, metabolizable, and net energy were the outgrowth of work by Armsby (1903) and Kellner (1905).

The TDN and calorie system approaches to defining the nutritive value of feedstuffs have continued up to the present time. Feed composition tables were published in the United States in Morrison's "Feeds and Feeding" until the 22nd edition which appeared in 1956. The introduction of digestible nutrients by species of animals first appeared in Schnieder's "Feeds of the World" (Schnieder 1947).

In 1952, the United States National Academy of Sciences recognized the need for a review of feed composition information. This resulted in two publications, one on the composition of concentrates (NRC 1956) and one on the composition of forages and grains (NRC 1958).

Within recent years, comprehensive tables of feed composition have been published (NAS 1971; McDowell et al. 1974; Gohl 1975; ARC 1976; and Kearl et al. 1979).

It seems to be more than mere accident that in the home countries of the afore–mentioned pioneers in compiling of feed composition tables, Germany and the United States, two separate centers of feed data documentation were compiled. Documentation began in Germany in 1949 (Haendler, 1963; Haendler and Jager, 1971); and in the United States in 1952 (Harris et al. 1968).

Although there was some contact between the centers for several years, it was not possible to combine or adapt the two systems to each other. Personnel at the Utah (United States) center contacted FAO concerning the need for world cooperation. FAO, in turn, sent a consultant to visit various centers that were compiling data on feed composition (Alderman, 1971). This resulted in two informal meetings at FAO headquarters in Rome in 1971 and 1972 (Harris and Christiansen, 1972; Haendler and Harris, 1973). These meetings generated the organization of the International Network of Feed Information Centers (INFIC). At the regular annual meetings since that time, discussions have centered around policy matters and strengthening and expanding the organization.

INTERNATIONAL NETWORK OF FEED INFORMATION CENTERS

INFIC Centers are classified according to the internal organization and the services they perform. Currently there are three types of centers. Type I, Type II, and Observer.

Type I centers are processing centers. These centers perform the following functions:

- Cooperate with analytical laboratories in the exchange of information and chemical data concerning nutrient values of feed.
- Cooperate with biological laboratories in acquiring information on the utilization of feeds by various species of animals.
- Check and validate data.
- Code and process data into the databank.
- Output data in forms applicable to user demands (feed tables, on–line acquisition, etc.).
- Exchange data with other INFIC centers.

Type II centers are collection and dissemination centers. They perform the following functions:

- Cooperate with analytical laboratories in the exchange of information and chemical data concerning nutritive values of feed.
- Cooperate with biological laboratories in acquiring information on the utilization of feeds by various species of animals.

- Check and validate data.

- Forward data to a Type I center for processing and entry into the databank.

- Disseminate information received from Type I centers (This information may be by request)

Observer centers are dissemination centers and perform the following functions:

- Observe the functions of other centers and assist in establishing contact with laboratories and other institutions providing pertinant information.

- Disseminate information received from Type I or Type II centers (information may be by request).

MEMBERSHIP IN INFIC

INFIC is open to all organizations concerned with feed information. Each INFIC center functions independently with regard to financing, personnel, data exchange, research, and publication.

Current membership is:

Type I Centers

Australian Feeds Information Center
Dokumentationsstelle der Universitat Hohenheim
International Feedstuffs Institute

Type II Centers

Agriculture Canada
Arab Center for Studies of Arid Zones and Dry Lands
College of Fisheries, Aquaculture Division
University of Washington
Institute d'Elevage et Medecine Veterinaire des Pays Tropicaux
Instituto Interamericano de Ciencias Agricolas
Korean Feedstuffs Institute
Ministry of Agriculture, Fisheries and Food, U.K.
Tropical Products Institute

Observer Members

Centraal Veevoederbureau in Nederland
Institut National de la Recherche Agronomique
International Livestock Center for Africa
Universiti Pertanian, Malaysia
University of Ibadan
Verband Deutscher Landwirtschaftlicher Unter-suchungsund Forschungsanstalten

Unofficial Observing Status

Food and Agriculture Organization

Geographic Responsibilities

INFIC representatives are responsible for acquiring feed information from the following geographical areas:

Africa: The Documentation Center, Hohenheim University, Stuttgart, Federal Republic of Germany, in cooperation with FAO; The International Live-stock Center for Africa, Addis Ababa, Ethiopia; and The L'Institut d'Elevage et de Medecine Veterinaire des Pays Tropicaux, Miasons-Alfort, France.

Europe: The Documentation Center, Hohenheim University, Stuttgart, Federal Republic of Germany

Latin America: The Instituto Interamericano de Ciencias Agricolas, San Jose, Costa Rica; and the International Feedstuffs Institute, Utah State University, Logan, Utah, USA.

North America: The International Feedstuffs Institute, Utah State University, Logan, Utah, USA; and The Canadian Department of Agriculture, Ottawa, Canada.

Oceania and Southeast Asia: The Australian Feeds Information Center, Sydney, Australia.

AN INTERNATIONAL SYSTEM FOR NAMING AND DESCRIBING FEEDS

In recording feedstuffs data from different parts of the world and processing them for use in a common databank, a standardized, unambiguous identification system is essential. This must include: (a) a vocabulary consisting of elements (descriptors) that do not overlap, and (b) regulations for the use of these descriptors in naming feeds. A new international system was proposed by Harris (1963) and Harris, et al. (1968) in order to overcome incon-sistencies in naming feeds. This system was modified by a joint working party – Logan – Hohenheim – Maisons Alfort, and is now known as the International Feed Vocabulary. This vocabulary is in English, French, German, and Spanish, and has been adopted by INFIC. The vocabulary is divided into logical categories (or facets) as explained below. A feed name is established by com-bining descriptors of different facets and a translation by computer is possible--for example, from English into French names. The terms used in the vocabulary might not always correspond to those in common use in a given country. In these instances, adjustments are made to convert the international feed descriptions into short names. The international feed vocabulary is in wide–spread use and minimizes feed identification difficulties by assigning descriptive names to feeds.

The International Feed Vocabulary is designed to give a comprehensive and concise description to each feed. A complete name may have several individual components. Each component describes an essential attribute in eval–uating a particular feed. These components are arranged in six facets.

Origin including scientific name (genus, species, variety) common name (generic, kind, strain) and chemical formula when applicable.

Part fed to animals and as affected by process(es).

Process(es) and treatment(s) to which the origin of part was subjected to prior to being fed to the animal.

Stage of maturity and development (applicable to forages and animals).

Cutting (primarily applicable to forages).

Grade (official grades with guarantees, etc.).

All applicable descriptors are used to describe each feed unequivocally.

Feeds have been assigned to eight classes. These are:

Class 1 Dry forages and roughages (more than 18 percent crude fiber).

Class 2 Pasture, range plants and forages fed green.

Class 3 Silages.

Class 4 Energy feeds (products with less than 20 percent protein and less than 18 percent crude fiber).

Class 5 Protein supplements (products which contain 20 percent or more protein).

Class 6 Mineral supplements.

Class 7 Vitamin supplements.

Class 8 Additives (antibiotics, coloring material, flavoring, hormones, medicants).

Since the descriptive feed names are not practicable for data processing, a consecutive order 5–digit identification number (International Feed Number) is assigned to each name. The code for the feed class is inserted in front of this number (as outlined above, making a 6–digit number in all (see Table 1). Examples of two feed descriptions with the International Feed Number are:

No. 1: *Zea mays indentata.* Maize, dent, aerial part, ensiled, dough stage. IFN 3-02-912

No. 2: *Gossypium spp.* Cotton, seeds oil residue solvent extracted, less than 36 percent protein. IFN 5-01-632.

TABLE 1 Examples of International Feed Descriptions

Name Components	Feed No. 1	Feed No. 2
Genus (of original material)	*Zea*	*Gossypium*
Species	*mays*	*spp.*
Variety or kind	*indentata*	-----
Generic name	Maize	Cotton
Kind	dent	-----
Part eaten	aerial part	seeds oil residue
Process(es) and treatment(s) to which product has been subjected	ensiled	solvent extracted ground
Stage of maturity	dough stage	-----
Cutting or crop	-----	-----
Grade (or quality designation)	-----	less than 36 percent protein
Class	(3)	(5)
International feed number	3-02-912	5-01-632

All feed names are listed in the INFIC International Name File. Feed names are added to this file as they are coined.

THE COLLECTION AND RECORDING OF FEED DATA

A document known as the "International Source Form" is used to record the information about a feed (Harris 1970). On this form, in use in many laboratories throughout the world, the following information is included: identification of the sample; information on the geographical area in which the feed originated; the reference source, published or unpublished; and pertinent information about factors which may influence the nutritional characteristics of the product. The form also has space for describing the animal and procedures used in digestion and balance trials.

Chemical and biological values that have been determined on the feed sample can be recorded on this form.

These forms are available to all INFIC institutions and are printed in five (5) different languages.

Data and other information about feeds are requested by INFIC centers in the following ways:

- from chemical and biological analyses of feed samples received from a laboratory under contract to an INFIC center.
- from cooperating feed analysis laboratories and research institutions. These are forwarded by mail or obtained by personal contact.
- from a literature search.
- from publications containing feed information that are forwarded to the centers.

After the data are put on the source form, they are coded (Knight et al. 1966 and Harris et al. 1968). For example, all information concerning the area (country, region, state, province), the sources of reference and the feed description are coded and punched into one card. Data pertaining to soil condition, fertilizer applied, etc., are recorded on a second card. Information about metabolic studies is recorded on a third card and a fourth card is used to record the chemical and biological data. Additional cards are used for environmental and other information. The system thus provides flexibility and can be expanded to meet changing conditions.

BENEFITS TO THE USER

The information stored in the combined INFIC databank will be of particular value to those involved in research and education, planning and development, the feed industry, and practical animal production. Eventually the total output will provide ready access to:

- all relevant values for chemical, physical and biological data of existing and potential feeds.
- information on factors which affect the nutritional value of feeds (e.g., age of plant, soil, fertilization, and method of processing).
- information relevant to the incorporation of feeds into diets and rations (e.g., physiological restrictions of the animal, intake levels, efficiency of utilization, and toxicity levels).

Information retrieval may be accomplished in various ways depending on the user's needs and facilities. Access to information would be given by feed tables and specific printouts when direct use of computer or via a remote terminal is impracticable for a user. Abstracts of information pertaining to specific questions can be selectively withdrawn by some centers.

The system also permits analysis of factors affecting composition and nutritional value of feeds (e.g., environment and technology of processing), provided the sample analysed has been sufficiently described (for example, as requested on the International Source Form distributed to the cooperating laboratories). Data may also be suitable for developing regression equations. The importance of giving consideration to the experimental conditions under which data were obtained and of distinguishing between actually determined and derived values is well recognized. Especially important is the efficient use that can be made of the information stored in the data bank by connecting it with computerized programs for the formulation of diets for maximum profit.

COOPERATION REQUIRED TO SUPPORT INFIC'S OBJECTIVES

It is obvious that the potential quantity and quality of output from a databank depends on its input. To draw information across fields of specialization, countries, and languages requires close cooperation among institutions all over the world. Certainly, there are a number of limitations to achieving the aim of an optimal coverage in the documentation of world data. Particular assistance is sought by INFIC from:

- feed analyses laboratories and collecting organizations, in particular those serving developing countries, who could make their results available to the central data bank;
- leading workers in the field of feed analyses and energy metabolism, who could recommend the most economic determination to employ and appropriate systems to use in expressing energy values;
- research workers and users who could support the international standarization of terminology in organizing future data input into a common data base.

Representatives from the participating countries have expressed interest in the work of INFIC and pledged continued support for it. The United States Agency for International Development (US AID) has made an essential contribution through its Florida project, which had 69 laboratories in 23 Latin American countries cooperating in producing, collecting, and forwarding analysis results to the Project Center. Using these data, comprehensive feed composition tables have been published in

Spanish, Portuguese and English, and a publication has been made in Arabic, and some names have been translated into Turkish. USAID is providing financial support for the participation of the International Feedstuffs Institute in INFIC and provided some funds to assist the Latin America Program in San Jose, Costa Rica. The Government of the Federal Republic of Germany is supporting work toward INFIC's objectives undertaken by the Hohenheim Center in cooperation with FAO and the International Livestock Center for Africa. The Australian Center is cooperating with several organizations in Southeast Asia in an effort to determine a suitable location for a center to serve this region. The Arab Center for the Studies of Arid Zones and Dry Lands, Damacus, Syria in cooperation with the International Feedstuffs Institute, is working in the 22 Arab States.

REFERENCES CITED

Alderman, G. 1971. Proposals for establishment of a feeds information system for the Food Agricultural Organization, FAO AGA/MISC/71/28.

ARC. 1976. The Nutrient Requirements of Farm Livestock No. 4. Composition of British Feedstuffs (prepared by Leitch and A. W. Boyne). Agricultural Research Council (obtainable from Her Majesty's Stationery Office, 49 High Holburn, London W. C. I. 710 pp.).

Armsby, Henry Prentill, 1903. The Principles of Animal Nutrition, First Edition, John Wiley and Sons. New York.

Atwater, W. V. 1874. Annual Report, Connecticut Board of Agriculture.

Bossingault, Jean–Baptiste, 1843. Economic rurale consideree dans ses rapports avec la chimie la physique et al meteorologie Bechet Heunne. Paris. (In 2 volumes). Translated by Sir George Lawes. 1845. Rural economics in its relation with chemistry, physics, and meterology. D. Appleton and Company, New York.

Gohl, Bo. 1975. Tropical Feeds. Food and Agriculture Organization of the United Nations, Rome, 661 pp.

Haendler, H. 1963. Bedentung and anfgaben des archivs for Futtermittel Hohenheim. Krafifutter 46(1): 555-556.

Haendler, H. and F. Jager. 1971. Stand und Entwicklung der Befundokumentation Futtermittel. Mitteilunger der Gesellschaft fur Bibliontthekswesen und Dokumentation dey Lankbaues H., 15:23-31.

Haendler, H. and L. E. Harris. 1973. Data documentation in the field of feed analysis and the international cooperation it includes. Quarterly Bull. Interna. Assoc. Agr. Libarians and Documentalists. 18(2): 87–94.

Harris, L. E. 1963. A system for naming and describing feedstuffs, energy terminology, and the use of such information in calculating diets. J. Animal Sci. 22:535–547.

Harris, L. E., J. Malcolm Asplund and Earle W. Crampton. 1968. An international feed nomenclature and methods for summarizing and using feed data to calculate diets. Utah Agr. Exp. Sta. Bull. 479.

Harris, L. E. 1970. Nutrition Research Techniques for Domestic and Wild Animals. Vol. 1. International Agri. Services, P.O. Box 3529, Logan, Utah, USA.

Harris, L. E. and W. C. Christiansen. 1972. International Network of Feed Information Centers (INFIC). Special publication from Millerlungen der Gessellschaft fur Bibliothekswesen and Documentation des Landbanes. H 17: 93–100;

Henry, W. A. and F. B. Morrison. 1910. Feeds and Feeding. Tenth edition. W. A. Henry, Madison, Wisconsin.

Kearl, L. C., L. E. Harris, H. Lloyd, M. Farid and M. Wardeh, 1979. Arab and Middle East Tables of Feed Composition. Utah State University, Logan, Utah 84321.

Kellener, Oscar Jahann. 1905. Der Ernshrung der Landwirtschaftlichen Nutztiere. Verlagsbuchhandlung. Paul Parey. Berlin.

Knight, Arlin D., Lorin E. Harris, Earle W. Crampton, and Alice Denney. 1966. Collection and summarization of feed composition data. III. Coding of the source form for compiling feed composition data. J. Dairy Sci. 49: 1548.

Lehmann, Curt. 1899. Emil Wulffs Rationelle Futterung der Landwirtschaftlichen Nutztiere. Verlagsbuchhandlung. Paul Parey Berlin.

McDowell, Lee R., Joe H. Conrad, Jenny E. Thomas, and Lorin E. Harris. 1974. Latin American Tables of Feed Composition. University of Florida, Gainesville, Florida. 509 pp.

Morrison, Frank B. 1956. Feeds and Feeding. 22nd Edition. F. B. Morrison, Ithaca, New York.

National Research Council. 1956. Composition of Concentrate By–product Feeding Stuffs. (Prepared by Donald F. Miller, R. F. Boucher, H. E. Bechtel, K. C. Beeson, L. E. Harris, C. F. Huffman, H. L. Lucas, F. B. Morrison, E. M. Nelson, and B. F. Scheider) Nat Academy of Sci. Nat. Res. Council, Washington, D. C. USA.

National Research Council. 1958. Composition of Cereal Grains and Forages (Prepared by Donald F. Miller, R. F. Goucher, H. E. Bechtel, K. C. Beeson, L. E. Harris, C. F. Huffman, H. L. Lucas, F. B. Morrison, E. M. Nelson, and B. F. Scheider) Nat Academy of Sci. Nat. Res. Council, Washington, D. C. USA.

NAS. 1971. Atlas of Nutritional Data on United States and Canadian Feeds (Prepared by E. W. Crampton and L. E. Harris). Printing and Publishing Office National Academy of Sciences, 2101 Constitution Avenue, Washington, D. C. USA. 20418. 772 pp.

Schneider, Burch Hart. 1947. Feeds of the World, Their Digestibility and Composition. Jarrett Printing Company. Charleston, W. Va.

Thaer, A. 1809. Grundsatze der rationelle Landwirtschaft. Vol. 1. Sec. 275. Die Realschulbuchhandlung. Berlin.

Wolff, Emil, 1874. Rationelle Futterung der Landwirtschaftlichen Nutztiere. Verlagsbuchhandlung. Paul Parey. Berlin.

INTERNATIONAL FEED VOCABULARY[1]

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SUMMARY

The International Network of Feed Information Centers (INFIC) has been organized to standardize the naming of feeds and the methods used for analyzing and reporting feed composition data throughout much of the world. Centers are located in the following countries: Australia, Canada, Costa Rica, France, West Germany, Syria, United Kingdom, United States, and in two international organizations; the International Livestock Center for Africa and FAO. Other center(s) are being organized in Southeast Asia.

INFIC has developed an "International System" to name feeds, record chemical and biological data about feeds, and to code the data so it can be stored, summarized, retrieved, and printed in flexible formats. On–line data is available for using a remote terminal for calculating diets to obtain maximum profit.

An "International Feed Description" is made up by combining descriptors from six facets:

- origin including scientific name (genus, species, variety), common name (generic, breed or kind, strain) and chemical formula.
- part fed to animals and as affected by process(es).
- process(es) and treatment(s) to which the part eaten was subjected,
- stage of maturity or development (applicable to forages and animals).
- cutting (primarily applicable to forages).
- grade (official grades and guarantees, etc.).

All applicable facets are used to describe each feed.

To the extent information is available, the facets give a qualitative description of the feed. Also, according to their physical and chemical characteristics, feeds are grouped into eight classes. These are:

- Dry forages and roughages (more than 18 percent crude fiber or 35 percent cell walls on a dry basis).
- Pasture, range plants, or forages fed green.
- Silages.
- Energy feeds (less than 20 percent crude protein, and less than 18 percent crude fiber or 35 percent cell walls on a dry basis).
- Protein supplements (products which contain 20 percent or more crude protein on a dry basis).
- Mineral supplements.
- Vitamin supplements.
- Additives (antibiotics, coloring material, flavors, hormones, medicants).

Each class represents special characteristics peculiar to a given group of feed products for formulating diets.

Each feed is assigned a 5–digit feed number. For computer programming purposes, this number becomes the central code that links the chemical and biological data and the international feed descriptions and other feed names together. This number is used when recalling information from the databank and in linear programs for calculating the most profitable animal diets. To make the number more meaningful, the feed class number (1 digit) is placed in front of the feed number making a 6–digit number that is known as the international feed number (IFN).

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This publication describes the system used by INFIC personnel to formulate international feed descriptions and international feed names. Country names are also discussed.

Key Words: feed centers, feed databanks, feed nomenclature, feed vocabulary, feed names.

AN INTERNATIONAL SYSTEM FOR DESCRIBING AND NAMING FEEDS

The system uses three types of feed names:

- The "International Feed Description" outlines in detail the use of six facets with descriptors (origin, part, process, maturity, cut and grade) to describe the feed in detail.
- The "International Feed Name" uses the same principles, but in some cases descriptors are dropped out of the international feed description if they are understood. In other cases, some descriptors are changed to terms used in commerce.
- "Country Names" are added where they are different than the international feed description or the international feed name.

The international feed description, the international feed name, and country names are discussed below.

International Feed Description

Many by–products arising from the preparation of human food are suitable as animal feeds. As new technology develops for processing human foods, additional by–products are constantly being introduced. Many grain products are changed by subjecting them to some form of mechanical process, e.g., blending, grinding, pelleting, and steam or dry rolling. This often alters the nutritive value of feeds. Generally, these changes increase nutritive values and enhance the efficiency of animal production. This, however, complicates the task of precisely naming these materials. The names of many feeds are controlled officially by regulation in the United States of America (USA), Canada, and the European Economic Community (EEC). Such names, however, are usually common or trade names and do not describe the feed accurately.

In reviewing the literature, more than 20 percent of the "common names" were found to be different names (synonyms) for the same product from different areas of the world. This complicates the identification of feeds. A new international system was proposed by Harris (1963) and Harris et al. (1968) to overcome inconsistencies in naming feeds. This system was modified by a joint working party drawn from Logan -- Hohenheim – Maison – Alfort, and is now known as the "International Feed Vocabulary" (Harris et al. 1980).

Using this vocabulary, over 17,000 feeds have been recorded and given "International Feed Descriptions and International Feed Names" in English, German, and some in French. The Portuguese and Spanish versions are being prepared. These international feed descriptions and international feed names are now in wide use.

The international vocabulary is designed to give a comprehensive name to each feed as concisely as possible. Each feed description is coined by using descriptors taken from one or more of six facets:

Facet 1: origin (original material) consisting of scientific name (genus, species, variety); common name (generic name, breed or kind, strain), and chemical formula as appropriate.

Facet 2: part fed to animals as affected by process (es).

Facet 3: process (es) and treatments (s) to which the part has been subjected.

Facet 4: stage of maturity or development (applicable to forages and animals).

Facet 5: cutting (primarily applicable for forages).

Facet 6: grade (official grades with guarantees or other grades).

A complete "International Feed Description" consists of all descriptors applicable to that feed.

In addition to the description, feeds are grouped into eight classes according to their physical and chemical characteristics.

Facet 1: Origin

The origin or parent materials may be one of three types:

plants	specific (BARLEY, OATS, COCONUT, SOYBEANS)
	non–specific (CEREALS, GRASS, MEADOW PLANTS)
animals	specific (CATTLE, CHICKENS, SWINE)
	non–specific (ANIMAL, POULTRY, FISH)

minerals, chemical products, drugs and others

For specific plants and animals, each descriptor of the facet Origin is composed of:

Scientific name (Latin)

Genus

species

variety or kind

Common name (in English, German, French, . . .).

When possible, feeds should be described by their common names at up to three levels. The first level should be the generic name, e.g., CATTLE, FISH, CLOVER, WHEAT, etc. The second level should be more specific (such as breed or kind), e.g., HEREFORD, COD, RED (clover), WINTER (wheat), etc. The third level should list other important characteristics (such as a strain of wheat, e.g., DELMAR). Examples are given in Table 1. The descriptors are capitalized.

TABLE 1 International Feed Description: Origin (Example)

With Specific Origin				
genus	*BOS*	*GADUS*	*TRIFOLIUM*	*TRITICUM*
species	*TAURUS*	*MORRHUA*	*PRATENSE*	*AESTIVUM*
Level 1 generic name	CATTLE	FISH	CLOVER	WHEAT
Level 2 breed or kind	HEREFORD	COD	RED	WINTER
Level 3 strain	---	---	---	DELMAR
With Non Specific Origin				
Level 1 generic name	ANIMAL	GRASS	POULTRY	MEADOW PLANTS
Level 2 breed or kind	---	---	---	---
Level 3 strain	---	---	---	---

The above are examples of feeds with specific origins. Some feeds have no specific origin, and are described by their common name (non–specific origin), e.g., ANIMAL, GRASS, POULTRY, MEADOW PLANTS (Table 1).

Minerals, drugs and chemicals are listed according to the nomenclature of the Chemical Rubber Company (1977–1978). The chemical formulas are designated when applicable.

Facet 2: Part Fed to Animals as Affected by Process (es)

This component of the feed description represents the actual part of the parent material fed to the animal. In the past, the edible parts of plants and animals were obvious, such as leaves, stems, seeds, meat trimmings, or bones. Today, due to the extensive fractionation of plant seeds and the reconstitution of many of the parts into new processed foods, innumerable by–products are available for animal feeding. Also, there are by–products from the preparation of meats and fish for human consumption.

Each part has to be described unambiguously by a descriptor, the use of which is clearly defined.

Example part descriptors with definitions are:

BRAN The pericarp of cereal grains.

COBS The fibrous inner portion of the ear of maize from which kernels have been removed.

GERMS The embryo found in seeds and frequently separated from the starchy endosperm during milling.

Examples of International Feed Descriptions or Names with parts are given in Table 2.

TABLE 2 International Feed Description: Origin + Part (Example)

genus	*BOS*	*GADUS*	*TRIFOLIUM*	*TRITICUM*
species	*TAURUS*	*MORRHUA*	*PRATENSE*	*AESTIVUM*
generic	CATTLE	FISH	CLOVER	WHEAT
breed or kind	HEREFORD	COD	RED	WINTER
strain	---	---	---	DELMAR
part	MILK	WHOLE	AERIAL PART	GRAIN

Facet 3: Process (es) and Treatment (s)

Many processes are used in the preparation of animal feeds and some of these may significantly alter their nutritional value. Heat may damage some nutrients and conversely, it may make others more available.

Pelleting increases consumption while grinding may affect digestibility of protein and carbohydrates. Such treatments also alter the proportions of the lower fatty acids produced by rumen microflora of milking cows, which decreases the quantity of fat in the milk.

It is important, then, that a livestock manager be aware of the processes to which a feed has been subjected. Also, the type of animal being fed and its physiology must be considered relative to the feed factors. Therefore, origin and part terms are followed by those distinguishing the different methods of processing that may have been used (alone or combined) e.g., separating, reducing size or heating. The term DEHYDRATED when applied to AERIAL PART means feeds which are artificially dried. Similarly, FAN AIR DRIED indicates the AERIAL PART (hay) has been dried indoors by air convection.

The term MECHANICAL EXTRACTED has been used in the place of expeller extracted, hydraulic extracted or old process. (This new term has been adopted by the Association of the American Feed Control Officials, 1978.)

Examples of process descriptors with definitions are:

DRY–RENDERED Residues of animal tissues cooked in open steam–jacketed vessels until the water has evaporated; fat removed by draining and processing the solid residue.

FRESH Recently produced or gathered; not stored, cured, or preserved.

HYDROLYZED Subjected to hydrolysis, process by which complex molecules (e.g., those in proteins) are split into simpler units by chemical reaction with water molecules. (The reaction may be produced by an enzyme, catalyst, or acid, or by heat and pressure).

Examples of International Feed Descriptions with processes are given in Table 3.

TABLE 3 International Feed Description: Origin + Part + Process (Examples)

genus species	*BOS TAURUS*	*GADUS MORRHUA*	*TRIFOLIUM PRATENSE*	*TRITICUM AESTIVUM*
generic	CATTLE	FISH	CLOVER	WHEAT
breed or kind	HEREFORD	COD	RED	WINTER
strain	——	——	——	DELMAR
part	MILK	WHOLE OR CUTTINGS OIL RESIDUE	AERIAL PART	GRAIN
process	BOILED	MECHANICAL EXTRACTED GROUND	ENSILED	GROUND

Facet 4: Stage of Maturity or Development

Although stage of maturity may be unimportant or not even apply to feeds such as grain by–products, it is probably the most important factor influencing the nutritive value of forages. There is an optimal stage of maturity for forage crops beyond which lignification or the reduction of the ratio of leaf to stem greatly reduces digestibility. Examples of International Feed Descriptions with stage of maturity for animals and plants are given in Table 4. Table 5 gives the stage of maturity terms for animals and Table 6 gives the stage of maturity terms for plants.

TABLE 4 International Feed Description: Origin + Part + Process + Maturity (Examples)

genus species	*GALLUS DOMESTICUS*	*GADUS MORRHUA*	*TRIFOLIUM PRATENSE*	*TRITICUM AESTIVUM*
generic	CHICKEN	FISH	CLOVER	WHEAT
breed or kind	LEGHORN	COD	——	WINTER
strain	——	——	RED	DELMAR
part	WHOLE	WHOLE	AERIAL PART	GRAIN
process	FRESH	BOILED	DEHYDRATED	GROUND
maturity	DAY OLD	GROWER	EARLY BLOOM	——

TABLE 5 Maturity Terms for Animals

Ruminants and Non–Ruminants	Poultry	Fish
day old	day old	larval
suckling	chick	fry
grower	pullet (broiler)	fingerling
adult	adult	grower
aged	aged	adult
		aged

Facet 5: Cutting

Many forage crops are harvested several times during the year. Each cutting has a unique nutrient content as well as characteristic physical properties. The description for cutting refers to the sequence of cutting from the first to the last during the year (cut 1, cut 2, etc.). The maturity terms refer to stage of growth or of regrowth, and must be considered within the limits of a particular cutting.

In tropical and subtropical areas, crops may be cut through–out the year, particularly when they are irrigated. The time to start counting cuttings for non–irrigated forages would be the first rainy season. For irrigated forages, the count should start from the first cutting of the year.

Since stage of maturity is more important than cutting date, the various cuts for forages are sometimes combined with the stage of maturity when data are summarized for feed composition tables. Examples of feed names with cuttings are given in Table 7.

Facet 6: Grade

Some commercial feeds and feed ingredients are given official grades on the basis of their composition and other quality characteristics. Such feeds are sold on a quality description basis in accordance with their official grad–ings. Thus, these grades and quality designations must be included in the description of the feed. These guarantees for various attributes are expressed in terms of "more than" (minimum % of protein, fat, etc.); and "less than" (maximum % of crude fiber, moisture, etc.). Low gossypol is an example of a quality grade. Such guarantees and quality ratings are descriptors in this facet (Table 8).

In addition to official grades, many feeds are designated and sold in the marketplace according to the percent of protein, fat, etc., present in the material. These quality descriptors are classified as grades; e.g., Soybean, seeds, solvent extracted ground, 43% protein.

TABLE 6 International Stage Of Maturity Terms (Revised 1973)

Preferred term	Definition	Comparable terms
For Plants that Bloom		
Germinated	Stage in which the embryo in a seed resumes growth after a dormant period	Sprouted
Early vegetative	Stage at which the plant is vegetative and before the stems elongate	Fresh new growth, before heading out, before inflorescence emergence, immature prebud stage, very immature, young
Late vegetative	Stage at which stems are beginning to elongate to just before blooming; first bud to first flowers	Before bloom, bud stage, budding plants heading to bloom, heads just showing, jointing and boot (grasses), prebloom, preflowering, stems elongated
Early bloom	Stage between initiation of bloom and stage in which 1/10 of the plants are in bloom; some grass heads are in anthesis	Early anthesis, first flower, headed out in head, up to 1/10 bloom
Midbloom	Stage in which 1/10 to 2/3 of the plants are in bloom; most grass heads are in anthesis	Bloom, flowering, flowering plants, half bloom, in bloom, mid anthesis
Full bloom	Stage in which 2/3 or more of the plants are in bloom	3/4 to full bloom late anthesis
Late bloom	Stage in which blossoms begin to dry and fall and seeds begin to form	15 days after silking, before milk, in bloom to early pod, late to past anthesis
Milk stage	Stage in which seeds are well formed but soft and immature	After anthesis early seed, fruiting, in tassel, late bloom to early seed, past bloom, pod stage, post anthesis, post bloom, seed developing, seed forming, soft, soft immature
Dough stage	Stage in which the seeds are of dough-like consistency	Dough stage, nearly mature, seeds dough, seeds well developed, soft dent
Mature	Stage in which plants are normally harvested for seed	Dent, dough to glazing, fruiting, fruiting plants, in seed, kernels ripe, ripe seed
Post ripe	Stage that follows maturity; some seeds cast and plants have begun to weather (applies mostly to range plants)	Late seed, over ripe, very mature
Stem cured	Stage in which plants are cured on the stem; seeds have been cast and weathering has taken place (applies mostly to range plants).	Dormant, mature and weathered, seeds cast
Regrowth early vegetative	Stage in which regrowth occurs without flowering activity; vegetative crop aftermath; regrowth in stubble (applies primarily to fall regrowth in temperate climates); early dry season regrowth	Vegetative recovery growth

TABLE 6 International Stage of Maturity Terms (Revised 1973) (continued)

Preferred term	Definition	Comparable terms
Regrowth late vegetative	Stage in which stems begin to elongate to just before blooming; first bud to first flowers; regrowth in stubble with stem elongation (applies primarily to fall regrowth in temperate climates)	Recovery growth, stems elongating jointing and boot (grasses)
Immature	Used foı fruit and leaves	
For Plants that Do Not Bloom[a]		
1 to 14 days' growth	A specified length of time after plants have started to grow.	2 weeks' growth
15 to 28 days'growth	A specified length of time after plants have started to grow	4 weeks'growth
29 to 42 days'growth	A specified length of time after plants have started to grow	6 weeks'growth
43 to 56 days'growth	A specified length of time after plants have started to grow	8 weeks'growth
57 to 70 days'growth	A specified length of time after plants have started to grow	10 weeks'growth

[a] These classes are for species that remain vegetative for long periods and apply primarily to the tropics. When the name of a feed is developed, the age classes form part of the name (e.g., Pangolagrass, 15 to 28 days' growth). Do not use terms which apply to plants that bloom and those which do not bloom in same name. For plants growing longer than 70 days, the interval is increased by increments of 14 days.

TABLE 7 International Feed Description: Origin + Part + Process + Maturity + Cut (Examples)

genus	*GALLUS*	*GADUS*	*TRIFOLIUM*	*DIGITARIA*
species	*DOMESTICUS*	*MORRHUA*	*PRATENSE*	*DECUMBENS*
generic name	CHICKEN	FISH	CLOVER	PANGOLAGRASS
breed or kind	LEGHORN	COD	RED	---
strain	--	---	---	---
part	WHOLE	WHOLE	AERIAL PART	AERIAL PART
process	FRESH	BOILED	DEHYDRATED	ENSILED
maturity	DAY OLD	GROWER	EARLY BLOOM	28–42 DAYS' GROWTH
cut	---	---	CUT 1	CUT 1

TABLE 8 International Feed Description: Origin + Part + Process + Maturity + Cut + Grade (Examples)

genus	*GLYCINE*	*MEDICAGO*	*GADUS*
species	*MAX*	*SATIVA*	*MORRHUA*
generic name	SOYBEAN	ALFALFA	FISH
breed or kind	---	---	COD
strain	---	RANGER	---
part	SEEDS OIL RESIDUE	AERIAL PART	WHOLE
process	SOLVENT EXTRACTED GROUND	DEHY-DRATED	BOILED
maturity	---	---	GROWER
cut	---	CUT 1	---
grade	44% PROTEIN	17% PROTEIN	---

Feed Classes in Relation to Composition and Usage

Feeds are grouped into eight classes on the basis of their composition and the way they are used in formulating diets (Table 9). These classes, by necessity, are arbitrary, and in borderline cases, the feed is assigned to a class according to its most common use in normal feeding practices.

Examples of international feed descriptions for feed classes 1 to 6 are shown in Table 10.

TABLE 9 International Feed Classes by Composition and Usage

Code	Class Description
1	**Dry forages and roughages** This class includes all forages and roughages cut and cured and other products with more than 18 percent[a] crude fiber or containing more than 35 percent cell wall. Forages and roughages are low in net energy per unit weight usually because of the high cell wall content. Examples of dry forages and roughages are: hay STRAW[b] fodder (AERIAL PART, MATURE [includes ears with husks] for the Maize plant or AERIAL PART, MATURE [includes heads] for the Sorghum plant) stover (AERIAL PART WITHOUT EARS WITHOUT HUSKS, MATURE or AERIAL PART WITHOUT HEADS, MATURE for the Maize plant or Sorghum plant) HULLS PODS
2	**Pasture, range plants, and forages fed green** Included in this group are all forage feeds either not cut (including feeds cured on the stem) or cut and fed fresh.
3	**Silages** This class includes only ensiled forages (MAIZE, ALFALFA, GRASS, etc.)
4	**Energy feeds** Included in this group are products with less than 20 percent protein and less than 18 percent crude fiber or less than 35 percent cell wall, GRAIN, MILL BY–PRODUCTS, FRUIT, NUTS, ROOTS, and TUBERS. Also, when these feeds are ensiled, they are classified as energy feeds.
5	**Protein supplements** This class includes products which contain 20 percent or more of protein from animal origin (including ensiled products) as well as oil meals, GLUTEN, etc.
6	**Mineral supplements**
7	**Vitamin supplements** (including ensiled yeast)
8	**Additives** This class includes feed supplements such as antibiotics, coloring material, flavors, hormones, and medicants.

[a] Percentages are on a dry basis.

[b] Descriptors are capped.

TABLE 10 Examples of International Feed Descriptions

Components	Feed No. 1	Feed No. 2	Feed No. 3	Feed No. 4	Feed No. 5	Feed No. 6
Specific Origin						
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Genus	*TRIFOLIUM*	*AVENA*	*MEDICAGO*	*ZEA*	*BOS*	*MAGNESIUM*
species	*PRATENSE*	*SATIVA*	*SATIVA*	*MAYS*	*TAURUS*	*CARBONATE*
variety	---	---	---	*INDENTATA*	---	---
Generic	CLOVER	OATS	ALFALFA	MAIZE	CATTLE	MAGNESIUM
breed or kind	RED	---	---	DENT	GUERNSEY	CARBONATE
strain	---	---	---	YELLOW	---	$MgCO_3 \cdot Mg(OH)_2$
part	AERIAL PART	AERIAL PART	AERIAL PART	GRAIN	MILK	---
process	SUN–CURED	FRESH	ENSILED	DEHY–DRATED	FRESH	GROUND
maturity	LATE VEGE–TATIVE	EARLY BLOOM	EARLY BLOOM	---	---	---
cutting	CUT 2	---	CUT 1	---	---	---
grade	---	---	---	GRADE 2 695 G/L	---	---
International feed number (IFN)	1-01-395	2-03-287	3-07-844	4-02-931	5-08-626	6-02-754

Components	Feed No. 1	Feed No. 2	Feed No. 3	Feed No. 4	Feed No. 5	Feed No. 6
Non specific Origin						
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Genus	MEADOW PLANTS	GRASS	LEGUME	BAKERY	ANIMAL	ROCK PHOSPHATE
species	INTERMOUN–TAIN	---	---	---	---	---
variety	---	---	---	---	---	---
Generic	MEADOW PLANTS	GRASS	LEGUME	BAKERY	ANIMAL	ROCK PHOSPHATE
breed or kind	INTERMOUN–TAIN	---	---	---	---	---
strain	---	---	---	---	---	---
part	AERIAL PART	AERIAL PART	AERIAL PART	WASTE	BLOOD	---
process	SUN–CURED	FRESH	ENSILED	DEHY–DRATED	SPRAY DEHYDRATED GROUND	GROUND
maturity	LATE BLOOM	EARLY BLOOM	---	---	---	---
cutting	CUT 1	---	---	---	---	---
grade	---	---	---	---	---	---
International feed number (IFN)	1-09-176	2-08-431	3-07-796	4-00-466	5-00-331	6-03-945

International Feed Number

Each feed description is assigned a five–digit "International Feed Number (IFN)" for identification. The numbers are assigned consecutively as new feed descriptions are created. These numbers are particularly useful for feed identification when calculating information within the databank, when transferring from one coding system to another, or when calculating animal diets for maximum profit. The feed class number (as identified in Table 9) is placed in front of the international feed number. When making up feed composition tables, the entire six–digit number is entered immediately following the international feed name. This number identifies the feed and the class to which it has been assigned (Table 10).

Explanation and Rules for International Feed Names

The international feed description gives considerable detail and may not include descriptors generally used in commerce. For this reason, "International Feed Names" are coined using software developed to change or delete certain part and process descriptors that are used in the international feed descriptions. The same principles are used in making up these names as are used in the international feed descriptions. However, the international feed descriptions are used when entering new information into the feed databank.

Usually the international feed name and the international feed description are the same. In some cases, however, the international feed names are much shorter. This is accomplished by leaving out descriptors that are understood.

In other cases, descriptors are replaced with terms commonly used in industry, or those designated by feed control officials as official feed names for a country. Because of their brevity, the international feed names are usually used in the preparation of feed composition tables and reports. Also, these names have been adopted as the official feed names by some countries.

Examples of international feed names compared to international feed descriptions are given in Table 11.

Explanation and Rules for Country Names

There are two kinds of country feed names, official and non–official or local names. Official names are generally adopted by joint agreement of government and industry. Manufacturers of feeds and feed additives petition a government appointed investigator or committee for the approval of feed names they submit for new products to be marketed. After studying all aspects of the new feed or feed additive including its toxic properties, the product name is accepted or rejected. When these names are accepted, they become the official country name for that product (Table 11). These procedures are in effect in many countries throughout the world.

Usually these official names are not used as international feed descriptions or international feed names because they are either incomplete or do not begin with the "origin" or parent material. Other country names are also used to identify feeds in local areas.

When making up feed composition tables or reports, the official country name and other names may be handled in three ways:

- Used as cross references to the international feed name. Examples are:

  Meat meal – see Animal meat meal rendered

  Linseed meal, solvent extracted – see Flax, seeds, meal solvent extracted

- Listed under the international feed name.

  Oats, grain clipped by–product

  Clipped oat by–product

  Oats, cereal by–product, less than 4% fiber

  Oat middlings
  Feeding oat meal

- The full country name or a part of it is entered in parentheses after the international feed name.

  Rice groats (Rice, brown)
  Pineapple, process residue, dehy (Pineapple bran)

Summary of Facets and Component Codes for International Feed Descriptions, International Feed Names, and Country Names

The facets, component codes, and descriptions that make up the international feed description file (name file) are given in Table 12 and Figure 1. It will be noted that four origins (for example for forages) can be entered into the system (component codes 025–080).

The International feed description may be entered on the international feed description form (Figure 1) as outlined under Facets 1 to 6 in Table 12.

The international feed name is entered under component tag 350 or a computer program may be used to formulate

TABLE 11 International Feed Description, International Feed Names and Country Names (Examples)

Components	Feed No. 1	Feed No. 2	Feed No. 3	Feed No. 4	Feed No. 5	Feed No. 6	Feed No. 7
International Feed Descriptions							
Genus	*ANIMAL*	*LINUM*	*AVENA*	*FISH*	*MEDICAGO*	*TRITICUM*	*MEDICAGO*
species	---	*SPP*	*SATIVA*	---	*SATIVA*	*AESTIVUM*	*LUPULINA*
variety	---	---	---	---	---	---	---
Generic	ANIMAL	FLAX	OATS	FISH	ALFALFA	WHEAT	MEDIC
breed or kind	---	---	---	---	---	---	BLACK
strain	---	---	---	---	---	---	---
part	LIVERS	SEEDS OIL RESIDUE	GROATS BY–PRODUCT	WHOLE OR CUTTINGS OIL RESIDUE	AERIAL PART	FLOUR BY–PRODUCT	AERIAL PART
process	DEHYDRATED GROUND	SOLVENT EXTRACTED GROUND	---	MECHANICAL EXTRACTED GROUND	SUN–CURED	---	FRESH
maturity	---	---	---	---	EARLY BLOOM	---	---
cutting	---	---	---	---	---	---	---
grade	---	---	---	---	---	LESS THAN 4.5% FIBER	---
International Feed Names							
Genus	*ANIMAL*	*LINUM*	*AVENA*	*FISH*	*MEDICAGO*	*TRITICUM*	*MEDICAGO*
species	---	*SPP*	*SATIVA*	---	*SATIVA*	*AESTIVUM*	*LUPULINA*
variety	---	---	---	---	---	---	---
Generic	Animal	Flax	Oats	Fish	Alfalfa	Wheat	Medic
breed or kind	---	---	---	---	---	---	Black
strain	---	---	---	---	---	---	---
part	livers	seeds	groats by–product	---	hay	flour by-product	---
process	meal	meal solvent extracted	---	meal mechanical extracted	sun–cured	---	fresh
maturity	---	---	---	---	early bloom	---	---
cutting	---	---	---	---	---	---	---
grade	---	---	---	---	---	less than 4.5% fiber	---
Country Name							
	Animal liver meal (CFA)[a]	Solvent extracted linseed meal (CFA)	Oat feed (CFA)	Fish meal (CFA)	---	Middlings, less than 4.5% fiber (CFA)	Trefoil yellow fresh
	Animal liver (AAFCO)[b]	Linseed meal, solvent extracted (AAFCO)	Oat mill by–product (AAFCO)	Fish meal (AAFCO)	---	Wheat red dog, less than 4% fiber (AAFCO)	
International feed number	5-00-398	5-30-288	1-03-332	5-01-977	1-00-059	4-05-203	2-03-070

[a] Canada feed act name.

[b] American Association of Feed Control Officials name.

this name. If the international name is not readily understood, an explanation is put in parentheses after the international name and entered on component line 360; for example, Pineapple, process residue, dehydrated (Pineapple bran). If bran is defined as the pericarp of cereal grains, then bran cannot be used with pineapple. Therefore, the descriptor PROCESS RESIDUE is used. Pineapple bran is put in parentheses so the new international name can be recognized.

Country names are put with the component codes 425 to 504 (Table 12). Three of these codes 425, 430, and 435 are on the international feed description form (Figure 1).

TABLE 12 Facets, Component Codes and Country Name Component Codes that Make up the International Feed Description File

Facet No.	Description	Component (tags)	Description
1	Origin (original material)	025	Genus (first)
		030	Species (first)
		035	Variety (first)
		040	Genus (second)
		045	Species (second)
		050	Variety (second)
		055	Genus (third)
		060	Species (third)
		065	Variety (third)
		070	Genus (fourth)
		075	Species (third)
		080	Variety (third)
		155	Generic (common) name
		156 for continuation of 155	
		157 for continuation of 156	
		158 for continuation of 157	
		185	Breed or kind
		186 for continuation of 185	
		195	Strain or chemical formula
		196 for continuation of 195	
2	Part	215	
		216 for continuation of 215	
		217 for continuation of 216	
3	Process	245	
		246 for continuation of 245	
		247 for continuation of 246	
4	Maturity	275	
		276 for continuation of 275	
5	Cutting	300	
6	Grade	325	
		326 for continuation of 325	
		327 for continuation of 326	
		328 for continuation of 327	
		350	International name
		351 for continuation of 350	
		352 for continuation of 351	
		360	International name
		361 for continuation of 360	
		362 for continuation of 361	
		370	International name
		371 for continuation of 370	
		372 for continuation of 371	
		425	Country feed name (first)
		426 for continuation of 425	
		427 for continuation of 426	
		428 for continuation of 427	
		429 for continuation of 428	
		430	Country feed name (second)
		431 for continuation of 430	
		432 for continuation of 431	
		433 for continuation of 432	
		434 for continuation of 433	
		435–504 in groups of five as above	Country feed name (third–fifteenth)

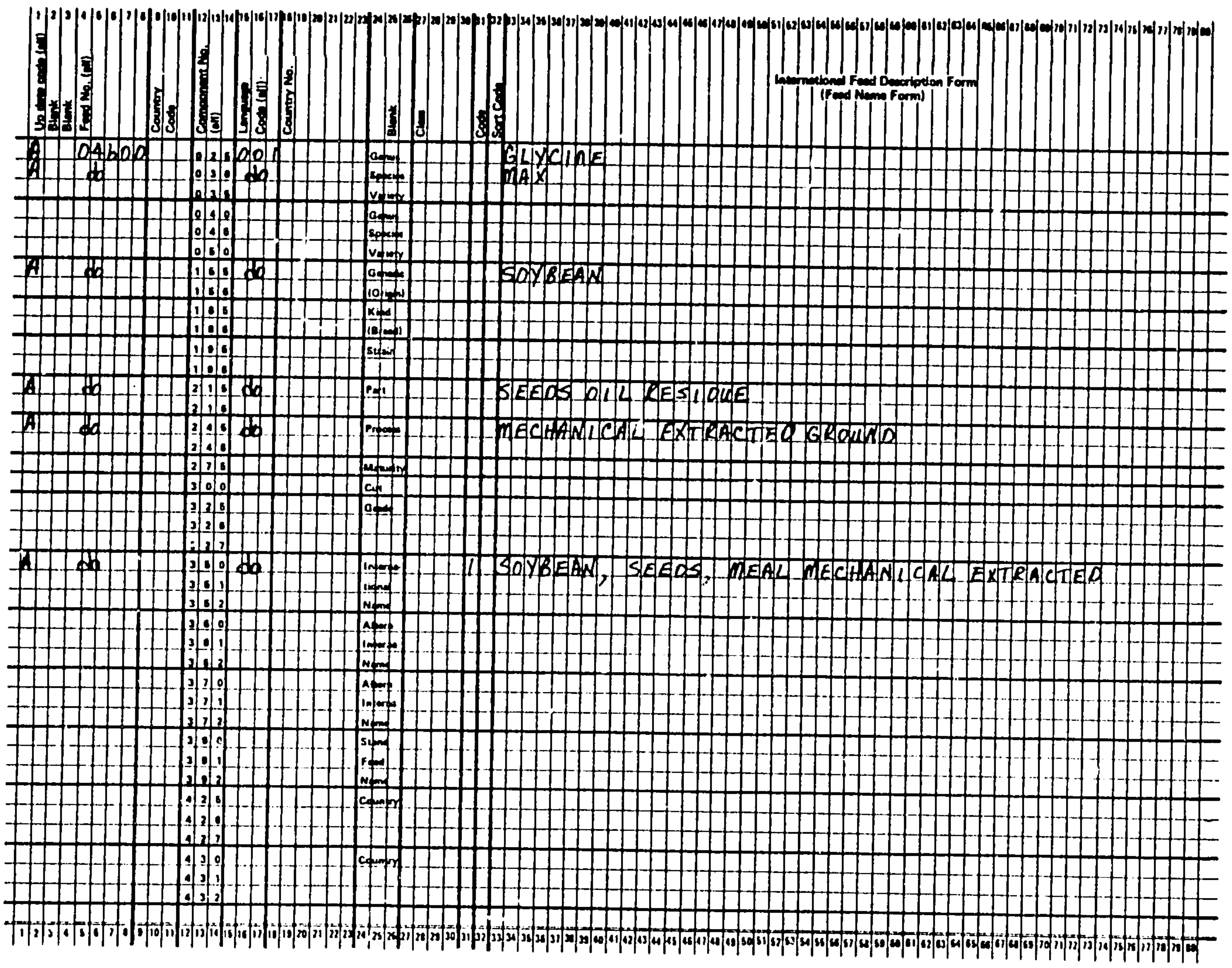

Figure 1 An example of how to enter an international feed description and an international feed name on the feed description form.

REFERENCES CITED

Chemical Rubber Company. 1977– 1978. Handbook of Chemistry and Physics, 49th edition. Editor Robert C. Weast. The Chemical Rubber Co. 18901 Cranwood Parkway, Cleveland, Ohio, 44128.

Harris, L. E. 1963. Symposium on Feeds and Meat Terminology: III. A system for naming and describing feeds, energy terminology, and the use of such information in calculating diets. J. Animal Sci. 22:535.

Harris, L. E., J. Malcolm Asplund and Earle W. Crampton. 1968. An international feed nomenclature and methods for summarizing and using feed data to calculate diets. Utah Agr. Exp. Sta. Bul 479. 391 pp.

Harris, L. E., H. Haendler, R. Riviere and L. Rechaussat. 1980. International feed databank system; instructions for naming feeds and recording data. International Network of Feed Information Centers (INFIC), Publication2. Prepared on behalf of INFIC by the International Feedstuffs Institute, Utah State University, Logan, Utah, USA 84322.

IS A FEED DATABANK NEEDED IN SOUTHEAST ASIA?

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SUMMARY

The rapidly growing livestock industry in Southeast Asia raises many problems. Some of these are the harmonization of feed nomenclature, the standardization of methods for chemical and biological analyses of feeds, the relationships between organizations associated with feeds, the communication with users, and the growth of the network. Facilities are required to process transitory data, such as quantities or prices of feeds. Feed composition tables have been published, but most often they are lacking basic data, and are inconsistent in terminology, resulting in limited applicability of these tables for feed formulation. The great diversity of products used as feeds necessitates summarization of feed information for efficient collection, documentation and rapid dissemination of reliable information on feed composition throughout the region. With the ever increasing role of feedstuffs in livestock production, a special feed databank center needs to be established. Its role should include the standardization of the naming process, describing, coding, recording and data processing of feeds. A regional INFIC center can provide information on nutrient utilization and animal requirements to formulate the most profitable diet for animals in various physiological states and environments. To make the center successful, cooperation among all laboratories and organizations working with feeds in the region and support from funding organizations are necessary.

Key Words: feed databank, feed composition, data documentation, Southeast Asia.

INTRODUCTION

It has been well recognized that feed is the major cost item in producing farm animals. This is especially true in developing countries because the supply of feed has always been more critical. The knowledge of feed composition and nutritive values is , therefore essential for successful livestock production.

In the light of the important role of feeds in livestock production, much time and effort has been spent in assessing and publishing feed composition tables in order to provide ways and means to utilize individual feedstuffs for various classes of animals. Much feed composition information has been published for the Southeast Asian region. However, due to the diversity of products used for feed formulation, inconsistencies in naming, the evolution of feed composition, and the increased demands for information, all indicate the need for a regional center with the capability of storing, organizing, tabulating and disseminating feed information. Such a center would greatly encourage effective utilization of regionally available feedstuffs.

Many varieties of feedstuffs are specific to the region in terms of availability and their uses in feed formulation. Because of a lack of data, particularly on their chemical and feeding values, feed formulation is presently based on data published in the temperate or other tropical regions (Morrison 1956, NAS 1971, Gohl 1974, McDowell 1974, A.R.C. 1976). The situation is further complicated by the large variation and applications which gives rise to frequent diet imbalances, resulting in the inability of farmers in the region to meet the nutrient requirements of farm animals.

Attempts have been made to bring together available information on the chemical composition and nutritive values of feeds common to the region, but these have not been successful mainly due to low funds, the high costs of establishing and maintaining laboratory and research facilities, and a lack of coordination among researchers and agencies.

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[2] The author wishes to acknowledge the International Feedstuffs Institute, Utah State University, Logan, Utah, U.S.A. 84322, for the travel assistance to participate in the workshop.

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To effectively determine the nutrient requirements of animals and the increased need for more accurate and easily retrievable information about the composition and nutritive values of feeds, specialized methods and a center for processing large amounts of data for comprehensive feed composition tables for the region are required. The establishment of feed composition tables for the region is considered basic to improving and encouraging animal production. This paper analyzes the current situation as to the documentation and publication of feed composition tables. In addition, reasons for the establishment of a regional center for feed data documentation in Southeast Asia are discussed.

BACKGROUND OF FEED DOCUMENTATION IN SOUTHEAST ASIA

Feed Composition Tables

For over 40 years, feed composition tables have been published in this region. The objective has always been to provide essential information on chemical composition and, to a lesser extent, the digestibility of nutrients to those engaged in livestock production.

From the information available, the earliest recorded data on feed composition in Malaysia are those of Georgi (1934), while Burkill (1935) and Rosedale (1935) provided information on foods.

Twenty years later, Gunn (1951) attempted the first comprehensive publication on Malaysian feed composition. He classified feedstuffs into green fodders, pasture grasses, roots and by–products, dry fodders, and concentrates (grains and oil seeds and their by–products). Feed composition tables were divided into 198 feedstuffs for proximate analyses, digestibilities, minerals (mainly Ca and P), with 184 feedstuffs analyzed for vitamins (A, B and C).

Despite the constraints imposed by the tedious analytical methods of that period and transition between English and Japanese occupations, Gunn provided valuable information not only on feed composition, but also on the results of digestibility trials using a variety of grasses, typical diets for all classes of livestock and other details pertaining to the nutritive value of feedstuffs. This work was further updated and expanded by Lim (1967, 1968) with the chemical composition and digestibilities of 127 concentrate feeds and 94 forage feeds, respectively. Occasional publications on toxic components (e.g., aflatoxin, HCN) of some feedstuffs to provide more accurate information on the existing feeds in Malaysia were made available (Lim and Yeap 1966, Hew et al., 1977, Hew and Hutagalung 1977). There was no attempt to revise or extend this feed composition until 1977, when the first regional symposium on feedstuffs was held in Malaysia as an attempt to identify those people and organizations involved in the evaluation of feedstuffs (Devendra and Hutagalung 1978). This was followed by the recent publication (Devendra 1979) of feed composition tables listing 820 feedstuffs used in Malaysia. These tables present the proximate analysis and calculated TDN, ME and digestible crude protein for these feeds.

A somewhat similar feed composition information situation exists in other countries. Among the earliest feed composition tables was one published by Lubis (1955), presenting the chemical composition, mineral and vitamins of more than 50 locally available feedstuffs found in Indonesia. Because of limited funds (in Indonesia) limited data have been available during the last two decades. Attempts have been made to collect, document and retrieve information on livestock feeds in Indonesia as evidenced by the reports published by Muller (1974) on feed formulation and by Nell and Rollison (1974) on feed availability and requirements. More intensive studies to evaluate locally available feedstuffs are presently underway by the Center for Animal Research and Development (P_3T) Bogor, and several universities. These studies are a direct result of the great emphasis on the part of the government in improving production in the country (Cresswell 1979, personal communication).

Although Thailand is known to be the major exporter of grains in the region, it has only limited data available on feed composition. Some feed manufacturing industries have compiled feed composition tables, but their use is restricted. Holm (1971) published feed composition tables, mainly on the proximate analysis of forages in Thailand.

Few feed composition tables are available for the Philippines with the exception of that published by Castillo and Gerpacio (1976). Feed composition tables published for Taiwan (Anon. 1976), India (Sen and Ray 1971), Nigeria (Oyenuga 1968), and Kenya (Dougall 1960) have often been used for feed formulation in these areas. The FAO's comprehensive tables of feed composition on tropical feedstuffs (Gohl 1975) and McDowell et al. (1974) have also been used in this region.

These publications are certainly useful for the region, especially within the country for which the data were published. Unfortunately, the users have not been able to appreciate the results because the feeds studied lack reliable chemical, physical, and biological values. The following problems are also evident:

- Standardized terminology is not used in naming common feeds (e.g. leaf meal, leucaena meal, ipil–ipil, lamtoro, cassava root meal, tapioca meal, cassava chips, tepung ubi kayu).

- The quality of the raw materials analyzed varies widely.
- The chemical and physical properties of feedstuffs are inadequately described.
- Analytical methods and unit terms for nutrient composition are not standardized.
- Practical guidelines to using the feed composition tables for feed formulation have not been available.

To achieve improvement in livestock production in the region, farmers, extension services, governmental agencies and others must make a concerted effort to fully utilize feed and animal resources. Apart from these limitations, the higher demand for cereal grains by the human population makes it necessary for researchers to study such alternative feed sources as by–products and crop residues which are not used for human consumption.

Within this region, abundant by–products are available from agro–based industries. These can be utilized to increase the supply of feeds for livestock. Results from experiments conducted in Indonesia, Malaysia, the Philippines, Singapore and Thailand on the feeding value of regionally available agro–industrial by–products and wastes have shown that some of these can be substituted for traditional feedstuffs in farm animal diets. Data for these agro–industrial feeding values have been well documented (Hutagalung 1977, 1978, 1979; Devendra 1979; Devendra and Hutagalung 1978) as have the methods of processing by–products. Since most of these by–product feeds are specific to this region, their names are usually the names used where they are produced. As a result, duplication in feed composition tables is likely to occur. The use of various names for by--products from cassava, oil palm, rubber, pineapple, kapok and tree legumes in this region has often led to inconsistencies and duplication in feed composition tables. Since environment is important to the chemical and physical properties of plant species, applications of nutrition principles has to take into consideration the peculiar conditions prevailing in the region. For example, a humid environment, poor drying facilities, and toxic properties of certain plant products necessitate a more strict quality control, as in the monitoring of aflatoxin and HCN in concentrate feeds. These problems lead to an immediate need to standardize terminology for feed names and descriptions. Methods for evaluation of feedstuffs and generated data must also be standardized through applied nutrition research in the region.

Organization

Perhaps it is appropriate at this juncture to mention the institutions and organization which are engaged in the research and quality control of feedstuffs in this region. This list is by no means complete, but only represents those organizations where information is available. The participants at this workshop are requested to assist in identifying additional people, laboratories, organizations and institutions associated with chemical, physical, and biological assessments of feeds. The following are some of the organizations and institutions which have been actively involved in feed evaluation:

Indonesia

- Center for Animal Research and Development (P_3T), Bogor,
- Bogor Agricultural University (IPB), Bogor,
- Gajah Mada University (UGM), Jogjakarta,
- Udayana University, Bali,
- Animal Husbandry Research Institute, Bogor.

Malaysia

- University of Agriculture Malaysia (UPM), Serdang Selangor,
- Malaysian Agricultural and Research Development Institute (MARDI), Serdang, Selangor,
- Livestock Development Authority (MAJU TERNAK),
- Rubber Research Institute of Malaysia (RRIM), Kuala Lumpur,
- Chemara Research Station (Kumpulan Guthrie Sdn. Bhd.), Seremban, Negeri Sembilan,
- University of Science, Malaysia (USM), Penang,
- Standards and Industrial Research Institute of Malaysia (SIRIM), Shah Alam.

Philippines

- University of Philippines at Los Banos, Laguna,
- Bureau of Animal Industry, Manila.

Singapore

- Pig and Poultry Research and Training Institute, Singapore 26.

Thailand

Kasetsart University, Bangkok,

Khon Kaen University, Khon Kaen

Asian Institute of Technology (AIT), Bangkok.

For the efficient and effective cooperation for data exchange among these organizations, a regional center is required to collate and disseminate information on feeds. In addition, such a center could provide guidelines to describing materials used as animal feeds and help standardize methods for chemical and biological analyses of feeds.

REGIONAL CENTER FOR FEED DOCUMENTATION AND INFORMATION

The primary objectives of this workshop are: 1) to determine the most suitable place to establish a regional INFIC center in Southeast Asia and, 2) to locate an organization engaged in animal research having resources and capabilities to discharge the responsibilities of either an INFIC collection or an INFIC processing center.

The previous speakers have reviewed the aims of INFIC; to integrate world data on the composition and nutritive value of products that are or that can be used as feeds and to provide abstracts of and references to other information about feeds (INFIC 1978). Detailed information about the background of INFIC and its current activities have been well documented (Harris 1963, Harris et al. 1968, Harris and Christiansen 1972, Haendler and Harris 1973, Haendler et al. 1976, IFI 1979).

An interest in the collection and dissemination of feed composition information is increasing throughout the world. Data collection takes place almost everywhere except parts of Africa, Asia and Southeast Asia. Current members of INFIC include IFI (USA), College of Fisheries, University of Washington (USA), Agriculture Canada (Canada), ILCA (Ethiopia), IICA (Costa Rica), AFIC (Australia), HUDOC (Germany), IEMVT (France), ACSAD (Syria), FAO (Rome, Italy) and TPI (England).

Constraints to and reasons for Regional INFIC establishment can be summarized as follows:

- Inappropriate terminology in naming common feeds. This often means duplications and errors in feed composition tables. Standardization of terminology would simplify feed identification and identify processing and treatment methods.
- Large variations in the quality of feedstuffs indicate a need to classify or grade these feeds.
- Lack of basic and reliable data on the chemical physical and biological values of feedstuffs could be offset in a center where standard methods for chemical and biological analyses of feed could be established.
- The collecting, analyzing and documenting of feeds in the region would facilitate a regional exchange and translation of information.
- The significant effects of environment on the chemical and physical properties of plant species must be accounted for in applications of nutritional principles.
- Regional coordination relative to methods of feeding, easier feed formulation, economizing on feed costs and facilitating quality control could be accomplished through a center.
- Valid feed composition tables could eventually be published.

Southeast Asia is unique because it includes having a humid tropical environment and an abundance of agro-industrial products, by-products, and wastes which can be used as animal feeds.

Because of continuing intensive research in feedstuff evaluation, the coordination of regional activities can best be accomplished through the establishment of a regional INFIC center.

Because the Animal Production and Health Commission for Asia (APHCA) coordinates livestock production and disease prevention, the establishment of a feed databank to provide physical, chemical and biological information on raw materials used in animal feeding programs in the region appears appropriate and timely. INFIC centers have been successful in other parts of the world, and should be just as successful in Southeast Asia. Part of this success is due to the fact that the roles and functions of regional INFIC centers have been clearly defined (INFIC 1978).

DATABANK

A major problem in existing feed evaluation work is the scarcity of reliable data. A databank is therefore needed to store nutritional information about all feeds used in formulating diets in the region.

Dr. Lorin E. Harris, the present Director of the International Feedstuffs Institute at Utah State University, is the orignator of a systematic method for collecting analyical data on feeds. Dr. Harris also devised methods for the recording and processing of such data. His efforts resulted in the establishment of a feed databank center whose activities include data collecting and processing. The major problem anticipated in the databank is the potential overlapping of data from various centers.

There is no question that a databank of the appropriate type is valuable. Rechaussat (1976) indicated that databanks could be classified into a depository type and an observatory type. Feed composition databanks belong to the latter category where large quantities of data are being recorded. This type databank must be responsible for the quality of its data.

In a feed databank, it is possible to integrate much more information than just feed composition. Data may include information about the environment (site, soil, fertilizers, climate), about the ingredient under consideration (physiological state, yield, technological treatment) and about observations taken from the transforming animal (e.g. level of dry matter intake, zootechnical performances, observed diseases) Sauvant 1976.

So that the quality of data can continue to improve, cooperation from chemical and biological laboratories, agronomists, research workers, scientists, and end-users must be solicited. The information stored in the databank of regional INFIC Centers is useful to those involved in research and education, planning and development, the feed industry, and in practical animal production. It is also useful in formulating diets for maximum profit.

REFERENCES CITED

Anon. 1976. The tables of Feed Compositions, Taiwan. Published by Taiwan Livestock Research Institute (TLRI), Hsin-hua, Taiwan, and Animal Industry Research Institute (AIRI), Taiwan Sugar Corporation, Chunan, Miaoli, Taiwan, Republic of China, 167 pp.

ARC. 1976. The Nutrient Requirements of Farm Livestock – No. 4, Composition of British Feedstuffs (prepared by I. Leitoh and A. W. Boyne). Agricultural Research Council, London, 710 pp.

Arnott, G. W. and H. K. Lim. 1966. "Animal Feeding Stuffs in Malaya I. General Review." Mal. Agric. J. 45: 370–386.

Arnott, G. W. and H. K. Lim. 1966. "Animal Feeding Stuffs in Malaya 2. Quality of rice bran and polishings." Mal. Agric. J. 45: 387–403.

Bhagwan, H. 1975. "The standardization and control of quality of animal feeds." Proc. Conf. Animal Feeds Trop. and Subtrop. Origin, p. 241–251.

Burkill, I. H. 1935. Dictionary of the Economic Products of the Malaya Peninsula. Vols I & II.

Castillo, L. S. and A. L. Gerpacio. 1976. "Nutrient composition of some Philippine feedstuffs." Tech. Bull. 21, Dept. of Animal Science, College of Agriculture, University of the Philippines, Los Banos, Philippines, 114 pp.

Devendra, C. and R. I. Hutagalung. 1978. Feedingstuffs for Livestock in Southeast Asia. Mal. Soc. Anim. Prod., Kuala Lumpur, 370 pp.

Devendra, C. 1979. Malaysian Feedingstuffs. Mal. Agric. Res. & Develop. Inst. (MARDI), Serdang, Selangor, Malaysia, 145 pp. Presented data on the chemical composition of about 820 feedingstuffs.

Dougall, K. W. 1960. "Average nutritive value of Kenya feedingstuffs for ruminants." E. Afric. Agric. For. J. 36:116–128.

Georgi, C. D. V. 1934. "Fodders and feedingstuffs in Malaya. General Series No. 17, Department of Agriculture Scientific Series, Fed. of Malaya and Singapore.

Gohl, B. I. 1975. Tropical Feeds. FAP Publ., 661 pp.

Gunn, L. T. 1951. Fodders and feedingstuffs in Malay. Bull. Scientific Series No. 24, Dept. of Agric., Federation of Malaya, 86 pp.

Haendler, H. and L. E. Harris. 1973. "Data Documentation in the field of feed analysis and the International cooperation it includes." Quarterly Bul. International Assoc. Agric. Librarians and Documentalists. 18(2):87–94.

Haendler, H. 1976. "Documentation of feed composition data." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl). Utah Agr. Exp. Sta., Utah State University, Logan, Utah p. 22–26.

Harris, L. E. 1963. Symposium on Feeds and Meat Terminology: III."'A system for naming and describing feeds, energy terminology, and the use of such information in calculating diets." J. Animal Sci. 22:535.

Harris, L. E., J. J. Asplund and E. W. Crampton. 1968. "An international feed nomenclature and methods for summarizing and using feed data to calculate diets." Utah Agric. Exp. Sta. Bul. 479.

Harris L. E. and W. C. Christiansen. 1972. International Network of Feed Information Centers (INFIC). Special publication from Mitteilungen der Gesellschaft fur Bibliothekswesen und Dokumentation des Landbaaues. H 17:93–100.

Harris, L. E., L. C. Kearl and P. V. Fonnesbeck. 1976. First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl). Utah Agr. Sta., Utah State University, Logan, Utah, p. 1–3.

Harris, L. E. and L. C. Kearl. 1976. The international network of feed information centers. First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl). Utah Agr. Exp. Sta., Utah State University, p. 27–32.

Harris, L. E., H. Haendler, R. Riviere and L. Rechaussat. 1978a. International feed databank system. Vol. I. International Network of Feed Information Centers. Utah State University Press, Logan, Utah, 84322. (Copies may be obtained from any INFIC Center).

Harris, L. E., L. C. Kearl, and P. V. Fonnesbeck. 1978b. "The rationale for naming feeds." Utah Agric. Extp. Sta. Bull. 501.

Harris, L. E., H. Haendler and L. R. McDowell. 1975. "Internattional feed nomenclature." Proc. Conf. Animal Feeds Trop. and Subtrop. Origin, p. 229–239.

Hew, V. F. and R. I. Hutagalung. 1977. "Aflatoxicosis in swine feeding." MARDI Res. Bull., 5(2):122–128.

Hew, V. F., K. S. Mellish and R. I. Hutagalung. 1977. "Observations on the effects of feeding moldy corn to rats." Mal. Agric. J. 51(2):173–178.

Holm, J. 1971. Feeding tables. Livestock Breeding Station, Huey Kaec, Chiang Mei, Thailand, Mimeograph, 23 pp.
Hutagalung. R. I. 1977. "Additives other than methionine in cassava diets." Cassava as Animal Feed (Nestel, B. and Graham, M., eds): Proceedings of a Workshop held at the Univ. of Guelph, April 18–20, 1977, Ottawa, IDRC-095e, p. 18–32.
Hutagalung, R. I. 1978. "Non–traditional feedingstuffs for livestock." Feedingstuffs for Livestock in Southeast Asia (Devendra, C. and Hutagalung, R. I., eds.) Mal. Soc. of Anim. Prod., Kuala Lumpur, p. 259–288.
Hutagalung, R. I. 1979. "The use of tree–crops and their by–products for intensive animal production. Occasional Meeting, British Society of Animal Production, Intensive Animal Production in Developing Countries, Harrogate, England, November 11–14, 1979, 39 pp.
Hutagalung, R. I. 1979. "Utilization of carbohydrate residues in Malaysia." Workshop on Bioconversion of Lignocellulosic and Carbohydrate Residues in Rural Communities, United Nation Task Force, Dec. 11–15, 1979. Bali, Indonesia.
IFI 1972. The International Feedstuffs, Animal Dairy and Veterinary Sciences Department, Utah State University, Logan, Utah, U.S. A. 20 pp.
INFIC 1977. International Databank System. Detailed Instructions. Vol. 1. International Network of Feed Information Centers. Publications Nos. 2 & 3, Nov. 1977.
Lim, H. K. and K. F. Yeow. 1965. "Fiber analysis of feedstuffs — Comparative studies of methods." Mal. Agric. J. 45: 191–199.
Lim, H. K. and G. S. Yeap. 1966. "The occurence of aflatoxin in Malayan imported oil cakes and groundnut kernels." Mal. Agric. J. 45:232–244.
Lim, H. K. 1967. "Animal feedingstuffs." Part 3. Composition data of feeds and concentrates. Mal. Agric. J. 46: 63–79.
Lim, H. K. 1968. "Animal feedingstuffs." Part 4. Compositional data of grasses and fodders. Mal. Agric. J. 46:405–420.
Lubis, D. A. 1951. Ilmu Makanan Ternak. Penerbit Pustaka, Jakarta, Indonesia, 169 pp.
McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris, 1974. Latin American Tables of Feed Composition. University of Florida, Gainesville, Florida. 509 pp.
Morrison, F. B. 1956. Feeds and Feeding. 22nd Edition. F. B. Morrison, Ithaca, New York.
Muller, Z. O., D. H. L. Rollinson, and A. J. Neil. 1974. "Suggested feed formulas for poultry and pigs." UNDP/FAO Project INS/72/009. Supporting Livestock Planning Working Paper, 69 PP.
NAS. 1971. Atlas of Nutritional Data on United States and Canadian Feeds (prepared by E. W. Crampton and L. E. Harris). Printing and Publishing Office, National Academy of Sciences, Washington, D.C., 772 pp.
Nell, A. J. and D. H. L. Rollinson. 197.. "The requirements and availability of livestock feed in Indonesia." UNDP/FAO Project INS/72/009. Supporting Livestock Planning Working Paper. 59 pp.
Oyenuga, V. A. 1968. Nigeria's Foods and Feedingstuffs. Their Chemistry and Nutritive value. Ibadan University Press, 99 pp.
Rechaussat, L. 1976. "International feed information network and its relationship with other agricultural networks." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl). Utah Agr. Exp. Sta., Utah State University, Logan, Utah, p. 33–38.
Rosedale, J. L. 1935. "Chemical analysis of Malayan foods." Govt. Printing Office, Singapore, 29 pp.
Sauvant, D. 1976. "Statistical methods for studying the variations of the feed analytical profiles of data bank." First International Symposium Feed Composition, Animal Nutrient Requirements, and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl). Utah Agr. Exp. Sta., Utah State University, Logan, Utah, p. 39–41.
Sen, K. C. and S. N. Ray. 1964. "Nutritive values of Indian cattle feeds and the feeding of animals." Indian Council of Agricultural Research No. 113, New Delhi, ICAR Bull. 25:22–133.

Feed Resources, Production Systems, Data Application, and Production Constraints

This section presents a brief discussion of the conventional and non–conventional feed resources, systems currently being used for the production of livestock and poultry, and problems associated with small–holder animal production

FEED RESOURCES IN SOUTHEAST ASIA

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SUMMARY

This is an overview of conventional and nonconventional livestock feedstuffs in Southeast Asia. The annual crop production in the region provides ample supply of energy sources; however, the major portion is exported or consumed by humans. The supplies of protein feedstuffs and good quality forages are limited. These, and all of the synthesized feed supplements, are imported. As a whole, the regional supply of feedstuffs for livestock is inadequate with the least deficiency in energy sources. The deficiency is not clearly apparent because a major portion of livestock are raised on subsistence farms and fed mainly on farm wastes and crop by–products.

Knowledge about the nutritive value of Southeast Asian feedstuffs is sparse. Feed formulation is based primarily on data available from developed countries and thus may not be applicable to the local conditions. It has been demonstrated on several occasions that some tropical feedstuffs are more likely to be adulterated, have mycotoxin or other toxic substances and have lower digestible nutrients than their temperate counterparts. Consequently, more research studies by local nutritionists are needed to develop feeding systems to more efficiently utilize by–products as rice bran; rice straw; cereal stovers; wastes from oil palm, pineapple, and sugar cane; and other oil meal wastes. Equal emphasis should be given to raising new feeds, such as single–cell protein, livestock wastes, leaf meal, and native forages. Each government should also do more to enforce feed quality control laws and regulations.

Key Words: Southeast Asia feedstuffs, subsistence farms, potential supply, non–traditional feeds, nutritive value, adulteration.

INTRODUCTION

Southeast Asian agriculture as a whole is export–oriented and has placed more emphasis on crop rather than livestock production. The primary demand for livestock is to provide farm power and transport; and secondarily meat, milk, and eggs. This is clearly indicated by the distribution of each species as compared to the pattern of the world livestock population (Table 1). The census, however, may not include all the small livestock and poultry owned by the subsistence farmers. In general, livestock in the region is primarily raised on small farms rather than in big, commercial herds. The commercial production of swine and poultry is a new industry and contributes only a minor portion of animal protein to the market. Ruminants, except for a few thousand head of dairy cattle in each country, are still fed with farm wastes and other by–products. Their productivity is generally low. With this type of management program, livestock production contributes approximately 17 percent of the average farm resources (Crump 1972). As a consequence, data concerning the production of livestock feeds, their availability to farmers, the nutritive value of these feeds and the total inventories required to meet the animal requirements for protein and energy is not known. Ration formulation is primarily based on data generated in the developed countries. Holm (1971), however, compiled data on chemical composition and nutritive value of a few feedstuffs in Thailand. Nell and Rollinson (1974) reported the availability and requirements of livestock feeds in Indonesia. Castillo and Gerpacio (1976) published a comprehensive table listing the feed inventories in the Philippines. Devendra (1979a) did the same in Malaysia. It is not the purpose of this paper to repeat those excellent presentations; rather it is aimed at overviewing the most common feedstuffs in the region. Where nutritive values are well documented, problematic aspects of their use will be examined. The emphasis will be given to the exploration of nutritive value of a few locally available feeds and agricultural by–products.

As stated previously, the agricultural activities in the region emphasized crop rather than livestock production. As a result of this, livestock feeds are primarily from

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TABLE 1 Livestock Population in Southeast Asia (F.A.O. 1978)

Countries	Cattle	Buffalo	Sheep	Goat	Swine	Chicken	Duck
			. . . . 000				
Burma	7,865	1,855	221	615	1,915	17,311	3,555
Indonesia	6,167	2,222	3,710	7,119	2,976	107,493	16,032
Kampuchea	1,300	580	1	1	750	4,600	1,800
Lao	534	1,303	––	39	1,576	17,672	190
Malaysia	430	293	46	375	1,136	47,536	204
Philippines	1,820	5,300	31	1,410	9,700	58,892	5,365
Singapore	9	3	––	2	1,100	13,102	2,308
Thailand	4,650	5,536	55	31	3,410	56,306	9,991
Vietnam	1,700	22,300	13	210	9,600	66,000	36,000
Total	24,475	19,392	4,077	9,802	31,894	388,972	75,445
% of world total	2.0	14.6	0.4	2.2	4.3	6.0	56.8

food crop by–product and/or residues; and secondarily from surplus main crops. Data in Table 2 indicate that the main food crops of the region are rice, sugarcane, cassava and other plantation crops such as coconut and oil palm. Other feed grains are secondarily important, whereas pulses and beans are the least important. The potential supply of some important by–products of these crops, based on the recovery rates reported by Devendra (1979b), is given in Tables 3 and 4. Table 3 also includes the feed grains and dry cassava root pro–duced in Southeast Asia in 1978. These feedstuffs are, however, not totally available for livestock production in the region. Apart from rice, our major staple food, the main food crops include corn, cassava, peanut and soybean produced in Indonesia and corn in the Philippines. These are consumed by the human population. In Thailand, most of the food crops, except beans and rice by–products, are exported (Table 5). Malaysia imports a major portion of required feed–stuffs from within and outside the region (Hutagalung, 1977). Therefore, the locally available energy feed–stuffs for nonruminants are mainly rice by–products and limited amounts of other feed grains. There is a general deficiency in protein feeds, with the exception of copra meal in the Philippines. Soybeans and peanuts produced in Indonesia are primarily used for

TABLE 2 Major Food Crop Production in Southeast Asia (F.A.O. 1978)

	Production by country								
Crop	Burma	Indon-esia	Kampu-chea	Lao	Mal-aysia	Philip-pines	Thail-land	Viet-nam	Total
			. . . . 000 metric tons						
Cereals, total	10,728	28,489	1,830	826	1,625	10,240	20,154	10,375	84,267
Tubers and roots, total	90	15,518	59	52	512	2,789	13,383	4,719	37,129
Pulses, total	308	324	21	14	–––	51	211	100	1,029
Beans, dry	186	–––	21	–––	–––	42	165	40	454
Rice (*Oryza sativa*)	10,500	25,739	1,750	796	1,590	6,907	17,000	9,880	74,162
Maize (*Zea mays*)	75	2,705	80	30	35	3,333	3,030	460	9,793
Sorghum (*Sorghum vulgare*)	–––	–––	–––	–––	–––	–––	120	35	155
Cassava (*Manihot esculenta*)	15	12,488	26	14	364	1,707	13,000	3,000	30,614
Sugarcane (*Saccharum officinarum*)	1,791	15,000	195	9	860	20,838	19,000	2,500	60,193
Palm kernels (*Elaeis quineensis*)	–––	98	–––	–––	364	2.2	0.4	–––	464.6
Coconut meat (*Cocos nucifera*)	–––	950	8	–––	207	2,600	48	24	3,837
Cotton seed (*Gossypium spp.*)	42	15	8	8	–––	3	66	8	150
Peanut (*Arachia hypogaea*)	450	687	18	1	25	47	170	105	1,503
Soybean (*Glycine max*)	16	530	4	4	–––	8	125	22	709

TABLE 3 Potential Supply of Some Concentrate Feedstuffs in Southeast Asia

International Feed Description	International Feed Number	Burma	Indonesia	Kampuchea	Lao	Malaysia	Philippines	Thailand	Vietnam	Total
		Yield by country								
		.... 000 metric tons								
Rice, bran with germ with broken grain with polishings, dehydrated	4-03-937	1,050	2,574	175	80	159	691	1,700	988	7,417
Rice, groats, polished and broken	4-03-932	472	1,158	79	36	72	311	765	445	3,338
Corn, grain	4-02-879	75	2,750	80	30	35	3,333	3,030	460	9,793
Sorghum, grain	4-04-383	----	----	----	----	----	----	120	35	155
Cassava, tubers dehydrated ground	4-01-152	6	4,995	10	6	146	683	5,200	1,200	12,246
Sugarcane, molasses, more than 46% invert sugars more than 79.5 degrees brix	4-04-696	63	525	7	----	30	729	665	88	2,107
Palm, meats oil	4-26-228	----	2	----	----	7	----	----	----	9
Palm, meats oil residue, solvent extracted	5-03-486	----	2	----	----	7	----	----	----	9
Coconut, meats oil residue, mechanically extracted ground	5-01-572	----	356	3	----	78	975	18	9	1,439
Cotton, seeds oil residue, mechanically extracted ground	5-01-609	18	6	3	3	----	1	28	3	62
Peanut, kernels oil residue, mechanically extracted ground	5-03-649	248	378	10	----	14	26	94	58	828
Soybean, seeds oil residue, mechanically extracted ground	5-03-659	12	384	3	3	----	6	91	16	515
Total energy feedstuffs		1,666	12,004	351	152	449	5,747	11,480	3,216	35,065
Total plant protein feedstuffs		278	1,126	19	6	99	1,008	231	86	2,853

TABLE 4 Potential Supply of Roughages From Some Crop By–Products in Southeast Asia

International Feed Description	International Feed Number	Burma	Indonesia	Kampuchea	Lao	Malaysia	Philippines	Thailand	Vietnam	Total
		Yield by country								
		.... 000 metric tons								
Rice, hulls	1-08-075	1,680	4,118	280	127	254	1,105	2,720	1,581	11,865
Rice, straw	1-03-925	10,500	25,739	1,750	796	1,590	6,907	17,060	9,880	74,162
Maize, aerial part without ears without husks, sun-cured, mature	1-12-179	54	1,994	58	22	25	2,416	2,197	334	7,100
Sorghum, aerial part without heads, sun-cured	1-04-302	----	----	----	----	----	----	120	35	155
Cassava, common, leaves, dehydrated	1-10-768	1	874	2	1	25	119	910	210	2,142
Sugarcane, bagasse	1-04-686	242	2,025	26	1	116	2,813	2,565	338	8,126
Sugarcane, top of aerial part with leaves, fresh	2-04-692	313	2,625	34	2	151	3,647	3,325	438	10,535
Palm press fiber		---	12	----	----	44	----	----	----	56
Peanut, aerial part, sun-cured, mature	1-03-623	221	445	9	----	12	23	83	51	844
Pineapple, process residue, dehydrated	4-03-722	----	----	----	1	11	15	20	1	48
Pineapple, process residue	4-26-968	----	----	8	20	185	267	350	24	854

TABLE 5 Feedstuff Exports and Imports for Thailand, 1977[a]

Feedstuffs			Export		Import	
International Feed Description	Common name	International Feed Number	Amount metric ton	Value 10^6 BHT	Amount metric ton	Value 10^6 BHT
Maize, grain	Corn	4-02-879	1,517,878	3,286.52	93	2.28
Sorghum, grain	Sorghum	4-04-383	135,464	298.71	----	----
Wheat, grain	Wheat	4-05-211	----	----	60,296	170.29
Wheat, bran	Wheat bran	4-05-190	23,728	53.94	----	----
Cassava, tubers, dehydrated pelleted	Cassava pellet	4-12-180	3,686,670	6,946.03	----	----
Cassava, tubers, dehydrated ground	Cassava chip	4-01-152	65,604	117.42	----	----
Cassava, starch process residue, dehydrated	Cassava waste	4-08-572	110	.19	----	----
Sugarcane, molasses, more than 46% invert sugars more than 79.5 degrees brix	Cane molasses	4-04-696	953,176	745.18	----	----
Beet pulp, dehydrated	Beet pulp	4-00-669	4,494	6.85	----	----
Castorbean, seeds	Castor seed	4-25-218	68,568	516.44	----	----
Coconut, nuts with shells	Coconut	----	2,468	3.17	----	----
Coconut, meats, dehydrated	Copra	4-08-190	----	----	2,102	17.02
Coconut, meats oil residue, mechanically extracted ground	Copra meal	5-01-572	6,968	11.60	----	----
Cotton, seeds	Cotton seed	5-13-749	5,729	13.94	----	----
Cotton, seeds oil residue, mechanically extracted ground	Cotton seed meal	5-01-609	5,344	14.22	----	----
Kapok, seeds	Kapok seed	5-21-137	8,339	25.14	----	----
Kapok, seeds oil residue, mechanically extracted ground	Kapok meal	5-02-467	7,406	17.87	----	----
Peanut, kernels, whole	Peanut	5-03-657	13,945	147.08	----	----
Peanut, kernels oil residue, mechanically extracted ground	Peanut meal	5-03-149	2,314	11.68	30,429	148.41
Soybean, seeds	Soybean	5-04-610	11,505	82.56	----	----
Soybean, seeds oil residue, solvent extracted ground	Soybean meal	5-04-604	----	----	53,559	252.76
Sesame, seeds	Sesame seed	5-08-509	11,799	116.61	----	----
Fish, whole or cuttings oil residue, boiled mechanically extracted	Fish meal	5-01-979	75.617	534.72	1,931	10.58
Other bean cake	----	----	289	.53	9,026	43.74
Other oil cake	----	----	3,015	3.63	----	----
Sweet forage and feed supplements	----	----	2,063	12.06	5,220	136.14

[a]Agricultural Statistics of Thailand 1977/1978. Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand. 1978.

human consumption (Cresswell 1979), while those being produced in Thailand are not sufficient to meet domestic consumption. In addition, eating habits of the Asian population limit the possibility of producing protein to meet their livestock needs from fish, meat, and/or meat and bone meals. Consequently, the main portion of protein in the compound feeds is supplied by imported soybean, fish, meat and bone, and other oil meals. Other feed supplements, e.g., amino acids, vitamins, antibiotics, trace mineral salts, and others are totally imported.

In attempting to assess the status of demand and supply of concentrate feeds in the region, compound feed requirements of the major nonruminants in each country were estimated and presented in Table 6. The estimation was based on the following annual

TABLE 6 Estimated Requirements of Compound Feeds in Southeast Asia[a,b]

Countries	Requirement by species, per year				
	Swine	Broiler[c]	Layer	Duck	Total
	.... 000 metric tons				
Burma	958	140	303	267	1,668
Indonesia	1,488	860	1,881	1,202	5,431
Kampuchea	375	36	81	135	627
Lao	788	140	309	14	1,251
Malaysia	568	380	832	15	1,795
Philippines	4,850	472	1,031	423	6,776
Singapore	550	104	230	173	1,057
Thailand	1,705	452	985	749	3,891
Vietnam	4,800	528	1,155	2,700	9,183
TOTAL	16,082	3,112	6,807	5,678	31,679

[a]Requirements based on number of livestock reported by F.A.O. (1978).
[b]Requirement of feed per head per year: pig 500 kg, broiler 16 kg, layer 35 kg, and duck 75 kg.
[c]Assuming 4 broiler crops (8 weeks) per year.

consumption rates: 500 kg feed per pig; 4 kg per broiler (8 weeks) and 4 broiler crops per year; 35 kg per laying hen; and 75 kg per duck. It appears that these species required approximately 31.7 million tons of compound feed per year. This amount of feed, on the average, comprises 19.0 million tons of cereals and their by–products, 7.7 million tons of plant protein sources, and 4.8 million tons of feed supplements and animal protein sources. Once these requirements are compared with the potential supply in Table 3, it appears that we can supply only 37.6 percent of the required plant protein and 184.5 percent of the required energy. As stated previously, a good portion of food crops produced in the region were exported or consumed by humans. The supply of protein feedstuffs is consequently low. Since livestock raised on small farms have never received complete diets, the deficiency is not easily visible. Only those livestock in intensive production systems are fed complete diets.

Compound livestock feeds for intensive production are mixed by both small and large mills around big cities. Basically, the diets being mixed contain cereals, soybean meal, and fish meal. In addition to compound feeds, large amounts of concentrates are prepared. These are designed to be mixed with rice by–products and/or maize by the farmers. These concentrates help lower feed costs in rice–or–maize producing areas.

The supply of roughage is as inadequate as that of concentrates. In a crop–intensive system, high land prices and low investment returns prevent farmers from establishing permanent pasture for beef production. In field crop production areas, therefore, ruminant animals are fed on farm wastes and natural grasses around the cultivated land throughout the rainly season. During the dry season when green herbages are limited, they are primarily fed on crop residues and/or crop by–products, and they normally lose weight during these periods. This cycle has been repeated for years. Agricultural by–products such as those listed in Table 4 are generally under–utilized. Rice straw may be the only item which has been widely utilized. Other by–products are normally burned as fuel, discarded into the environment, or ploughed back into the soil. The research to determine their feeding value as feeds for ruminants consequently deserves a high priority.

Another interesting aspect of ruminant feeds is the integration of livestock with plantation crops. This system is not new, since it has been widely practiced by small farmers for years. Its scientific evaluation, however, was only recently undertaken by producing forage under coconut (Boonklinkajorn 1978) or by grazing livestock under coconut (Nitis and Rika 1978), oil palms (Chen et al., 1978) and rubber trees (Lee et al., 1978). These workers obtained promising results in terms of controling weed growth, improving soil fertility, and possibly an increase in the main crop yield.

Therefore, the current status of available feedstuffs in Southeast Asia can be summarized as follows:

- Energy concentrate feeds would be about adequate if the resources were properly allocated and cereal by–products and other new feeds were fully and efficiently exploited.
- Protein concentrates are seriously deficient. Animal nutritionists are desperately needed to evaluate the nutritive value of the available new or nonconventional protein sources. Interest in this respect is currently increasing.
- Feed supplements are totally imported.
- Roughage supply is insufficient. Research in utilizing agricultural by–products for ruminant feeding and in integration of ruminant production with plantation crops should be emphasized.

FEEDING VALUES OF SOME IMPORTANT FEEDSTUFFS IN SOUTHEAST ASIA

Apart from short supplies, it is widely acknowledged that tropical forages possess a higher crude fiber content and contain larger amounts of lignin at an earlier age than their temperate-zone counterparts. This directly affects the amount of total digestible nutrient (TDN) available for livestock. Butterworth (1976) demonstrated that, at maturity, 96 percent of 760 samples of temperate grasses had a TDN value over 55 percent, whereas only 48 percent of tropical grasses (from 312 samples) were comparable. The TDN and metabolizable energy (ME) values of about 620 feedstuffs for ruminants in Southeast Asia have recently been estimated by Devendra (1979a).

According to the literature reviewed in this paper, there hasn't been any research conducted to compare the effects of (temperate vs. tropic) environments on the nutrient digestibility of each feedstuff. The analytical data shown elsewhere probably reflect the confusing effects of both environment and processing. At any rate, one can safely anticipate that the digestibility of tropical feedstuffs is lower than that of their temperate counterparts primarily because of accelerated cutinization and lignification. Apart from the effect of environment, feedstuff processing techniques in Southeast Asia cause more undigesible ingredients to be carried in the finished products. Adulteration during the processing of feed ingredients is a normal phenomenon in the region. Creswell (1979) reported the adulteration of fish meal (soil), soybean meal (maize), bone meal (soil) and maize bran (rice hulls) in Indonesia. In analyzing feedstuffs received at the university farm during 1975 to 1979, we at Khon Kaen University have regularly encountered the same problem. Protein sources tend to be more adulterated than the energy feeds (Table 7). This is clearly indicated by the wider variations (larger standard deviation) in most chemical components of protein than energy feeds. As a matter of fact, on a few occasions, we detected fish meal containing 43 percent crude protein and 39 percent ash. The level of insoluble ash present is a good indication of feed adulteration.

The adverse effect of feedstuff adulteration on the development of the livestock industry is well realized by the government of each nation. This is clearly evidenced by their issuance of feed quality control laws and regulations. The enforcement of these regulations, however, is rather weak in countries such as Thailand. This may be due to their lack of: funds, analytical equipment, and human resources to keep pace with the rapidly growing feed industry. Therefore, the livestock producers in the region may have to face the adulteration problem for another few years.

Apart from the effects of adulteration and low digestibility, Southeast Asian feedstuffs have occasionally been reported to possess other factors which lower their nutritive values. It is therefore relevant to make a continuing search of the literature dealing with the nutritive values of a few of the most common feedstuffs in the region. Limitations on the use of those feeds whose nutritive values are well documented will be emphasized.

Rice *(Oryza sativa)*

Rice Hulls. In the rice producing countries, rice bran, broken rice, rice hulls, and rice straw are the most important by–products. Among these by–products rice hulls have the lowest nutritive value. They contain 35.4 percent crude fiber, 19.6 percent ash, and 1.38 Mcal ME per kg for cattle (Devendra 1979a). Utilization of rice hulls as roughage has not been successful. Alkali–treated rice hulls should be limited to not more than 5 percent in sheep ration (Devendra 1979b).

Rice Bran. Rice bran is composed of pericarp and germs of the rice with only small quantities of hulls, clipped and broken rice. Approximately 10 percent rice bran is recovered in the milling process. The ME content of rice bran varies with its source of origin, and length and condition of storage. Under the storage condition encountered in the tropics, the ME may decrease rapidly due to hydrolytic rancidity resulting in triglyceride breakdown to free fatty acids (Creswell 1979). The 3.03 Mcal ME/kg (Maust et al. 1972) value is probably a reasonable average. Additional factors that prevent it from being a good substitute for cereals in swine and poultry rations are:

- Rice bran has a density of about 50 percent of that of maize meal (Creswell 1979). Therefore, a diet high in rice bran is normally bulky, restricting the feed intake of nonruminants. Pelleting could help to overcome this problem.

- Rice bran has a high level of phytate phosphorus (.77 to 1.95 percent DM) (Creswell 1979). However, when rice bran was fed at 60 percent in broiler diets, the phytate phosphorus did not interfere with the utilization of trace minerals (Kratzer et al., 1974).

- Rice bran may contain some growth–depressing factor(s) that acts somewhat as does the trypsin–inhibitor that causes pancreas hypertrophy (Kratzer et al., 1974). According to these workers, the factor(s) could not be extracted with hexane or methanol, but could be eliminated by autoclaving or steaming rice bran for at least 15 minutes.

TABLE 7 Proximate Composition of Some Concentrate Feedstuffs in Thailand[a]

International Feed Description	International Feed Number	No. of Sample	Proximate composition, % as fed basis[b] DM	CP	EE	CF	Ash	NFE	Insoluble ash	Ca	P
Rice, bran with germ with broken grain with polishings	4-03-937	17	91.5± 1.44	11.64± 1.94	15.90± 3.23	6.06± 1.34	8.69± 1.68	48.93± 3.4	1.87± 1.17	.23± .28	1.52± .26
Rice, bran with germ with hulls	1-03-931	2	90.90± .23	8.59± 1.63	9.16± 1.29	18.68± 3.68	13.31± .98	41.21± 2.10	8.72± 1.71	.28± .02	.96± .11
Rice, groats, polished and broken	4-03-932	11	88.40± .86	7.47± .82	1.49± .65	.40± .36	1.16± .58	77.88± 1.75	.28± .11	.23± .25	.19± .06
Maize, dent yellow, grain, ground	4-26-023	34	89.29± 2.17	8.80± .87	3.66± 1.00	2.01± 1.00	2.28± 1.79	72.33± 2.63	.45± .71	.24± .39	.30± .11
Sorghum, grain, ground	4-04-379	2	91.00± .25	10.21± .21	2.46± .24	1.82± .06	1.70± .41	74.81± .54	.26± .32	.11± .03	.33± .06
Cassava, tubers, dehydrated ground (washed)	4-01-152	13	89.14± 1.12	1.91± .42	.37± .12	2.33± .33	2.27± 77	82.96± 1.57	0.40± .22	.18± .06	.09± .05
Cassava, tubers, dehydrated ground	4-01-152	18	87.72± 4.16	2.10± .36	.43± .19	3.58± .77	3.14± 1.12	78.48± 4.53	1.04± .76	.26± .11	.08± .05
Cassava, tubers, dehydrated pelleted	4-12-180	25	89.30± 1.87	2.40± .59	.50± .35	3.39± .52	5.31± .99	77.87± 2.65	2.83± .99	.24± .12	.13± .07
Soybean,seeds oil residue, mechanically extracted ground	5-04-600	49	92.02± 2.63	44.98± 2.20	5.26± 1.93	5.87± .94	4.46± .80	29.22± 2.62	1.24± .70	.54± .23	.67± .19
Peanut, kernels oil residue, mechanically extracted ground	5-03-649	7	94.11± 1.99	36.39± 3.98	6.19± 1.51	10.36± 7.34	13.16± 5.66	27.31± 2.30	.78± .17	2.94± 3.30	.40± .22
Cereals, brewers grains, dehydrated	5-02-141	3	84.84± 13.48	9.54± 4.37	.52± .54	9.41± .90	23.97± 7.57	41.40± 5.73	19.73± .00	2.24± .34	.39± .06
Fish, whole or cuttings oil residue, boiled mechanically extracted dehydrated ground, 50% protein	5-01-979	31	93.10± 1.61	53.22± 7.31	6.02± 1.99	1.43± 1.07	29.30± 6.38	2.84± 2.37	5.15± 2.76	8.51± .79	2.30± .55
Poultry, feathers, hydrolyzed dehydrated ground	5-03-795	1	93.00	83.15	2.89	.67	4.37	1.92	----	.22	.70
Animal, bone, steamed dehydrated ground	6-00-400	5	96.64± 1.68	10.65± 5.24	2.61± 1.58	2.36± 2.10	70.92± 10.86	6.47± 4.98	15.06± .36	25.48± 1.19	1.75± .80
Oysters, shells, fine ground	6-03-481	4	99.48± .10	---- ----	---- ----	---- ----	96.44± .60	---- ----	32.02± 1.68	24.70± 1.01	.10± .09
Leadtree, leaves, dehydrated ground	1-14-436	4	93.18± 1.02	15.26± 2.30	2.18± .52	18.55± 2.08	26.85± 8.56	31.39± 5.11	19.15± 9.12	1.40± .30	20± .09
Cassava, common, leaves, dehydrated	1-10-7[illegible]3	7	91.24± 1.33	20.26± 2.29	6.10± 1.04	13.62± 1.66	11.06± 1.91	40.21± 2.40	4.38± 1.94	1.40± .16	.26± .09

[a]Khajarern, J. Unpublished data.
[b]Mean ± standard deviation.

- The growth depression of chicks fed rice bran is caused by the imbalance in the calcium–phosphorus ratio.

The normal range of incorporation of rice bran into swine and poultry rations in Thailand is 30 to 60 percent (Ratanapanlop 1979). Rice bran can be incorporated at up to 39.7 percent of the ration for layers, without depressing egg production. In case of autoclaved rice bran, as high as 74.7 percent can be safely used (Din et al. 1979).

Broken Rice. Broken rice is comprised mainly of germs and clipped and broken kernels. The normal recovery rate is 4 to 5 percent. Because it is low in fiber (5 percent), but high in nitrogen–free extract (NFE, 90 percent) and ME (3.74 Mcal/kg) for non–ruminants, it can directly replace other cereals in the diet without any problem. At present, an increasing portion of broken rice is used in human foods such as noodles. Thus, the availability for livestock is decreasing. In an attempt to compare the feeding value of various locally available energy sources for swine and poultry, broken rice was successfully included in rations at levels of 50.7 percent for broilers (Khajarern et al. 1979a), 51.9 percent for replacement layers (Phalaraksh et al. 1978), 43 percent for layers (Phalaraksh et al. 1979), and 53.8 percent for growing finishing swine (Khajarern et al. 1979b). Results of these trials strongly indicate the feeding value of broken rice to be comparable to that of corn (Tables 8, 9, 10 & 11).

TABLE 8 Hen–day Production of the Laying Pullets Fed Maize, Cassava, Broken Rice, and Sorghum in the Diets for the Accumulated Ten 28-day Periods.

Energy source (% of ration)	No. of hens	Laying Periods 1	1–2	1–3	1–4	1–5	1–6	1–7	1–8	1–9	1–10
Maize (43%)	96	74.01[a]	69.89[a]	64.88[a]	62.50[b]	59.70[a]	55.66[a]	53.85[a]	52.42[a]	51.42[a]	50.59[a]
Cassava (50%)	96	71.16[a]	70.36[a]	66.58[a]	63.55[b]	57.98[a]	55.31[a]	53.55[a]	51.86[a]	51.01[a]	50.29[a]
Broken rice (43%)	96	74.18[a]	67.18[a]	63.25[a]	61.56[b]	57.02[a]	53.90[a]	51.90[a]	50.17[a]	49.05[a]	48.50[a]
Sorghum (43%)	96	75.77[a]	74.38[a]	72.05[a]	70.25[a]	64.07[a]	60.04[a]	56.97[a]	54.17[a]	53.48[a]	53.19[a]
C.V. (%)		10.91	7.41	6.46	6.17	6.35	6.42	6.27	6.36	6.67	7.21

[a,b] The means within the same column bearing different superscripts differ significantly at $P < .05$.

TABLE 9 Effects of the Main Energy Sources on Growth Performance of Replacement–Layer Pullets

Performance % of ration	Main energy source: Maize 55.4	Cassava 53.3	Broken rice 51.9	Sorghum 56.5	C.V., (%)
No. of pullets	200	200	200	200	....
Mortality, %	1.5[illegible]	2.00	1.50	2.00	
Average weight (g)					
7 wk	571[a]	562[ab]	[illegible]4[b]	513	2.1
16 wk	1,513	1,478	[illegible]24	1,475	1.2
20 wk	1,823	1,766	1,849	1,765	1.4
Feed/gain					
2-7 wk	2.98	2.55	2.53	3.21	14.7
7-16 wk	4.64	4.63	4.22	4.21	5.1
16-20 wk	6.22	7.71	5.68	6.98	13.3
2-20 wk	4.29[ab]	4.51[a]	4.05[b]	4.26[ab]	2.4

[a,b,c] The means within the same row bearing different superscripts differ significantly at $P < .05$.

TABLE 10 Summarized Effects of Various Energy Sources on the Growth Performance and Carcass Characteristics of Broilers

Energy source (% of ration)	No. of birds	Mortality (%)	Performance Weight gain (g)	Feed/gain	PER
Maize (59.7)	140	2.14	1,689	2.27[a]	2.03[ab]
Sorghum (61.1)	140	2.80	1,694	2.30[a]	2.00[bc]
Broken rice (50.7)	140	2.14	1,675	2.27[a]	2.07[a]
Cassava A (52.0)	140	2.86	1,652	2.52[c]	1.88[d]
Native chip (52.0)	140	4.29	1,641	2.39[b]	1.96[c]
Native pellet (52.0)	140	.71	1,712	2.52[c]	1.84
C.V., %	----	----	1.51	.94	1.02

[a,b,c,d] The means within the same column bearing different superscripts differ significantly at $P < .05$.

TABLE 11 Effects of Various Energy Sources on the Performance and Carcass Characteristics of Growing–Finishing Pigs

Performance % of ration	Energy sources: Sorghum 77.5	Corn 75.8	Broken Rice 53.8	Cassava 60.3	C.V. (%)
Initial weight, kg	16.68	16.81	17.00	16.89	....
Final weight, kg	103.43	93.61	104.08	102.09	....
ADG, kg	.605	.450	.615	.521	11.54
Feed/gain	3.19	3.55	3.00	3.30	6.93
Daily feed consumption, kg	1.93	1.56	1.84	1.72	8.27
Feed cost/kg gain, Bht	11.42[a]	15.66[c]	12.92[ab]	13.44[b]	7.29
Dressing precentage	73.22	72.52	72.31	72.31	2.91
Carcass length, cm	79.60	78.33	74.73	75.13	3.48
Backfat thickness, cm	3.00	3.43	3.10	3.45	21.04
Lioneye area, sq cm	29.35	28.84	29.35	29.81	11.11
Iodine No. of fat	58.03	55.30	63.50	56.38	5.32

[a,b,c] The means within the same row bearing different superscripts differ significantly at $P < .05$.

Rice Straw. The value of rice straw as a roughage feed for ruminants has never been fully determined, although it has traditionally been used for feeding buffalo and cattle in the region. The straw contains 3 to 5 percent crude protein, 26 to 34 percent crude fiber, 35 to 55 percent NFE, .02 to .16 percent phosphorus, and .25 to .55 percent calcium (Jackson 1977). It differs from other straws in that it has a higher silica content (12–16 percent vs. 3–5 percent) and a lower lignin content (6–7 percent vs. 10–12 percent). The TDN of rice straw for cattle ranges from 35.9 to 50.3 percent resulting in an ME value of 1.30 to 1.82 Mcal per kilogram (Devendra 1979a). Thus, in general, rice straw is a poor livestock feed that provides little or no surplus energy over maintenance requirements. Several workers have tried to improve the feeding value of rice straw for ruminants. Dry matter digestibility and dry matter intake have been improved by spraying with a 5 percent NaOH solution at the rate of 1 liter/kg (Terry et al.

1975 and Garrett et al. 1976); soaking with a 1.5 percent NaOH solution; treating with lime (2 percent CaO) (Pacho and Perez, unpublished data cited after Javier 1977), and ammoniating using 3–5 percent aqueous ammonia (Guggolz et al. 1971). The dry matter digestibility of alkali–treated straw is 10 to 20 percent over that of untreated straw depending on the method used. Rice straw alone, however, treated or not, is not adequate to maintain animals. The addition of protein, Ca, and P supplements are needed (Jackson 1977). Urea–molasses is a popular supplement for a rice straw diet, but urea alone cannot suffice as the only source of nitrogen in this type of diet (Natural and Perez 1975). Some pre–formed proteins and soluble carbohydrates are needed. The treated straw can be successfully fed, with appropriate feed supplements, up to 60 percent of the ration for cattle (Pacho and Perea, unpublished data).

Maize (*Zea mays*)

Among the energy feeds available for livestock, maize is one of the few for which the nutritive value is well documented. However, the use of maize in diets fed in the tropics may cause problems to occur that will lower the animals response to maintenance and/or production. Apart from adulteration, the high residual effect of insecticides and mycotoxicity are the two major problems encountered. Hew and Hutagalung (1977) observed aflatoxicity in one of their experiments designed to study the effect of cassava used to replace maize in pig diets. Beginning in the thirteenth week pigs fed diets containing maize at a level higher than 39.4 percent of the ration had a depressed growth and loss of appetite. Carcass analysis revealed abnormal hemorrhagic congestion of the lungs, whereas those pigs being fed diets containing 5 and 22 percent maize did not exhibit these symptoms. Petechial and ecchymotic hemorrhages were observed on the surface of liver and spleen. Subsequently, the presence of aflatoxins B_1, B_2, G_1 and G_2 were detected in that batch of maize. Studies with rats confirmed that the depressed growth was caused by the presence of mold and aflatoxin. In studies at Khon Kaen University, Khajarern (unpublished data) observed symptoms similar to those described by Hew and Hutagalung (Table 12). In this particular case, a pig in Treatment 1 died during the twelth week. Hemorrhages were observed in the lung, stomach and spleen. A major protion of the liver was abssessed. Its penmate appeared unthrifty, parakeratotic and stunted. Therefore, when using maize in livestock rations, be very careful in selecting the material used. Under hot and humid climates, such as occur during the rainy season in Southeast Asia, maize can develop mold rapidly and mycotoxicity may cause large economic losses to the producers.

TABLE 12 Growth Performance of Growing–Finishing Pigs Fed Various Levels of Ground Maize (Khajarern, unpublished data)

Item	Treatment 1	2	3	4	C.V. (%)
Level of ground maize, % of ration	81.5	56.5	31.5	6.5	....
Level of cassava meal, % of ration	0	20	40	60	....
No. of pigs	4	4	4	4	....
ADG, kg	.365[a]	.592[b]	.741[c]	.759[c]	5.64
Daily feed consumption, kg	1.31[a]	1.75[b]	1.89[b]	1.87[b]	4.06
Feed/gain	3.58[a]	2.96[b]	2.54[c]	2.47[c]	4.29
Feed cost/kg gain, Bht	13.76[a]	12.04[b]	10.79[b]	10.92[b]	4.17

[a,b,c] The means within the same row bearing different superscripts differ significantly at $P<.05$.

Cassava (*Manihot esculenta*)

Cassava Root Meal. Feedstuffs from cassava root products are dry root chips and root pellets. In some areas, the starch by–product and cassava peels may be available. Sometimes these by–products are mixed with root meal diluting down starch content, and then pelleted. The nutritive value of cassava root product is well documented. In general, cassava root products contain high levels of starch, but are low in all other nutrients. However, the presence of hydrocyanic acid (HCN) and the need for large quantities of protein supplement are the biggest drawbacks in using these products as livestock feed. The ME of root products varies widely with age at harvest, processing technique and the form of diet used. The normal ME value for chickens of the Thai root chip is 3,045 kcal/kg and the pellet is 2,955 kcal/kg (Khajarern, unpublished data). The net energy value has recently been reported as 2,280 kcal/kg (Aquirre et al. 1979). Khon Kaen University is currently taking up a research project, supported by International Development Research Center (IDRC) of Canada and the Thai Government, aiming to establish the optimum levels of cassava root products in rations for all classes of livestock. Currently, the following recommendations have been made (Khajarern et al. 1979c).

- The maximum safe levels of cassava root meal into livestock diets are given in Table 13. However, the most economical level in replacing cereals by cassava is determined by the price structure of those feedstuffs involved.

TABLE 13 The Suggested Maximum Levels of Cassava Root Meal in Livestock Rations

Livestock Growth period	Maximum cassava level, % of ration				
	Starter	Grower	Finisher	Developer	Layer
Broiler	58.0	----	58.0	----	----
Replacement layer	40.0	60.0	----	60.0	----
Layer	----	----	----	----	50.0
Growing-finishing pig	50.0	60.0	70.0	----	----
Finishing beef cattle	----	----	60.0	----	----

- Since a cassava–based diet is bulky, diets containing more than 33 percent cassava must be fed in a form that encourages optimum feed intake, e.g., liquid, paste or pellet.

- High cassava–based diets must be carefully formulated assuring the balance of all nutrients, particularly phosphorus, zinc, iodine, and vitamin B_{12}.

- As cassava root is essentially free of carotene and xanthophylls, leaf meal or synthetic xanthophylls must be added to maintain the normal color of skin and egg–yolk.

- Methionine is likely to be deficient in cassava–soybean meal diets; consequently, methionine should be supplemented at levels of .1 to .2 percent of the ration. This will aid in detoxication of HCN.

However, more studies on the utilization of cassava as a livestock feed are needed, relative to long–range effects of cassava feeding on animals. Hew (1977) suggested that gestating sows could not be fed diets containing more than 30 percent cassava without the occurence of splay legs syndrome. Gilts fed high levels (70 percent) of cassava during gestation and lactation were observed to give birth to weak piglets and subsequent poor litter performance (Gomez 1979).

Cassava Leaf. Cassava leaf is a new protein source for livestock and poultry. The average leaf yield under conventional methods of cassava production is about 10 tons per hectare. The crude protein content is about 20 to 27 percent of dry leaves depending on age at harvest and the degree of contamination with leaf stalk and stem. The nutritive value of leaf meal has been reviewed by Eggum (1970), Seerly (1972), and Montaldo (1977). However, it should be emphasized that cassava leaf protein is deficient in methionine and marginal in tryptophan, causing its biological value to lie between 44 to 57 percent (Eggum 1970). When supplemented with methionine, the biological value of cassava leaf protein increased from 49 to 80 and the utilizable nitrogen increased from 2.00 to 3.20 percent.

Several attempts have been made by investigators to use cassava leaf meal as a protein source for livestock and poultry. Ross and Enriquez (1969) observed a progressive depression of chick growth when levels of cassava leaf meal increased from 0 to 20 percent of a ration. But when they added methionine, molasses and/or oil to the rations containing 15 to 20 percent leaf meal, growth and feed conversion were significantly improved. Similar responses were observed by Montilla (1979, personal communication). However, he suggested that the economic return from broilers fed diets containing less than 20 percent leaf meal was the same as from those fed commercial diets, and recommended as the optimum level for cassava leaf meal in broiler diets to be 16 percent. Mahendranathan (1971) fed fresh cassava leaf containing 250 to 300 ppm HCN to pigs (8 to 30 weeks of age) at levels of 1.4 to 2.3 kg per head per day with various levels of concentrate feed, and observed no clinical problems. He suggested that pigs receiving a diet containing 50 percent basal ingredients and 50 percent cassava leaves gained most economically. Fernandez et al. (1977) ran a 120–day feeding trial where fresh cassava forage was fed at 3 percent body weight to Zebu cattle with liquid molasses–urea fed *ad libitum*. They observed that after 56 days of poor performance, the cattle receiving long cassava forage gained 580 g/day and those receiving chopped cassava forage gained 660 g/day. Rumen sample analysis indicated that cassava forage intake caused an increase of acetate and decrease of butyrate and when compared to the typical pattern of feeding the molasses–based diets (high butyrate and low acetate). It was not clear whether the reason for the long required adaptation period (56 days) was for the adaptation to molasses–urea or the cassava forage. Moore (1976) fed 270 kg steers diets containing 100 percent elephant grass (Pennisetum purpureum) or mixture of elephant grass to cassava foliage (75:25; 50:50) and reported that the 75:25 treatment gave the best result in terms of body weight gain (461.0 g/head/day). The feed conversions of cattle on the 75:25 and 50:50 treatments were the same and better than the grass control treatment.

Therefore, the possible role of cassava leaf in livestock feeding in this region is obvious. However, much more work needs to be done before its optimum utilization in livestock feeds is known.

Leadtree (*Leucaena spp*)

On a dry matter basis, Leucaena leaf meal contains 25.9 percent crude protein, 26.4 percent ether extract, 11.9

percent crude fiber, 11.1 percent ash and 669 kcal ME (poultry)/kg (D'Mello and Thomas 1978). Amino acid patterns of leaf meal were comparable to that of alfalfa meal. However, leaf meal contains mimosine, a toxic amino acid, up to 2.3 percent of dry matter (Springhall and Ross 1956). This amino acid may depress growth and feed efficiency in chickens; cause an enlarged thyroid gland; hair loss; and growth retardation in cattle (Jones et al. 1976); and lead to loss of body weight and shedding of wool in sheep (Hegarty et al. 1964). Treating Leucaena leaf meal with ferrous sulfate solution eliminated the mimosine toxicity (Ross and Springhall 1963). Apart from mimosine toxicity, other factors in Leucaena leaves may cause low growth and production responses in poultry. D'Mello and Thomas (1978) suspected the low energy level and low digestibility of leaf meal might be the cause since they observed an enhanced output of excreta in chicks being fed a diet containing 40 percent leaf meal. The normal level of Leucaena leaf meal in poultry diets at present is 5 to 10 percent of the ration. This primarily serves as a source for carotene and xanthophylls. Rice straw rations containing 40 to 90 percent dry Leucaena leaf meal did not supply adequate energy needed for feedlot cattle; however, a diet containing 40 percent rice straw, 50 percent fresh Leucaena leaves (dry matter basis) and 10 percent rice bran–copra meal mixture was able to support a cattle weight gain of .70 kg per head per day (Sevilla and Perez, unpublished data cited after Javier 1977).

Copra Meal (*Cocos Nucifera*)

Copra meal is produced in large quantities in the Philippines and Indonesia. The meal is a potentially good protein source for livestock in the region. The nutritive value of the locally produced meal is not widely known. Creswell (1979) used 20 percent copra meal in broiler diets with various levels of lysine and/or methionine supplementation. It appeared that the chicks being fed diets containing .15 percent of dL–methionine or L–lysine gained less ($P< .05$) than did the control group whereas those being fed diets unsupplemented or supplemented with a .3 percent of either amino acid or both in combination had gain comparable with the controls. In swine, copra meal at 40 percent of the ration depressed weight gain and other growth performance (Creswell and Brooks 1971a). These workers suggested that the depression might be caused by the low protein and dry matter digestibility (Creswell and Brooks 1971b). In laying hens, copra meal at levels up to 40 percent of the ration did not adversely affect egg production but increased body weight loss (Wignjosoesastro et. al. 1972). This weight loss did not occur when those diets were supplemented with 10 percent coconut oil. Peak egg production in that trial was observed when copra meal was included in the ration at the 20 percent level.

Hydrolyzed Feather Meal

Feather meal is one of the most protein–rich feedstuffs available. In Thailand, commercial production of hydrolyzed feather meal has long been established, but most of the product is exported. Raw feather meal contains approximately 83 percent crude protein; however, only 7.7 percent is digestible (McCasland and Richardson 1966). According to their study, hydrolyzed feather meal has 80.3 percent digestible protein. Morris and Balloun (1973) indicated that for the best quality feather meal should be hydrolyzed by steam at 50 pounds per square inch for 1 hour with intermittent agitation. Feather meal protein is rich in glycine, cystine, arginine, and phenylalanine but deficient in methionine, lysine, histidine, and tryptophan (Moral el at. 1966). In a series of feeding trials, Balloun and Khajarern (1974) replaced a portion of soybean meal with various levels of feather meal in a 28 percent maize–soybean meal turkey poult diet. They demonstrated that feather meal could be safely included at 5 percent and 10 percent of the diets for 1–to–4 weeks and 4–to–8 weeks old poults, respectively. Clearly, the poults increased their ability to utilize feather meal with age. With chicks, Khajarern et al. (1978) incorporated feather meal, at the expense of soybean meal on an equivalent protein basis, into maize soybean meal–fish diets at levels of 0, 2, 4, 6, and 8 percent and did not find any significant differences in body weight gain, feed per unit of gain, or dressed carcass percentage of the broiler at 9 weeks of age. However, a nonsignificant quadratic response was observed in body weight gain with the peak at the 6 percent level (Table 14).

With growing–finishing swine, Khajarern and Khajarern (1977) added feather meal at 0.0, 5.2 and 10.4 percent of maize soybean meal rations. The pigs in the 5.2 percent treatment performed as well as the control group (Table 15). However, those on the 10.4 percent treatment gained weight at a slower rate ($P< .05$) and a slightly

TABLE 14 Effects of Hydrolyzed Feather Meal on Growth Performance and Dressed Carcass Percentage of Broilers

Item	Level of feather meal, % of ration				
	0	2	4	6	8
No. of chicks	30	30	30	30	30
Body weight gain (9 wk) g	1,829	1,924	1,921	1,933	1,918
Avg. feed consumption kg/chick	4.17	4.68	4.55	4.54	4.38
Feed/gain	2.28	2.43	2.37	2.35	2.41
Dressing percentage	83.1	83.4	83.8	86.0	84.0

TABLE 15 Effects of Hydrolyzed Feather Meal on Growth Performance and Carcass Characteristics of Growing–Finishing Swine

	Level of feather meal, % of ration			
Item	0	5.2	10.4	C.V. (%)
No. of pigs	11	11	11	....
Days on test	150.75	150.75	150.75	....
ADG, kg	.562[a]	.548[a]	.339[b]	20.1
Daily feed consumption, kg	1.67	1.73	1.30	15.7
Feed/gain	2.97	3.16	4.17	16.9
Dressing percentage	73.1	73.2	69.6	7.4
Carcass length, cm	82.55[a]	83.82[a]	76.2[b]	3.33
Backfat thickness, cm	3.23	3.15	3.18	20.19
Loineye area, sq cm	27.94	29.68	20.65	13.20

[a, b] Those means within the same line bearing different superscripts differ significantly at ($P<.05$).

poorer efficiency than other groups. Carcass quality of the 10.4 percent group was lower than the 5.2 percent and control groups. Thus, in Thailand, feather meal can be incorporated into swine and poultry diets at levels of 5 to 6 percent. However, this feedstuff deserves further study since it may be the most important ingredient to replace fish meal in swine and poultry diets in Thailand.

Dried Poultry Waste (DPW)

Dried poultry waste averages 32.4 percent crude protein, 13.5 percent true protein, 1.4 percent fat, 9.7 percent crude fiber, 28.6 percent NFE and 2.2 percent phosphorus (Smith 1974). The calcium and ash levels vary with type of diet being fed. Dried excreta from laying hens has 8.4 percent calcium (Smith 1974) and that from broiler hens has 3.4 percent (Bhargava and O'Neil 1975). Digestibility of DPW is quite high, 55.5 percent for dry matter, 66 percent for organic matter, and 72 percent for crude protein (Lowman and Knight 1970). Its ME content for poultry is 1,225 kcal per kilogram (Coon et al. 1978), and the quality of its true protein is comparable to standard feed–stuffs (Lee and Blair 1973). Its potential use as a feed ingred–ient is therefore considered to be very good. Lee and Blair (1973) fed 5 percent and 10 percent of DPW to broilers in four–week trials and observed no improvement in weight gain but a significant improved feed efficiency. These work–ers (Blair and Lee 1973) observed an increase in egg pro–duction of layers being fed low protein diets containing three levels of DPW. Trakulchange and Balloun (1975), however, observed the reverse when they fed layers 16 per–cent protein diets containing DPW at 12.5 and 15 percent levels. These data suggest that DPW should not be added to poultry diets at levels higher than 10 percent. With ruminants, low palatability presents a problem in getting the animals to consume large amounts of a diet contain–ing DPW. An adaptation period of 7 to 21 days is nor–mally needed for the animals to adjust to these types of diets (Thomas et al. 1972). Lactating cows being fed a diet containing 30 percent DPW give a slightly higher milk yield (20.8 kg/day vs. 19.6 kg/day) than those fed a soybean meal ration (Tinnmit.1977). Also, milk fat in the DPW–fed group was slightly higher (3.87 vs. 3.3 percent). Body weight gain, however, was less than that of the control animals. Meat or milk produced by cattle on a DPW diet is not distinguishable from those on a control diet. Therefore, DPW is a good protein source for ruminants when it is properly supplemented and fed at a moderate level.

CONCLUSIONS

This discussion represents only a small portion of work being done in Southeast Asia. The several excellent reviews on this particular subject include the symposium proceedings edited by Devendra and Hutagalung (1977) dealing with feedstuffs used in Malaysia. This volume contains excellent articles on the utilization of oil palm by–products (Devendra 1977), on nontraditional feed–stuffs (Hutagalung 1977), recycling of animal wastes (Muller 1977), utilization of pineapple bran (Raghavan 1977), and several others. In addition, the protein supply from single–cell organisms has increasingly attracted interest from several researchers (Vanavat and Chirarat–ananon, 1977; Hutagalung and Tan 1976; and Varghese et al. 1976). Bagasse and sugar by–products are other potential feedstuffs in the region. Limited amounts of research has been done in the United States (Marshall and Van Horn 1975; and Roman–Ponce et al. 1975) and in Puerto Rico (Randel et al. 1972) but, unfortunately, in Southeast Asia less attention has been given to them. Several indigenous feed sources such as Alangalang (Cylindrica imperata); water hyacinth (Eichhornia crass–ipes); seed meals from kapok; rubber; and others deserve attention to assess their value for local use. Since most of our cereals are used directly by humans, our livestock must have something to exist on. If every single effort of the nutritionists in the region was directed toward similar goals, there may come a time when we can reverse the statement made by Vorha (1977) that, "The supply of feed ingredients will help increase animal production in countries with developed economies only, and will have very little impact in countries with develop–ing economies."

REFERENCES CITED

Aquirre, M., A. Shimada and E. Avila. 1979. Metabolizable and net energy values of cassava meal for chicks. Poul. Sci. 58:694.

Balloun, S. L. and J. M. Khajarern. 1974. The effects of whey and yeast on digestibility of nutrients in feather meal. Poul. Sci. 53:1084.

Bhangava, K. M. and J. B. O'Neil. 1975. Evaluation of dehydrated poultry waste from cage reared broilers as a feed ingredient for broilers. Poul. Sci. 54:1506.

Blair, R. and D. J. W. Lee. 1973. The effects on egg production and egg composition of adding supplement of amino acids and/or urea or dried autoclaved poultry manure to a low protein layer diet. Brit. Poul. Sci. 14: 9.

Boonklinkajorn, P. 1978. Herbage production of grasses under coconuts in Southern Thailand. A paper presented to the Seminar on Integration of Animals and Plantation Crops. Penang, Malaysia. April 1978.

Butterworth, W. H. 1967. The digestibility of tropical grasses. Nutri. Abstr. Rev. 37: 349.

Castillo L. S. and A. L. Gerpacio. 1976. Nutrient composition of some Philippine feedstuffs. Tech. Bull. 21. Dept of Anim. Sci., College of Agriculture, University of the Philippines, Los Banos, Philippines.

Chen, C.P., K. C. Chang, A. S. Sidhu and H. Wahab. 1978. Pasture and animal production under five–year–old palm at Serdang. A paper presented to the Seminar on Integration of Animals with Plantation Crops. Penang, Malaysia April 1978.

Coon, C. N., J. P. Nordheim, D. C. McFarland and E. E. Gould. 1978. Nutritional quality of processed poultry waste for broilers. Poul Sci. 57: 1002.

Creswell, D. C. 1979. Poultry development in Indonesia, with particular reference to feeds and feeding. A paper presented to the Seminar on Animal Health and Nutrition in the Tropics. ADAB. James Cook University, Townville, Queensland, Australia, February 1979.

Creswell, D. C. and C. C. Brooks, 1971a. Composition, apparent digestibility and energy evaluation of coconut oil and coconut meal. J.Anim. Sci. 33: 366.

Creswell, D. C. and C. C. Brooks. 1971b. Effect of coconut meal on Coturnix quail and of coconut meal and coconut oil performance, carcass measurements and fat composition in swine. J. Anim. Sci. 33: 370.

Crump, D. K. 1972. The economics of beef production on semi–subsistence holdings. ASPAC/FFTC. Ext. Bull. 24, Taipei, Taiwan, Rep. of China.

Devendra, C. 1977. Utilization of feeding stuffs from the oil palm. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for livestock in Southeast Asia.

Devendra, C. 1979a. Malaysian Feeding stuffs. MARDI, Serdang, Selangor, Malaysia.

Devendra, C. 1979b. Ruminant nutrition and productivity in the ASEAN Region. A paper presented to the Seminar on Animal Health and Nutrition in the Tropics. ADAB, James Cook University, Townsville, Queensland, Australia. February 1979.

Devendra, C. and R. I. Hutagalung. 1977. Feedstuffs for Live–stock in Southeast Asia. The Proceedings of the Symposium held at Fact. Med., National University of Malaysia. Kuala Lumpur, Malaysia. 17-19 October 1977. 370 pp.

Din, M. G., M. L. Sunde and H. R. Bird. 1979. Effect of feeding plant by–product diets on growth and egg production. Poul. Sci. 58: 1274.

D'Mello, J. P. F. and D. Thomas, 1978. The nutritive value of dried Leucaena leaf meal from Malawi: studies with young chicks. Trop. Agr. Trin. 55: 45.

Eggum, B. O. 1970. The protein quality of cassava leaves. Brit. J. Nutr. 24: 761.

F. A. O. 1978. Production Yearbook 32:94–253.

Fernandez, A., N. A. Macleod and T. R. Preston. 1977. Cassava forage as a combined source of protein and roughage for cattle fed on molasses/urea. Trop. Anim. Prod. 2:195.

Garrett, W. N., H. G. Walker, G. O. Kohler and M. R. Bart. 1976. NaOH and NH_3 treated straw for ruminants. J. Anim. Sci. 43: 322. (Abstract).

Gomez, G. G. 1979. Cassava as a swine feed. World Anim. Rev. 29: 13.

Guggolz, J., J. M. McDonald, J. M. Walker, A. H. Brown, W. N. Garrett and G. O. Kohler, 1971. Chemical treatment of agric–ultural wastes to improve digestibilities as animal feeds. Proc. West. Sect., Amer. Sec. Anim. Sci. 22: 71.

Hegarty, M. P., P. G. Schinckel and R. D. Court. 1964. Reaction of sheep to the consumption of Leucaena glauca Benth, and to its toxic principle minosine. Aust. J. Agr. Res. 15: 153.

Hew, V. F. 1977. Problematic aspects of some carbohydrate sources used for pigs in Malaysia. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs For Livestock in Southeast Asia.

New, V. F. and R. I. Hutagalung. 1977. Aflatoxicosis in swine feeding. MARDI Res. Bull. 5: 122.

Holm, J. 1971. Feeding tables. Livestock Breeding Sta., Huey Kaew, Chiang Mai, Thailand. Mimeo. 23 pp.

Hutagalung. R. I. 1977. Non–traditional feeding stuffs for live–stock. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for Livestock in Southeast Asia.

Hutagalung, R. I. and P. H. Tan. 1976. Utilization of nutritionally improved cassava by nutrient supplementation and microbial enrichment in poultry and pigs. In J. Cock, R. MacIntyre and M. Graham (Ed.) Proc. of the Fourth Symp. Int. Soc. Trop. Roots Crops, CIAT, Cali, Colombia. August 1976.

Jackson, M. G. 1977. Rice straw as livestock feed. World Anim. Rev. 23: 25.

Javier, E. Q., 1977. Integration of fodder production with inten–sive cropping system in Southeast Asia. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for Livestock in Southeast Asia.

Jones, R. J., C. G. Blunt and J. H. G. Holmes. 1976. Enlarged thyroid glands in cattle grazing Leucaena pastures. Trop. Grassl. 10:113.

Khajarern, J., S. Khajarern, D. Bunsiddhi and V. Patanakulchai. 1979a. An evaluation of the replacing value of cassava root meal for maize, sorghum or rice by–products in broiler rations. In 1978 Annual Report, KKU–IDRC Cassava/Nutrition Project, Fact. Agr., Khon Kaen Univ. Khon Kaen, Thailand, P. 54.

Khajarern, S., J. M. Khajarern, A. Vibulchai and B. Intawong. 1979b. An evaluation of comparative feeding value of cassava root meal, sorghum, maize and rice by–products as energy sources for pigs. In 1978 Annual Report, KKU–IDRC Cassava/Nutrition Project, Fact. Agr., Khon Kaen Univ. Khon Kaen, Thailand, P. 104.

Khajarern, S. and J. Khajarern. 1977. A preliminary study on the utilization of feather meal as a protein source for pigs. Pig magazine (Thailand) 3(11): 23.

Khajarern, J., S. Khajarern, K. Phalaraksh, C. Patanasethakul, and S. Churastein. 1978. The nutritive value and utilization of feather meal by broiler chicks. Kaen Kaset (Khon Kaen University) 6 (2): 82.

Khajarern, S., J. Khajarern, K. Phalaraksh, N. Kitpanit and N. R. Hutanuwatr. 1979c. Substitution of cassava root products for cereals in livestock and poultry feeds. ASPCA/FFTC. Ext. Bull. 122. Taipei, Taiwan, Rep. of China.

Kratzer, F. H., L. Earl and C. Chiaravanont. 1974. Factors in–fluencing the feeding value of rice bran for chickens. Poul. Sci. 53: 1795.

Lee, D. J. W. and R. Blair. 1973. Growth of broilers fed on diets containing dried poultry manure. Brit. Poul. Sci. 14: 379.

Lee, K. A., Wan Mohd., Bin Wan Embong, L. H. Ng, F. C. Ng and A. K. Phang. 1978. Performance of sheep and goats under rubber. A paper presented at the Seminar on Integration of

Animals with Plantation Crops. Penang, Malaysia. April 1978.
Lowman, B. G. and D. W. Knight. 1970. A note on the apparent digestibility of energy and protein in dried poultry excreta. Anim. Prod. 12: 525.
Mahendranathan, T. 1971. The effect of feeding tapioca (Manihot utilissima Pohl) leaves to pigs. Malay. Agr. J. 48: 60.
Marshal, S. P. and H. H. Van Horn. 1975. Complete rations for dairy cattle. II. Sugarcane bagasse pellets as roughage in blended rations for lactating cows. J. Dairy Sci. 58: 896.
Maust, L. E., M. L. Scott and W. G. Pond. 1972. The metabolizable energy of rice bran, cassava flour and blackeye cowpea for growing chickens. Poul. Sci. 51: 1397.
McCasland, W. E. and L. R. Richardson. 1966. Methods for determining the nutritive value of feather meals. Poul. Sci. 45: 1231.
Montaldo, A. 1977. Whole plant utilization of cassava for animal feed. In B. Nestel and M. Graham (Ed.) Cassava as Animal Feed. Proceedings of a workshop held at University of Guelph. April 1977 Ottawa, International Development Research Center, IDRC-095e, 94–106.
Moore C. P. 1976. The utilization of cassava forage in ruminant feeding. International Seminar on Tropical Livestock Products. Acapulco, Mexico, March 1976.
Moran, E. T., Jr., J. D. Summers and S. J. Slinger. 1966. Keratin as a source of protein for growing chicks. I. Amino acid imbalance as the cause for inferior performance of feather meal and the implication of disulfide bonding in raw feathers as the reason for poor digestibility. Poul. Sci. 45: 1257.
Morris, W. C. and S. L. Balloun. 1973. Effects of processing methods on utilization of feather meal by broiler chicks. Poul. Sci. 52: 858.
Muller, Z. O. 1977. Economic aspects of recycling animal wastes. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for Livestock in Southeast Asia.
Natural, N. G. and C. B. Perez, Jr., 1975. Effect of copra meal and liquid molasses–urea supplementation to rice straw on performance of young bulls in feedlot and metabolism trials. Proc. XII Convention Phil. Soc. Anim. Sci.
Nell, A. J. and D. H. L. Rollinson. 1974. The requirements and availability of livestock feed in Indonesia. UNDP Project INS/72/009 Supporting Livestock Planning, Jakarta, Indonesia.
Nitis, I. M. and K. Rika. 1978. Bali cattle grazing improved pasture under coconuts. I. Effect of stocking rate on steer performance and coconut yield. A paper presented to the Seminar on Integration of Animals with Plantation Crops. Penang, Malaysia. April 1978.
Phalaraksh, K., C. Nikornkit, J. M. Khajarern and S. Puvadolphirod. 1978. An evaluation of the replacing value of cassava root meat for maize, broken rice or sorghum in starter, grower, developer and layer diets. In 1977 Annual Report, KKU–IDRC Cassava/Nutrition Project, Fact. Agr., Khon Kaen Univ. Khon Kaen, Thailand. P. 81.
Phalaraksh, K., J. M. Khajarern and S. Puvadolphirod. 1979. An evaluation of the replacing value of cassava root meal for maize, broken rice or sorghum in layer diet. In 1978 Annual Report, KKU–IDRC Cassava/Nutrition Project, Fact. Agr., Khon Kaen Univ. Khon Kaen, Thailand. P. 85.
Raghavan, V. 1977. Pineapple bran as a feeding stuff. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for Livestock in Southeast Asia.
Randel, P. F., A. Ramirez, R. Carrero and I. Valencia. 1972. Alkali–treated and raw sugarcane bagasse as roughages in complete rations for lactating cows. J. Dairy Sci. 55: 1492.
Tatanapanlop, P. 1979. Tendency of feed industry in Thailand. The Agricultural Economics Society of Thailand 18: 199.
Roman - Ponce, H., H. H. Van Horn, S. P. Marshall, C. J. Wilcox and P. F. Randel. 1975. Complete rations for dairy cattle. V. Interaction of sugarcane bagasse quantity and form with soybean meal, urea and starea. J. Dairy Sci. 58: 1320.
Ross, E. and F. Q. Enriquez. 1969. The nutritive value of cassava leaf meal. Poul Sci. 48: 846.
Seerly, R. W. 1972. Utilization of cassava as a livestock feed. A review. In C. H. Rendershott et al. (Ed.) A Literature Review and Research Recommendations on Cassava. AID Contract No. csd/2497. University of Georgia, Athens, Georgia. pp. 157–181.
Smith, L. W. 1974. Dehydrated poultry excreta as a crude protein supplement for ruminants. World Anim. Rev. 11: 6.
Springhall, J. A. and E. Ross. 1965. Preliminary studies with poultry rations for the Territory of Papua and New Guinea 1. Grower rations with copra, sago and Leucaena leucocephala. Papua New Guin. Agr. J. 17: 117.
Terry, R. A., M. G. Spooner and D. F. Osbourn. 1975. The feeding value of mixtures of alkali–treated straw and grass silage. J. Agr. Sci. 84: 373.
Thomas, J. W., Yu Yu, P. Tinnimit and H. C. Zindel. 1975. Dehydrated poultry waste as a feed for milking cows and growing sheep. J. Dairy Sci. 55: 1261.
Tinnimit, P. 1977. Dried poultry waste as animal feed. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs for Livestock in Southeast Asia.
Trakulchang, Nr. and S. L. Balloun. 1975. Use of dried poultry waste in diets for chickens. Poul. Sci. 54: 609.
Vanavat, P. and R. Chiraratananon. 1977. The use of brewery yeast in commercial type ration for poultry. Wrld. Poul. Sci. J. 33(2): 88.
Varghese, G., J. J. Thambirajah and E. M. Wong. 1976. Protein enrichment of cassava by fermentation with microfungi and role of natural nitrogenous supplements. In J. Cock, R. MacIntyre and M. Graham (Ed.) Proc. of the Fourth Symp. Int. Soc. Trop. Root Crops. CIAT, Cali, Colombia. August 1976.
Vorha, P. 1977. Feeding stuffs for animals –– demand and supply. In C. Devendra and R. I. Hutagalung (Ed.) Feedstuffs For Livestock in Southeast Asia.
Wignjosoesastro, N., C. C. Brooks and R. B. Herrick. 1972. The effect of coconut meal and coconut oil in poultry rations on the performance of laying hens. Poul. Sci. 51: 1126.

BEEF CATTLE AND WATER BUFFALO PRODUCTION IN SOUTHEAST ASIA

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SUMMARY

Most cattle and buffalo in Southeast Asia (SEA) are raised on small mixed farms rather than in large commercial enterprises. Large ruminants are mainly used for draft purposes, but their role as a source of meat is increasing in some SEA countries.

Cattle and buffalo feeds consist of green feeds (grass, shrub, tree leaf) and crop residues (cereal straw, pulse straw, and root crop straw). The proportion of legumes in the diet is small, and agro–industrial by–product feeding is not common. The straw, even though available in abundance, is still not used efficiently as a cattle and buffalo feed.

The extent of utilization of the green feed and crop residues depends on the class of the livestock, agricultural and animal husbandry patterns. The yield and quality of green feeds are affected by climatic zone, land utilization, topography and soil conditions.

Cattle and buffalo production can be enhanced by increasing the quantity and quality of the feeds. This can be accomplished by companion cropping (in the mixed farm system), protein–energy–concentrate supplement (in the intensive system), 3 strata (grass–shrub–tree) system (in the semi–intensive system), pasture improvement (in the extensive system), conservation and processing.

Feed inventory, tropical feeding standards, plant and animal raising in the mixed farming system and cooperation among institutions at the local, national, and regional levels require further research and development.

Key Words: large ruminant, draft animal, mixed farming, intensive–extensive systems, quality, nutritional constraint.

INTRODUCTION

Reviews on ruminant nutrition and productivity in the ASEAN region (Devendra 1979); recent developments in buffalo research and management in Asia (de Guzman 1979); potential of and limitations on livestock production in Thailand (Charan 1979); an approach for increasing livestock production in Indonesia (Wiryosuhanto 1979); and breeding, management and feeding water buffalo in the Philippines (Eusebio 1975) indicate that nutrition is one of the limiting factors in livestock production.

This paper describes beef cattle and water buffalo production in Southeast Asia (SEA) with particular reference to feedstuffs and feeding methods under different agricultural and animal husbandry patterns.

RESOURCES

There are about 18.23 million cattle in the SEA region (FAO 1976). Of these, 37.49 percent are found in Indonesia. The buffalo population is slightly less (17.94 million) with the largest concentration (31.09 percent) found in Thailand.

The age and sex distribution of these large ruminants vary in each country. In Thailand 31 percent of the water buffalo population over three years old is male (Suntraporn 1975), whereas in the Philippines, males constitute 86% of the population (Eusebio 1975). In Indonesia the buffalo population over three years old is 66 percent male (Anon 1976). Similar trends are also found among cattle in the SEA region.

An analysis of the population change (1971 to 1976) revealed that cattle population growth in Indonesia and Cambodia showed a negative trend of –6.6 and –22.28

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percent, respectively (FAO 1976). In the other SEA countries, the positive cattle population growth varied from 3.47 percent (Vietnam) to 36.65 percent (the Philippines). The growth in buffalo population is less encouraging, since in most SEA countries the buffalo population is declining from −2.2 percent (Vietnam) to −11.32 percent (Malaysia). In other SEA countries, the positive buffalo population growth varied from 3.19 percent (Indonesia) to 13.31 percent (Laos).

During the period 1971 to 1976, the cattle population for SEA countries increased 21.25 percent whereas the buffalo population decreased 1.85 percent. The decreasing number of buffalo in some SEA countries may be due to: 1)the temporary availability of bulls and bullocks for slaughter as a result of the motorization of road transport, 2) the lack of incentives to raise bullocks because their value as slaughter animals declines with age, 3) the temptation for farmers to sell productive females for slaughter because of the rapidly rising meat prices and 4) the change in attitude, particularly among younger people, towards unrewarding farm work at a time when opportunities for off–farm employment are generally improving (FAO 1978).

UTILIZATION

Draft

Cattle and buffalo are raised primarily for land preparation and transport. In Indonesia about 45 percent of the large ruminant population are used for farm traction (FAO 1978) and in Thailand 85 percent of the large ruminant are used for draft purposes (Charan 1975). Water buffalo are preferred for working on wet land, whereas cattle are preferred for working on dry land. The ability of cattle to plough land is 300 to 350 m^2/hr (Buranamanas 1963, cited by Charan and Suntraporn 1979). In one cropping season in Bali, a pair of cattle required 167 and 220 hours to till one hectare of wet and one hectare of dry land, respectively (Putra 1972). On an equal time basis, it takes 20 percent more cattle to till one hectare of dry land than one hectare of wet land.

Cost for tilling the land with hand (paddy) tractors has been shown to be 10 percent cheaper than using a pair of cattle (Putra 1972). For the small farmer in the mixed farming system, however, it is more convenient to use cattle or buffalo because they are cheaper to maintain, their numbers increase with time, there are no rust problems, and they have a higher salvage value.

Meat

In 1976, cattle slaughtered in SEA ranged from 2,000 (Singapore) to 800,000 head (Indonesia) (FAO 1976). The number of buffalo slaughtered varied from 35,000 (Cambodia) to 280,000 (Vietnam).

In Vietnam, meat production from cattle accounted for 5.95 percent of the total domestic meat production. In Indonesia, it was 53.72 percent. The meat produced from buffalo in the Philippines and Laos were 6.23 to 20.37 percent, respectively, of the total domestic meat production.

Milk

Even though beef cattle and water buffalo are raised mainly as draft animals, these large ruminants are used for milk production in some areas. In Indonesia, for instance, the milk production from beef–type cattle plus buffalo amounted to 8,500 and 28,000 tons, respectively.

The use of beef–type animals for milk production will decrease, since, apart from not being economical, dairy production by the small farmer is increasing. Malaysia, Indonesia, Thailand and the Philippines have current programs for small scale dairy farming (Javier 1977). Therefore, the need for dairy type cattle will increase in the future.

Export Earning

Some SEA countries imposed a quota on the export of cattle and buffalo. Thailand, for instance, has been exporting 25,000 to 50,000 cattle and buffalo annually, and 50,000 to 65,000 could be expected to be exported between 1977 and 1981 (Charan 1979). From 1971 to 1976, Indonesia exported 44,000 cattle and 16,000 buffalo annually, generating 4.1 million USD (Anon 1976).

Apart from live animals, hides and skins are also favorable export commodities. Between 1969 and 1976, Indonesia for instance exported 2,200 tons of cattle hides and 450 tons of buffalo hides annually, worth 2.1 million USD.

Fertilizer

The dung and urine of cattle and buffalo, when handled properly, are good sources of major and minor soil nutrients. A ton of well–prepared farm–yard manure contains about 5.0 kg N, 1.8 kg P_2O_5, 6.6 kg K_2O, 2.9 kg MgO and 4.4 kg CaO. Manure also increases the humus content of the soil and contains micro–organisms essential for the mineralization of the crop residue (Bredero 1977).

In a mixed farming system, a small farmer with two to three head of cattle will accumulate sufficient manure to supply NPK for 0.75 to 1.0 hectare of land.

Savings

The contribution of cattle and buffalo to the farm income varies in terms of importance. In Thailand, cattle and buffalo contribute 28 percent of the farm family income (Charan and Suntraporn 1979). In Indonesia, they contribute 10 percent in the wet region, 29 percent in the semi-arid region and 43 percent in the dry region (Putra 1979).

In economic terms, cattle or buffalo in the mixed farm system serve as a capital reserve, which can be liquidated in times of crop failure or other emergencies, or for ceremonial or festival activities.

Others

Increasing interest in using livestock manure for biogas production in SEA countries was highlighted at the seminar on Bioconversion of Lignocellulotic and Carbohydrate Residues in Rural Communities, held in Indonesia in 1979 under the sponsorship of the Netherlands, Indonesia, and United Nations University. It was reported (Apandi 1979) that in the Philippines, where firewood is not a problem, biogas production is primarily aimed at controlling pollution and public health. In Thailand, biogas production is primarily for replacing firewood, and in Indonesia, for household lighting.

Insignificant quantitatively but important socio-economically and traditionally is the use of cattle or buffalo for ceremonial and festival activities. In Bali for instance, ceremonies are not considered complete unless cattle or buffalo are included as sacrifices. In Madura, annual cattle racing is an important social and cultural event in the community. In some places in Bali, bone carving is becoming a well-established home industry, providing ready cash for the family.

QUALITY OF THE PRODUCT

The quality of meat produced for domestic consumption is low because some proportion of the beasts slaughtered is comprised of culled animals. On the other hand, the quality of exported meat should be higher because certain standards have to be met. Better finish and a minimum live weight of 375 kg in the case of Bali steers are examples of export criteria.

In terms of carcass weight for domestic consumption, the average carcass weight of cattle in SEA varied from 120 kg (Cambodia) to 200 kg (Thailand) (FAO 1976). The carcass weight of buffalo varied from 160 kg (Cambodia) to 253 kg (Thailand).

Information about the backyard dairy-beef farming in the Philippines (Eusebio 1978), backyard dairy-beef production in Thailand (Charan 1978) and package "PUTP" beef production in Indonesia (Team Khusus PUTP 1977) indicates the potential of this small scale approach to produce faster cattle growth and better meat quality for domestic consumption and for export. Interdisciplinary research and extension programs should be implemented. According to de Guzman (1978), the "backyard dairy-beef farming (in SEA) is a location and situation specific enterprise."

PATTERN OF PRODUCTION

Agricultural Pattern

Types and composition of feeds. In the mixed farming system, first priority is given to crop production, livestock keeping is a side-line enterprise. The cropping pattern is characterized by a system of polyculture in the dryland farming and monoculture system in the wetland farming. Growing crops especially for livestock feed is not practiced. Green feeds are secured from crop residue, ditches, road sides, from plantations and land temporarily not used for crop production.

During the wet season in Bali, 63 types of feed fed to cattle was comprised of grass (27), tree leaves (26), legumes (3), straw (4), trees (1), and others (2) (Nitis et al., in press). The botanical composition of the feed was comprised of 79 percent grasses, 14 percent tree leaves, 2 percent legumes, 2 percent straws, 1 percent banana stem, and 3 percent others. There are only 36 types of feed fed to buffalo. These are grass (23), tree leaves (4), legume (3), straw (2), and others (4) with a botanical composition of 88 percent grasses, 5 percent legumes, 2 percent straws, 1 percent tree leaves and 4 percent others. Different classes of cattle and buffalo are fed different types of green feeds with different botanical compositions.

Dryland farming. Intercropping, that is already practiced, not only intensified the land utilization but also increased the total yield. The crop residues consisting of cornstover, sweet potato vine, and bean straw are mostly fed to livestock. Since after the cash crop production, the land is usually too dry for another cash crop sequence, the land becomes invaded with volunteer species having low nutritive values. Therefore, the continuity of a dependable supply of feed is a problem.

Growing green feed for livestock under the plants grown for human consumption (companion cropping system) not only enhanced the productivity of the land during the dry period, but also increased the quantity and quality of the livestock feed. Experiments with Stylosanthes as a companion crop to cassava, showed that cassava tuber yield was not affected, whereas total grass feed production increased 69 percent (Nitis and Suarna 1976). A similar trend was also observed for maize–Stylosanthes companion cropping (Suarna and Nitis 1978). Furthermore, after the cash crop production, the land with the Stylosanthes aftermath produced twice as much green feed as did the land invaded with volunteer species (Nitis 1979a).

Wetland farming. Since rice is the main crop (in some places three crops/year), the main crop residue is rice straw. Rice straw is not fed to cattle or buffalo in large quantities because of its low digestibility, and also because it is not very palatable.

Productivity of wetlands can be increased by companion cropping. An experiment in Thailand (Shelton and Humphreys 1975) showed that Stylosanthes as a companion crop to rice has no adverse effect on the rice yield and at the same time increased the green feed production by 105 percent.

Plantation crop. During the rainy season, the volunteer species or the cash crop residue under coconut, rubber, coffee or oilpalm can be cut for or grazed by cattle or buffalo. However, during the dry season, soil under these trees and bushes is either bare or covered with scanty annuals of low nutritive value. The shortage of livestock feed in this region is common.

In an article by de Guzman and Allo (1975), it was reported that improved pasture (consisting of Brachiaria and Panicum) under coconut has no effect on the coconut yield and at the same time increased the green feed yield 4.2 percent. With controlled grazing and fertilization, the herbage yield can be increased 64.5 percent.

Critical land. As a result of shifting cultivation, some of the land not properly managed is invaded with blade grass (*Imperata cylindrica*). In Indonesia, the 16 million hectares of blade grass, which increases at the rate of 150,000 hectares annually (Suryani 1970), becomes a potential green feed supply for cattle and buffalo in this area. The nutritive value of blade grass is low (Anon 1972) and therefore, seldom used in ruminant diets. Experiments, however, have shown that with proper cutting (Bo Gohl 1975) or grazing (Falvey et al. in press) that yield and nutritive value of blade grass can be increased.

Due to volcanic eruptions, some of the productive agricultural land has been rendered useless because it is covered with sand. This idle land is either bare or covered with volunteer species of low nutritive values. The potential of this land for livestock feed should be evaluated.

Experiments on lava soil showed that with a light application of fertilizer, the improved pasture (Cenchrus, Macroptillium and Phaseolus) could produce 6 to 43 tons of fresh green feed/ha/year (Nugari et al., in press).

Animal Husbandry Pattern

Traditional system. The most distinctive feature of the cattle and buffalo industry in SEA is that most of these large ruminants are raised on small farms rather than under commercial operations. In the Philippines, more than half of the 2 million cattle and practically all of the 5 million water buffalo are raised on small farms (Javier 1977). In Thailand, practically all of the cattle and buffalo are raised on small farms (Charan 1975). In Indonesia, practically all of the 6.6 million cattle and 2.5 million buffalo are maintained on small holdings under the traditional management system (Soehadji and Hutasoit 1976).

Under the traditional system, cattle and buffalo are either continuously kept in a stall, tethered in the field during the day, turned loose with an attendant, or a combination of these systems. The pattern of agriculture governs the system of management.

Intensive system. In this system, cattle and buffalo are kept in a stall most of the time, except when they are used for work. During the wet season in Bali, 72 to 85 percent of the green feed fed to cattle consisted of grasses, the dominant genus being Paspalum (Nitis et al., in press). Cattle feed in wetland farming contained more grass but fewer tree leaves than did those in dryland farming. A similar trend was observed for buffalo feed.

During the wet season, straw comprised only 1 to 3 percent of the green feed fed to cattle or buffalo. However, during the dry season, straw comprises 30 to 60 percent of the diets fed to large ruminant.

Guided or package approach system. This system is still in the developmental stage in the Philippines (Eusebio 1978), Thailand (Charan 1978) and Indonesia (Team Tehnis PUTP 1977). In this system, as in Indonesia, selected farmers are given small investment credits to raise cattle under governmental guidance as to breeding, nutrition, management, disease prevention, and marketing practices. In the case of feeds and feeding, certain areas have been allocated to grow green feed, and the cattle are supplemented with certain amounts of protein or energy concentrate feed.

Semi-intensive system. In this system, cattle or buffalo are loose duirng certain periods, and are permitted to selectively graze the available feed. During the wet season in Bali, the fields grazed by cattle consisted of 36 to 93 percent grasses, 6 to 62 percent broad leaf species and up to 3 percent weeds (Nitis 1979b). When the grass supply is depleted, the cattle are supplemented with shrubs which are cut and fed to them. When the shrub supply begins to dwindle, the cattle feed mainly consists of tree leaves. By the time all the trees are lopped, rainfall is sufficient to allow the natural grass to become established and ready for resumed grazing. With this three strata system (grass–shrub–tree) the farmers are able to maintain a year round green feed supply. However, a prolonged dry spell may cause a shortage of green feed.

Extensive system. In an area where land is not suited for crop production, the traditional way of keeping cattle and buffalo is to allow these large ruminants to graze in the field all the year round. In Java for instance, a typical grazing field is comprised of 43 to 68 percent grasses; 15 to 26 percent legumes and 17 to 30 percent weeds (Harmadji et al. 1975). In the drier part of Eastern Indonesia, the grazing fields consist mostly of grass with Themeda and Heteropogon genera, the most common species (Sherman et al. 1976). Cattle production is very low and it is a common practice to store feed during the dry season.

An interest in ranching has developed in some countries in SEA. Between 450,000 and 500,000 hectare have been taken by private individuals, private companies, or the State Ranching Cooperation for cattle production in Indonesia (FAO 1978). Land leases, species and breeds of animals, pasture development, lack of trained personnel, custom and tradition are constraints that should be critically analysed if ranching is to be successful in Southeast Asia.

NUTRITION, ONE OF THE MAIN CONSTRAINTS IN PRODUCTION

Utilization of Green Feed

During the rainy season (November to March) natural grasses produced 14.80 tons DM/ha with 10.91 percent CP and 3.97 kcal GE/g, whereas during the dry season (April to October), grasses produced 8.40 tons DM/ha with 9.31 percent CP and 3.87 kcal GE/g (Nitis 1979b). Apart from season, climatic zone, and topography, land utilization and soil condition affected the yield and quality of the natural grasses (Nitis et al., in press). Since cattle and buffalo feeds mainly consist of green feed, increasing the quantity and quality of this resource is a prerequisite for increasing cattle and buffalo production. It has been shown in the preceeding discussion that this can be accomplished by companion cropping, pasture improvement, improvement of the 3–strata system and better management of native pastures.

Results of a feeding experiment showed the importance of improved pasture for ruminant feeding. A pen feeding experiment showed that cattle fed grass supplemented with Stylosanthes (50:50 percent basis) gained more weight than those fed grass only; cattle fed grass supplemented with tree leaves and banana stems gained more weight than those fed grass only (Nitis 1979c). Grazing experiments under coconut palm in Indonesia (Nitis and Rika 1978) and under oilpalm in Malaysia (Chen et al. 1978) showed that cattle grazing improved pasture under coconut gained more weight than those grazing natural grasses. Grazing experiments on the high land in Thailand also showed a similar trend in the wet season (Falvey and Andrew 1979). In a review article, Evans (1978) indicated the potential for improved pasture to increase cattle production in Malaysia.

Apart from improving the pasture, concentrate supplements can also be used to increase livestock production fed natural grasses. A pen feeding experiment has shown that cattle fed natural grass (70 percent) supplemented with concentrate mixture (30 percent) gained more weight than those fed grass only (Nitis 1979b).

Cattle fed blade grass supplemented with energy concentrate or pelleted blade grass gained more weight than those fed blade grass only (Soewardi 1976).

Utilization of Crop Residue

Rice straw, is the only crop residue in abundance in the mixed farming system that has not been affectively utilized for large ruminant feeding. Experiments show that rice straw supplemented with urea and molasses could maintain live weight of cattle for 15 weeks (Parakhasi and Hutasoit 1978). In a review article, Jackson (1978) reported that experiments in India, Egypt and Malaysia show that treating rice straw with NaOH could increase the rice straw digestibility by 29 to 36 percent and cattle or buffalo fed the treated rice straw could gain 36 to 60 percent more weight than those fed untreated rice straw. Though promising, the practical application of the NaOH treated rice straw in the traditional mixed farming system needs to be studied.

Utilization of Agro–Industrial By–Products

The use of oil processing and grain–milling by–products in cattle and buffalo diets in SEA is not prevalent because of competition with the non–ruminant animals. A pen feeding experiment in Indonesia showed that cattle up to 200 kg live weight, supplemented with 15 percent copra meal + 15 percent cassava chips gained more weight than those supplemented with 5 percent copra meal + 15 percent rice bran + 10 percent cassava chips; whereas after 200 kg live weight the reverse was true (Nitis 1979b).

This suggests that feeding concentrate supplements could produce better gain at lower feed cost. A case study in Malaysia showed that the inclusion of 10 percent (on DM basis) oilpalm sludge in a diet consisting of cassava, palm press fiber, palm kernel cake and molasses has no significant effect on the growth of cattle or buffalo (Dalzell 1978).

A beef feed lot project is now underway in Malaysia to use organic residue resources (such as pineapple residue, oilpalm fiber residue and crop residue) as the main ingredient in a beef cattle diet (Muller 1978).

In a review article, Devendra (1979) indicated that grasses and agro–industrial by–products, when properly utilized, can play an important role in increasing buffalo production in Asia.

Utilization of Dietary Nutrients

Comparative studies between cattle and buffalo showed that the digestibility of CP in buffalo was greater than in cattle (Escano et al. 1971; Sutardi 1978). Total N in the rumen liquor of buffalo was greater than that in cattle and this total N in buffalo rumen liquor decreased faster than that in cattle (Aranas et al. 1971). Furthermore, buffalo rumen liquor contained more NPN and NH_3–N than that of cattle, and the NH_3–N in buffalo was 18 percent NPN, whereas in cattle it was 20 percent NPN. It has also been reported that buffalo liquor rumen has a higher concentration of bacterial N than that of cattle (Reddy et al. 1976).

With regard to CF, it has been shown that digestibility of CF in buffalo was higher than in cattle (Escano et al. 1971; Sutardi 1978). A similar trend was also reported for cellulose and hemicellulose (Sutardi loc. cit.; Raxas et al. 1975).

The available data suggest that buffalo utilize protein and energy more efficiently than cattle.

STRATEGY FOR INCREASING PRODUCTION

Breeds, disease, nutrition, management, marketing and politico–socio–economic factors should be considered simultaneously in determining the strategy for increasing cattle and buffalo production in SEA. Since more than 80 percent of cattle and buffalo are raised by small farmers in the mixed farming system, and since nutrition is the most limiting factor, it seems appropriate to consider strategies for feeds and feeding, extension, and research to increase the beef cattle and water buffalo production in SEA.

Feeds and Feeding

In the mixed farming system, companion cropping (legume for livestock feed under the cash crop for human need) would increase the quantity and quality of the livestock feed during and after the cash crop production. In the case of plantation crops, a shade tolerant grass–legume mixture (i.e. Brachiaria Panicum, Macroptilium, Stylosanthes) would increase the quality and quantity of the green feed for a cut–and–carry system or for grazing.

In the intensive system of production, the home–made by–product feeds (i.e. rice bran, coconut oil meal, soybean sludge), mainly fed to non–ruminant animals should be fed strategically to large ruminants to insure maximum live weight gain at minimum cost.

In the semi–intensive system of production, the 3–strata system (grass–shrub–tree), is well fitted to wet–dry periods. The quantity and quality of green feed can be increased by introducing better varieties of grasses (i.e., Cenchrus, Digitaria), legumes (i.e., Stylosanthes, Centrosema, Macroptillium), shrubs (i.e., Glyricidia, Leucaena, Sesbania), and trees (i.e., Caliandra, Visum).

In the extensive system of production, native pasture production can be increased by proper cutting or grazing management, by mixing in new grass and legume species, or by pasture renovation.

Since seeds and cuttings of good quality tropical forage are not readily available, a seed center should be established at appropriate locations to ensure a continuous and cheap suppy of materials for the farmers.

Extension

Even though disease prevention and cure, breed aquisition, and distribution are in the hands of the government in some SEA countries, the role of extension service should not be overlooked. Extension in terms of programs on breeding, disease control, management, nutrition and marketing should be simultaneously and continuously carried out. Cooperative efforts among Institutions and Agencies must be emphasized. There must be separate but effective roles created for government extension officers and private consultants.

Research

Much research has to be done in the field of beef cattle and water buffalo production in SEA. The following merit special attention:

Feed inventories of local roughage (grass, legume, shrub, trees and crop residue) and agro–industrial by–product feeds; including the types, availability, distribution, chemical composition and feeding values.

Utilization and storage of local roughage and agro–industrial by–product feeds and their nutritive values when combined or supplemented with other ingredients.

Feeding standards for cattle and buffalo under tropical conditions.

Plant and animal compatibility in a mixed farming system.

Development of breeds of cattle and buffalo and species of crops and forage plants that could satisfy different agricultural and animal husbandry patterns.

REFERENCES CITED

Anonymous. 1972. Hasil analisa hijauan bahan makanan penguat dari Jawa, Madura dan Bali (Chemical analysis of roughage and concentrate in Java, Madura and Bali). Fakultas Peternakan, Univ. Gajah Mada.

Anonymous. 1976. Indonesian Agriculture census and survey book. Dept. Agr. Indonesia, 45 p.

Apandi, M. 1979. Pemanfaatan instalasi gas bio dalam bidang perternakan (The importance of biogas installation in animal production). Preprint, Seminar nasional panelitian peternakan, Bogor, November 5 to 8, 13p.

Aranas, J. J., L. C. Eala, A. Y. Rables and P. L. Lopez. 1971. Preliminary observation on the composition of the rumen contents of carabaos and cattle fed napier grass. Phil. J. Anim. Sci. 8: 139.

Bo Gohl, 1975. Tropical feeds. FAO Agr. Studies No. 96.

Bredero, Tk. J. 1977. The role of farm yard manures and green manures in soil fertility restoration in the humid tropics. Trop. Agr. 3: 9.

Charan, C. 1975. The buffaloes of Thailand. – their potential, utilization and conservations. In the Asiatic Water Buffalo ASPM/FFTC. Ext. Bull. No. 114, p. 15.

Charan, C. 1978. Backyard dairy–beef production in Thailand. ASPAC/FFTC. Ex. Bull. No. 114, p. 15.

Charan, C. 1979. Potential and limitation of livestock production in Thailand. Preprint, Seminar on Anim. Health and Nutr. in the Tropics, Townsville, February 18 to 23, 21p.

Charan, C. and R. N. P. Suntraporn. 1979. The role of swamp buffalo in small farm development and the need for breeding improvement in Southeast Asia. ASPAC/FFTC Ext. Bull. No. 125.

Chen, C. P., K. C. Chang, A. S. Sidhu and H. Wahab. 1978. Pasture and animal production under five year old oilpalm at Serdang. Preprint No. 16, Seminar on Integration of Anim. with Plantation Crop, Pulau Pinang, April 13 to 15, 11p.

Dalzell, R. 1978. A case study on the utilization of effluent and by–products of oilpalm by cattle and buffalo on an oil–palm Estate. Proc. Symp. Feedingstuffs for Livestock in Southeast Asia, Malaysia, October, 17 to 19, p. 132.

De Guzman, Jr., M. R. and A. V. Allo. 1975. Pasture production under coconut palm. ASPAC/FFTC: Taiwan.

de Guzman, Jr., M. R. 1978. Integration of backyard dairy–beef farming with cropping systems of Southeast Asia. ASPAC/FFTC. Ext. Bull. No. 110.

de Guzman, Jr., M. R. 1979. An overview of recent developments in buffalo research and management in Asia. ASPAC/FFTC., Ext. Bull No. 124.

Devendra, C. 1979a. Ruminant nutrition and productivity in the Asian region. Preprint, Seminar in Anim. Health and Nutr. in the Tropics, Townsville, February 18–23, 25 p.

Devendra, C. 1979b. The potential value of grasses and crop by–products for feeding buffalo in Asia. ASPAC/FFTC. Ext. Bull. No. 126.

Escano, J. R., C. B. Perez, Jr. and A. L. Ordoveza. 1971. The yield and chemical composition of napier grass (Pennisetum purpureum achum) and its intake, digestibility and nitrogen retention by cattle versus caraboa as affected by stage of growth and season. Phil. J. Anim. Sci. 8: 107.

Eusebio, A. N. 1975. Breeding, management and feeding practices of buffalo in the Philippines. In the Asiatic Water Buffalo. ASPAC/FFTC: Tiwan, p. 257.

Eusebio, A. N. 1978. Bakcyard dairy–beef farming and feed grain substitutes in the Philippines. ASPAC/FFTC. Ext. Bull. No. 114.

Evans, T..R. 1978. The potential for increasing cattle production in Malaysia from improved tropical pasture. Proc. Symp. Feedingstuffs for Livestock in Southeast Asia. Malaysia, October 17 to 19, p. 37.

Falvey, L. and A. Andrews. 1979. The productivity of improved pasture compared to native highland pastures. Thai–Australian Highland Agr. Project, 4th Report: ADAB.

Falvey, L., P. Hengnicrai and P. Pengpiachan. In Press. The productivity and nutritive value of Imperata cylindrica in the Thai highland. In press.

FAO. 1976. FAO production yearbook. Vol. 30 FAO:Rome

FAO. 1978. Draft report of the Indonesia livestock sector survey Vol. I. FAO Report No. 6/78 INS 18.

Harmadji, Soedomo dan M. Kamal. 1975. Laporan survai potensial padang pangonan de Jawa Tengah dan D.I. Yogyakarta (Report on the potential of grazing area in Central Java and Yogyakarta D. C.). Laporan Univ. Gajah Mada.

Jackson, M. G. 1978. Treating straw for animal feeding. FAO Anim. Prod. and Health paper no. 10.

Javier, E. Q. 1977. Integration of fodder production with intensive cropping system in Southeast Asia. Proc. Symp. Feedingstuffs for Livestock in Southeast Asia. Malaysia, October 17 to 19, p. 19.

Muller, Z. O. 1978. Economic aspects of recycling animal wastes. Proc. Symp. Feedingstuffs for Livestock in Southeast Asia. Malaysia, October 17 to 19, p. 289.

Nitis, I. M. and M. Suarna. 1976. Undersowing cassava with Stylosanthes grown under coconut. Proc. 4th Inter. Symp. on Trop. Root Crop. Colombia, August 1 to 7, p. 98.

Nitis, I. M. and K. Rika. 1978. Bali cattle grazing improved pasture under coconuts. 1. Effects of stocking rate on steer performance and coconut yield. Preprint No. 10. Seminar on Integration of Anim. With Plantation Crop. Penang, April 13 to 15, 8.

Nitis, I. M. 1979a. Stylosanthes aftermath as companion crop to cassava and its subsequent effect on the pasture production. Final Report to IFS, Sweden. Project No. R. 76, 48p.

Nitis, I. M. 1979b. Effects of replacing 30 percent of the green roughage with concentrate on the performance of Bali steer. Progress Report to IDRC, Canada, center file: 3–P77–0087, 25 p.

Nitis, I. M. 1979c. Performance of Bali cattle fed grass supplemented with Stylosanthes. Progress Report to IFS, Sweden, Project No. RR 76, 15p.

Nitis, I. M., K. Lana, I. B. Sudana, N. Sutji and I. G. N. Sarka. In Press. Persodiaan dan kebutuhan hijauan ternak de Bali (Roughage supply and requirement of Livestock in Bali.)

Nugari, K., D. P. Winaya, I. B. Sudana, N. Sutji and I. G. N. Sarka. Evaluasi pasture pada tanah lahar Gunaksa (Pasture evaluation on lava soil at Gunaksa). In Press.

Parakasi, A. and J. H. Hutasoit. 1979. Rice straw and corn–stover for live weight maintainance in beef cattle. Proc. Seminar on Ruminant. Bogor, July 24 to 25, 8p.

Putra, I. B. 1972. Tenaga sapi dalam pertanian de Bali (Cattle traction in the farming system in Bali). IR. Thesis in Anim. Husb. Univ. Udayana.

Raxas, D. B., C. B. Perez, and O. M. Gatmaitan. 1975. In vitro and in vivo digestion by cattle and carabao of rice straw based ration. Phil J. Vet. Anim. Sci. 1:149.

Reddy, J. T. and G. V. Raghavan. 1976. Effect of level of intake and time of sampling on the ruminal nitrogen fraction in cattle and buffalo. Indian Vet. J. 53: 106.

Shelton, H. M. and L. R. Humphreys. 1975. Undersowing rice (Oriza sativa) with Stylosanthes guyanonsis. Part 1, 2 and 3 Exp. Agr. 2:89 – 95, 97 – 101 and 103 – 111.

Sherman, A. E., J. S. Lare and K. Rika. 1976. Livestock production and range management in East Indonesia. Tech. Report. No. 6. CIDA: Canada.

Soehadji and J. H. Hutasoit. 1976. Package approach towards integrated small farm–animal production system in Indonesia. In Integration of Livestock with Crop Production at small Farm Level. Vol. 2, FAO No. RAFE 27. p. 139.

Soewardi, B. 1976. Penelitian tentang pemanfaatan alang–alang (Imperata cylondrica) untuk makanan sapi (Experiment on the role of blade grass for cattle feeds. Ph.D. dessertation. Bogor Agr. Inst.

Suarna, M. and I. M. Nitis. 1978. Pertumbuhan kembali stylosanthes sebagai tanaman sela pada jagung (Stylosanthes aftermath as companion crop to corn). Univ. Udayana FKHP Bull. No. 102.

Sutraporn, R. Na. P. 1975. Improvement of buffalo production through breeding and management under Thailand conditions. In the Asiatic Water Buffalo. ASPAC/FFTC: Taiwan, p. 157.

Suryani, M. 1970. Alang–alang (Imperata cylendrica). Pattern of growth as related to its problem of control. BIOTROP. Bull. No. 1.

Sutardi, T. 1978. Intensitas pencernaan pada kerbau (Digestive intensity of buffalo). Proc. Seminar on Ruminants, Bogor, July 24 to 25, p. 1.

Team Tehnis PUTP. 1977. Petunjuk tehnis pelaksanaan panca usaha ternak potong (Technical guide in package beef production). Directorat Jendral Peternakan: Jakarta. 52 p.

Wiryosuhanto, S. D. 1979. Pendekatan perencanaan dalam peningkatan produksi peternakan nasional (Planning approach for increasing national livestock production). Prepring. Seminar Nasional Penelitian Peternakan, Bogor, November 5 to 8, 14p.

SHEEP AND GOAT PRODUCTION IN SOUTHEAST ASIA

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SUMMARY

Sheep and goats constitute an important genetic resource in the Southeast Asian region. In 1977, the population of sheep and goats was 67.6 and 112.6 million, respectively. This represents 6.6 and 27.4 percent, respectively, of the total world population of about 1,028 million sheep and 410 million goats. The region ranked second in the population of goats. The importance of the relatively higher goat population in the region is reflected in the production of the highest precentage of goat meat (28 percent), goat milk (21 percent) and goat skins (80 percent). The productivity is in general low, and is mainly limited by poor quality animals, and more particularly, by a low level of nutrition.

The five systems of production are: tethering, extensive production, intensive production, semi–intensive production, and integration with cropping systems. The prevailing production systems are classified according to ecozones in individual countries. Tethering and extensive production are by far the most important. Intensive production, based either on grazing cultivated pastures or zero grazing of grass plus agro–industrial by–products, hasn't been adequately used. Tree leaves are a very common feed, but their value in feeding systems for goats is underestimated; examples are given of potentially important tree leaves in the region. The integration of sheep and goats with cropping systems has economic potential.

Production objectives must be defined for sheep and goats, and there must be a thorough exploitation of genetic resources as well as a more efficient use of feed resources in the region.

Key Words. sheep, goats, production systems, genetic resources, efficiency potential

INTRODUCTION

Sheep and goats are an important resource in Southeast Asia. This importance is associated with their contribution to small farmers and others who make a subsistence income. Increased development of sheep and goats, therefore, represents a means of increasing the living standards of these people, especially in eliminating protein deficiencies and also upgrading their population's income.

To achieve a maximum contribution from sheep and goats, however, the production systems for these animals must become more efficient. It is essential to keep three broad objectives in perspective:

- The full exploitation of the species and genotypes,
- a realistic potential level of productivity, and
- the maximum utilization of the available dietary ingredients in each production system is to identify these clearly in terms of production and profitability.

This paper reviews the current status of sheep and goats in the Southeast Asian Region: their contribution, socio–economic importance, production systems, present level of production and potential possibilities of increasing food production. The Southeast Asian Region hereafter referred to as the Region, is defined here to include Pakistan, India, and countries to the east, excluding Australia and New Zealand.

DISTRIBUTION AND POPULATION OF SHEEP AND GOATS

Distribution

Table 1 illustrates the distribution of sheep and goats by region in the developing countries (DCs). Southeast Asia ranked second in goats and fourth in sheep relative to the population of these species in other regions.

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TABLE 1 The Distribution of Sheep and Goats in The Developing Countries by Region (FAO, 1977)

Region	Total Sheep population (10^3)	Distribution[a] (%)	Total Goat population (10^3)	Distribution[a] (%)	Ratio Human:Sheep :Goats
Africa	160,555	15.6	131.126	32.0	3:1.0:1
Central America	9,005	.9	10,759	2.6	10:0.8:1
South America	102,117	9.9	18,230	4.4	12:6.0:1
Neat East	124,736	12.1	51.605	12.6	3:2.0:1
Southeast Asia	67,571	6.6	112,560	27.4	10:0.6:1
TOTAL	463,984	45.1	324,280	57.9	9:1.0:1

[a] Relative to the total world population of sheep and goats respectively.

Population

The populations of sheep and goats in the Region were 67.6 and 112.6 million, respectively (Table 1). This is equivalent to 6.6 and 27.4 percent, respectively, of the total world population of sheep and goats in the Region. The ratio of humans:sheep:goats indicate that goats were more important than sheep. Over the period 1961–65 to 1977, the annual increase in the rate of growth of sheep and goats were 1.4 and 0.8 percent,respectively.

FUNCTIONAL IMPORTANCE OF SHEEP AND GOATS

According to the Statistical Yearbook (1976), about two million full time equivalent economically active people are dependent on sheep and goats, constituting about one percent of the total labor force in the Region. The real number of people actually engaged in rearing sheep and goats is much higher in view of the considerable numbers of agricultural laborers, such as in India, who rear sheep and goats.

Meat Production

Table 2 presents the contribution of sheep and goats to meat production. Sheep and goats in the DCs produced about 34 and 74 percent of the total world production of mutton and goat meat, respectively. Southeast Asia produced the highest percentage of goat meat (28 percent), but only a small percentage of mutton and lambs (4 percent). Much of the mutton produced comes from Pakistan and India. This is consistent with the high sheep populations in those countries; both countries together produced 89 percent of the total output in the Region. India alone produced about 57 percent of the total production of goat meat in the Region.

Milk Production

The importance of goats in milk production in DCs is reflected by their production of about 66 percent of the world supply of goat milk, compared to the production of 44 percent of the world's sheep milk (Table 3).

It is significant to note that Southeast Asia produced the most amount of goat milk in the DCs (20.8 percent), followed closely by the Near East. Goat milk was produced mainly in India, Bangladesh and Pakistan which together produced 97 percent of the total production in the Region (Table 4).

Fiber, Skins and Hides

The Region is generally unimportant in the production of greasy wool. However, the supply of skins and hides is very significant, with goats and sheep producing about 80 percent and 40 percent, respectively, of the total world production of skins from individual species. In Southeast Asia, 75 percent of the total regional production was from India, Bangladesh, Indonesia and Nepal.

Miscellaneous Functions

In addition to the above functions, both species are also valuable for a variety of miscellaneous functions which have been discussed (Devendra 1976a). In addition, they make a significant impact on rural health and nutrition of several million people, especially at the poverty line in DCs (Devendra 1979a).

PRODUCTION SYSTEMS

There are five systems of sheep and goat production identifiable in the Asian Region (Devendra 1980) as follows:

TABLE 2 The Contribution of Sheep and Goats to Meat Production (FAO 1977)

Region	Total production from ruminants[a] (m tons, 10^3)	Mutton and lamb (m tons, 10^3)	Annual carcass per head yield (kg)	Goat meat (m tons, 10^3)	Annual carcass per head yield (kg)	Mutton and lamb as % of total world mutton and lamb production[b] (%)	Goat meat as % of total world goat meat production[c] (%)
Africa	3,569	651	14.0	425	10.0	11.7	24.7
Central America	1,203	18	15.5	20	10.3	.3	1.2
South America	7,280	285	14.0	64	11.0	5.1	3.7
Near East	1,503	707	17.6	279	14.0	12.7	16.2
Southeast Asia	1,665	245	12.2	484	11.6	4.4	28.1
World	53,545	5,586	15.0	1,720	12.0	---	---

[a] Beef and veal + mutton and lamb + goat meat
[b] Contribution from DC's as percent of total world mutton and lamb production = 34.2%.
[c] Contribution from DC's as percent of total world goat meat production = 73.9%.

TABLE 3 The Contribution of Sheep and Goats to Milk Production (FAO 1977)

Region	Total milk production[a] (m tons, 10^3)	Sheep milk (m tons, 10^3)	Goat milk (m tons, 10^3)	Sheep milk as % of total world sheep milk production[b] (%)	Goat milk as % of total world goat milk production[c] (%)
Africa	12,429	558	1,271	7.7	19.4
Central America	9,024	----	229	----	3.5
South America	23,922	32	126	.4	1.9
Near East	10,565	2,540	1,341	34.9	20.5
Southeast Asia	38,169	45	1,365	.6	20.8
World	450,343	7,268	6,548	----	----

[a] From cows + buffalo + sheep + goats.
[b] Contribution from DC'S as percent of total world sheep milk production = 43.6%.
[c] Contribution from DC's as percent of total world goat milk production = 66.1%.

- Tethering
- Extensive production
- Intensive production
- Semi–intensive production
- Integration with cropping systems

These systems have been adequately described (Devendra and Burns 1970; Devendra 1976c). It is relevant to stress that the Region as a whole has the unique distinction of including four important ecozones. Several factors affect the application of these production systems, and they have evolved commensurate with the available resources and various socio–economic factors. An attempt has been made to classify the prevailing production systems according to ecozone and, more particularly, as each ecozone affects each individual country. This broad classification (Table 5) is by no means complete, and

TABLE 4 The Contribution of Sheep and Goats to Fiber and Skin Production (FAO 1977)

Region	Total Wool (greasy) production[a] (m tons)	Total fresh hides and skin production[b] (m tons)	Sheep skins fresh (m tons)	Goat skins fresh (m tons)	Sheep skins as % of total world sheep skin production[c] (%)	Goat skins as % of total world goat skin production[d] (%)
Africa	201,010	618,887	116,150	83,640	11.8	25.4
Central America	7,260	160,866	5,745	5,719	.6	1.7
South America	293,440	1,129,081	81,393	14,176	8.3	4.3
Near East	139,710	261,203	125,788	42,238	12.8	12.8
Southeast Asia	70,774	1,306,235	65,951	117,540	6.7	35.7
World	2,587,885	6,758,147	983,083	329,423	----	----

[a] Contribution from DC's as percent of total world production = 27.5%.
[b] Cattle + buffalo + sheep + goat skins.
[c] Contribution from DC's as percent of total world sheep skins production = 40.2%.
[d] Contribution from DC's as percent of total world goat skins production = 79.9%.

TABLE 5 Classification of Production Systems Relative to Ecozones by Countries in the Asian Region (Devendra 1980)

Production systems	Ecozone	Annual rainfall (mm)	Countries concerned
Tethering	Sub–humid Humid	> 1200 > 1200	South India, Indonesia, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Thailand.
Extensive production (highlands)	Arid	< 500	Afghanistan and Nepal
Extensive production (lowlands)	Semi–arid	500–1200	North India, Afghanistan, Australia, Bangladesh and Iran.
Intensive production	Sub–humid Humid	> 1200 > 1200	South India, Indonesia, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Thailand.
Integration with cropping systems	Semi–arid Sub–humid Humid	500–1200 > 1200 > 1200	South India, Indonesia, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Thailand.

inevitable overlapping does occur, as for example in the extensive production system. Although this system is really suited to semi–arid and arid zones, it can be applied to sub–humid and humid zones.

The ecozones in the Asian region embrace four principal rangelands: tropical savannah, tropical forests, desert bush and temperate highlands. Within the tropical savannahs, goats are found in the low rainfall areas; the long alternate wet and dry spells attract more goats than the tropical forests that have no prolonged dry spell. The desert bush zone extends from the northeast plains of India through Pakistan and Afghanistan. The vegetation is sparse, but the variety of the browse plants available and the low rainfall level enables goats to flourish in this region. The temperate highlands refer to the

Himalayas and the other mountain ranges that border the entire region east of Afghanistan and Pakistan and run all the way to the east of Nepal.

Tethering and Extensive Systems

Tethering and the extensive systems are by far the most common in Southeast Asia. Tethering lends itself to easy management of goats especially in situations where a few animals are kept, there is limited land for grazing due to the emphasis on crop cultivation, and due to the farmers' preoccupation with cultivating crops makes it, in fact, the traditional system with all small farmers in the region.

The extensive system operates in situations where flock sizes are larger. This system is based on the utilization of large areas of land which is relatively unproductive because it is arid, or marginal. This land is unable to support crop production and is similar to that found in northern Pakistan and India. In this system, the animals browse and scavenge on what feeds are immediately available. Stocking rates fall generally within the range 1–4 animals/ha. The rainfall is generally higher than in the very extensive systems and pasture growth is limited by the total rainfall.

Very extensive systems are found where there is a very large amount of land available for grazing. Here, flock size is also large and stocking rates are below 0.5 animals/ha. However, this system is rare in the region. The rainfall is very low (< 300 mm), and the climate is severe. Together these factors greatly restrict the availability of feed for sheep and goats.

Intensive System

The intensive system involves feeding of animals with cultivated grasses and/or by–products while having limited access to land (stall feeding) in situ. or the utilization of pasture involving such grasses as guinea grass *(Panicum maximum)*, pangola *(Digitaria decumbens* Stent*)*, african star *(Cynodon plectostachyus)*, and setaria *(Setaria anceps)*. Intensive pasture grazing, however, is not common partly because the land is used for alternative purposes, less favorable environmental conditions and limited knowledge of grassland technology. An isolated study in India, using male Barbari goats to graze a cultivated pasture of anjan grass *(Cenchrus ciliaris)* and siratro *(Phaseolus atropurpureus)* while being fed a concentrate supplement, has shown that this regime gave meat with more protein and fat than was obtained without supplements (Dabadghao et al. 1976). In comparison to the extensive systems, stocking rates are much higher, about 6–20 animals/ha. It is, by definition, a system with a high labor and cash input.

Concerning stall feeding, the system is quite popular in the region, but it is not applied intensively. Usually, stall feeding is combined with limited grazing and this procedure is commonly found in Pakistan, Sri Lanka, Malaysia, Indonesia and the Philippines, especially in situations where there is some grazing land available.

In this system, cut grass (cultivated or uncultivated) is usually fed along with tree leaves. Usually, very little or no concentrates or mineral licks are fed, although salt is commonly given. Very seldom, however, are these grasses fed at the right stage of growth or chopped prior to feeding, so there is much room for improvement. This system is likely to become important especially in situations where goats are valued for milk, such as in South India, Bangladesh, West Java and the Philippines, and also where there is an abundant supply of agro–industrial by–products and/or a supply of tree leaves. This trend is apparent in South India, West Java and the Philippines.

Tree Leaves and Browse Plants

The effective utilization of tree leaves is possibly the most underestimated aspect of goat management, and merits much more investigation (Devendra 1979). Farmers traditionally feed varying quantities of it; the amounts fed are dependent on the time available to the farmer, duration of grazing and availability. The feeding of tree leaves is justified by the fact that goats relish variety in their diet, and the supply of tree leaves also enables the animals to meet much of their requirements for energy, protein and minerals. There is also the possibility that on account of their higher digestive efficiency of coarse roughages, goats derive a higher uptake of metabolizable energy (ME) from these feed resources; possible reasons for this have recently been reviewed (Devendra 1978a).

The Region as a whole has a variety of tree leaves and browse plants that are relished by goats, and can be used to a much greater extent than they are at present. The main reason for limited use of these feeds is that they are non–conventional, underlined by the fact that there is limited scientific investigations on their nutritive values and usefulness in feeding systems.

The sparse knowledge of the value of such non–conventional feeds is reflected in only ten studies on goats in India: barged and pipal leaves (Mia et al. 1960a; 1960b), gular leaves (Majumdar and Momin 1960), leucaena leaves (Upadhyay et al. 1974), jackfruit leaves (Devasia et al. 1976), shisham pods (Saraswat et al. 1974), raintree fruit meat (Thomas et al. 1976), and sal seeds (Tripathi 1975). Cow pea fodders given to stall–fed Jamnapari goats have been shown to produce satisfactory milk yields (Maheswari and Talapatra 1975). Cow pea fodders like cowpea hay and water hyacinth hay have been fed to sheep in India (Singh et al. 1972). Thomas et al. (1976) have further shown that a 20 percent level of raintree meal in the diet gave a comparable daily live weight gain (87g) compared to that obtained by feeding a concentrate mixture (90g). More particularly, the cost of this gain was reduced by 20 percent. Recently, goats have been shown to utilize four tree leaves and four shrubs in the more arid regions of New South Wales in Australia (Wilson 1977), cassava leaves (Devendra 1979c) and pigeon pea leaves and stems (Devendra and Chee 1979) in Malaysia.

In view of the potential importance of tree leaves and browse plants, typically non--conventional feeds, an attempt has been made to indentify the more important ones in selected countries in the Region; Appendix 1 tabulates this. Inadequate data currently exist on the proximate components, digestible nutrients and value in feeding systems: all these aspects need more vigorous investigation.

Integration with Cropping Systems

The integration of sheep and goats with crop agriculture (Devendra 1978b) has been practiced variously in most countries. The system is variable depending on the type of crops being grown and the relative importance of sheep and goats. In Fiji, for example, 70 percent of the total goat population is found in the sugarcane growing areas. Likewise in Sri Lanka, Malaysia, Indonesia and the Philippines, sheep and goats undergraze coconut, oil–palm or rubber plantations. The advantages of this system are: 1) increased fertility of the land by the return of dung and urine, 2) control of waste herbage growth, 3) reduced fertilizer wastage, 4) easier management of the crop, and 5) possibilities of increased crop yields and greater economic returns. More recently, realization that this system has economic potential has encouraged a number of countries in the Region to investigate the system more closely.

PRESENT LEVEL OF PRODUCTION

The present level of productivity of both goats and sheep in the Region is low. This is due to a combination of malnutrition, diseases, and poor husbandry. Goats, for example, have evolved especially in the extensive and free–range system, mainly in relation to fluctuations in the environment, notably the availability of feedstuffs. In most extensive areas which are often unsuited for effective crop cultivation, low productivity is to be expected. Nevertheless, goats can, on account of their browsing habits, secure essential nutrient requirements from the natural grasslands, waste vegetation and crop residues.

Poverty of the peasants in rural areas also inhibits sheep and goat production. Where chronic malnutrition is evident, heavy parasitic burdens effectively reduce productivity. Periods of starvation alternate with intervals of low production, and become manifest in small size and slow maturity in adapting to low planes of nutrition.

Of the various environmental factors which limit production from both species nutrition is by far the most important and it is a significant factor which affects productivity from both goats and sheep.

Table 6 demonstrates the magnitude of improvement that is feasible due to the improved feeding and management of goats. Notable in the parameters measured are live weight at slaughter, hot carcass weight, dressing percentage and weight of meat which can be improved by as much as 53.8, 79.3, 7.1 and 47.1 percent, respectively. Equally significant is the fact that the total saleable weight and the return on sales can be improved by 34.1 percent.

TABLE 6 Magnitude of Improvement Feasible in Indigenous Kambing Katjang Goats Due to Improved Nutritional Management in Malaysia (Devendra 1979a)

Production trait	Rural goats[a]	Experimental goats[a]	Improvement feasible (%)
Live weight at slaughter (kg)	18.6	28.6	53.8
Hot carcass weight (kg)	8.2	14.7	79.3
Dressing %	44.2	51.3	7.1
Weight of meat (kg)	5.5	8.1	47.3
Meat:bone ratio	4.1	4.9	19.5
Forequarter (kg)	1.2	2.9	108.3
Hind leg (kg)	1.2	2.2	83.3
Total edible weight (kg)[b]	13.2	18.2	36.8
Total saleable weight (kg)	17.9	24.0	34.1

[a] Adult goats about three years of age. Each value is the mean of six animals

[b] Includes meat + edible offals.

Parallel evidence of low productivity in sheep due to poor nutrition, and real possibilities of increased offtakes when properly fed have also been reported in the Eastern Mediterranean (Demiruren 1972). This improvement can be quite substantial (Table 7).

Tables 6 and 7 demonstrate the opportunities for increased offtakes from both goats and sheep in terms of meat, milk or wool production are quite enormous. Every effort must be made to ensure that the animals are well

TABLE 7 Comparative Production Performance of Iranian Sheep Under Extensive and Improved Semi-Intensive Systems of Husbandry in the Eastern Mediterranean (Demiruren 1972)

Production	Extensive system (Unimproved)	Semi-intensive system (Improved)	Possible increase in production (%)
Lamb production/ewe	0.8	1.12	40
Avg. carcass weight (kg)	21.0	28.0[a] 34.0[b]	33
Milk production/ewe/lactation (kg)	45.0	59.5	32
Wool production/ewe (kg)	1.3	2.2	69
Flock offtake (%)	3.3	4.2	27

[a] Ewe carcasses
[b] Ram carcasses

fed, quantitatively and qualitatively, applying current concepts of applied nutrition. The generally low level of productivity from sheep and goats in the Region will persist until there is substantial improvement in husbandry management practices. The potential for improving the contribution from upgrading the species will be immensely beneficial to the income and well-being of poor people in the DCs.

MEASURES OF EFFICIENCY

Measures of efficiency are both interesting and important for sheep and goat production enterprises. There are several measures of efficiency, and there is no efficiency value for a species, since efficiency depends on many factors, such as reproductive rate and slaughter weight. Usually, the concepts of feed efficiency are used to compare different species of domestic livestock (Holmes 1970; Large 1973). Most of the theoretical calculations have been made on a per animal basis, and more recent analyses take into account the whole farm system on a total flock basis allowing for breeding replacement stock. These calculations are complex because they must consider soil, pasture–animal interactions and variability of seasons. The general conclusion that emerges from the calculations is that within ruminants, dairy cattle, goats and sheep are more efficient than meat animals. For lactating dairy goats, values of 24.0, 23.7 and 14.5 percent have been reported for energy, protein and energy cost of protein, respectively (Devendra 1976b).

The dairy goat, especially high producing breeds like the Saanen or British Alpine, appears to be a biologically very efficient animal. Precise reasons for this, if true, needs more investigation (Devendra 1979d). The basis for this possibility is reflected in calculations of yield per unit live weight in goats (Devendra and Burns 1970). The differences were found to be of the order of 8 to 28 percent higher compared to cows or buffalo, and further emphasizes the value of this species. It is significant to note in this context, that Spedding (1968) has also reported a higher efficiency of milk production in the goat (185 kg/100 kg DOM), compared to the cow (1962 kg) and the ewe (35 kg) in a temperate environment.

With reference to extensive goat production and the use of marginal or wasteland by these species, it is quite clear that goats are presently making the most efficient use of those areas which are unproductive agriculturally or otherwise. In these situations, their value increases as the quality of grazing decreases. The economics of high biological efficiency in such environments with minimum capital investment suggest that the returns fully justify their retention as is evident in the arid parts of Pakistan and India.

Measures of efficiency must also consider economic efficiency based on analyses of the various individual costs of production. It can be measured in terms of gross and net returns per animal, per month or annum, per hectare, per family and rates of return per unit of invested capital.

In order to furnish some understanding of the influence of management systems on productivity, and, therefore, on gross profit, different alternatives have been studied. The results of this study with calcuations included are summarized in Table 8. The significance of the systems to small farms in the Southeast Asian Region has recently been discussed (Devendra 1976a).

GENETIC RESOURCES

The efficiency with which available feeds are utilized in individual production systems depends to a large extent, on the effective use of genetic resources. It is doubtful that these resources are currently being fully exploited, because of inadequate knowledge and understanding of the genetic resources available, their productive capacity, and limited genetic improvement based on breeding and selection. These reasons, coupled with a low level of nutritional management result in a generally low level of performance.

The fact remains, however, that Southeast Asia is a reservoir of very valuable sheep and goat breeds. Many

TABLE 8 Measures of Economic Efficiency and Approximate Gross Margins of Profit in Meat Goats (Devendra 1976a)

Type of management system	Approximate gross value ($ Malaysian)[a]
b Grazing cultivated grass:	
(i) Per flock/yr	446.90
(ii) Per breeding doe/yr	44.70
(iii) Per month	37.20
b Grazing uncultivated grass:	
(i) Per flock/yr	510.00
(ii) Per breeding doe/yr	51.10
(iii) Per month	42.50
c Zero grazing cultivated grass:	
(i) Per goat per hectare/yr	11.00
d Growth and fattening on agricultural by–products	
(i) Value of live weight gain/goat/annum	76.65
(ii) Value of daily live weight gain/goat/annum	36.50

[a] I U.S $ = $2.40 (Malaysian) approximately.

[b] The calculations are specific to a foundation herd of ten breeding does, a 100 percent fertility, 25 percent culling/annum and cost of cultivated grass 1.8 cents/kg fresh grass. No cost is attached to uncultivated grass and unpaid family labor.

[c] Fed on guinea grass (*Panicum maximum)* at a cost of 1.8 cent/kg fresh weight.

[d] (i) Fed on cultivated grass and rice/straw molasses–urea diet in the ratio of 3:1 total dry matter intake and (ii) Fed exclusively on rice straw/molasses–urea diet.

of these have outstanding genetic and production qualities, but much more needs to be done to assess that productive potential. Tables 9 and 10 present a list of the outstanding sheep and goat breeds in the Region. Increasing the contribution from these resources necessitates breeding better quality animals and improved management practices.

TOWARDS INCREASED EFFICIENCY OF PRODUCTION

Increasing the efficiency of production also depends on the removal of the constraints to production, of which feed availability and effective utilization are particularly important. Limitations in the availability of feed is a major constraint. An assessment of the annual requirements of metabolizable energy (ME), and digestible crude protein (DCP) in the Region (Table 11) indicates

TABLE 9 Some Outstanding Indigenous Sheep Breeds in Southeast Asia

Breed	Speciality	Climate and country of origin
Bellary	Coarse wool	India, tropical, dry
Bikaneri	Coarse wool	India, tropical, dry
Chokla	Coarse wool	India, tropical, dry
Deccani	Meat, hair	India, tropical, humid
East Java fat-tailed	Meat, coarse wool	Indonesia, tropical, humid
Jaisalmere	Coarse wool	India, tropical, dry
Kathiawari	Coarse wool	India, tropical, dry
Lohi	Coarse wool, mutton	Pakistan, tropical, dry
Magra	Coarse wool	India, tropical, dry
Mandya	Meat, hair	India, tropical, humid
Marwari	Coarse wool	India, tropical, dry
Nellore	Meat, hair	India, tropical humid
Poorch	Wool	India, temperate (Himalayas)
Priangan	Meat, coarse wool	Indonesia, tropical, humid
Rampur–Bushair	Wool	India, temperate (Himalayas)

that the feed requirements for goats alone are enormous. When these requirements are related to similar requirements for other ruminants (buffalo, cattle and sheep) in the Region, the total needs are staggering, and clearly suggest that the feed requirements cannot be met.

Indeed this situation exists in India and Pakistan; therefore, value of untapped potential in a vast variety of agro–industrial by–products, including non-conventional feeds, has recently been discussed (Devendra and Raghavan 1978).

Clearly, the subject of feeds, their characterization and effective utilization by farm animals in general, and sheep and goats in particular, merits thorough study. Detailed attention to the following is imperative (Devendra 1979b):

- Feed inventories are needed which completely describe the type, quality and quantity available of various individual feeds. These include crop residues, tree leaves, and other native feeds. Information on their feeding value would make these inventories even more valuable.

TABLE 10 Suggested Improved Breeds of Goats in The Asian Region (Devendra 1980)

Speciality		Breed	Climate and country of origin
Milk	High yield	Anglo–Nubian[a]	Temperate, tropical, dry
		Saanen[a]	Temperate, sub–tropical, wet
	Medium yield	Barbari	India, tropical, dry
		Beetal	India, tropical, dry
		Damani	Pakistan, tropical, dry
		Dera Deen Panah	Pakistan, tropical, dry
		Jamnapari	India, sub–tropical, dry
		Kan.ori	Pakistan, sub–tropical, dry
		Marwari	India, tropical, dry
Meat		Anglo–Nubian	Temperate, tropical, dry
		Fijian	Fiji, tropical, humid
		Jamnapari	India, sub–tropical, dry
		Kambing Katjang	Indonesia, Malaysia, tropical, humid
		Ma T'ou	China, sub–tropical, humid
		Sirohi	India, tropical, dry
Prolificacy		Barbari	India, tropical, dry
		Black Bengal	Bangladesh, India, tropical, dry
		Malabar[a]	India, tropical, humid
		Ma T'ou	China, sub–tropical, humid
Mohair		Angora	Sub–tropical, humid
Skin		Black Bengal	India, tropical, dry

[a] Indicates breed is polled

- Information concerning the feeding value of new sources of roughage such as ipil–ipil (*L. latisiliqua* [L]), sesbania (*S. grandiflora*) and cassava (*M. esculents* Crantz) is required.

- The development of appropriate management regimes, including comparisons of both grazing and stall feeding systems is essential. Little, for example, is known about the values of tree leaves in stall feeding systems.

- The definition of production systems must be specified, giving attention to individual situations and demonstrating both the high production of animals and their profitability.

CONCLUSIONS

The thorough exploitation of sheep and goats represents an important means of increasing food production in the Region. This objective depends, however, on the application of efficient production systems, consistent with improved nutritional management, giving maximum response from genetically improved animals. It also depends on enlightened interest, increased resource use and expanded development of both species in the Region.

TABLE 11 Annual Metabolizable Energy (ME) and Digestible Crude Protein (DCP) Required by Goats in Asia, 1978 (Devendra 1980)

Nutrient	Requirement
ME (Mcal x 10^9)[a]	46,683.5
DCP (MR x 10^4)[b]	5,073.5

[a] Calculated according to: average live weight of goats is 25 kg, maintenance requirement/day = 500 Mcal, requirement for meat 11 Mcal/kg and requirement for milk 1.2 Mcal ME/kg.

[b] Based on a DCP requirement for maintenance of 61 g/day and 67 g DCP/kg milk.

REFERENCES CITED

Dabadghao, A. K., V. S. Upadhyay, and A. Rekib. 1976. Meat production from Barbari kids grazed on *Cenchrus* siratro pastures with or without supplementation. Indian Vet. J., 53: 535.

Demiruren, A. S. 1972. Sheep production potential in the eastern Mediterranean. Wld. Anim. Rev. (FAO), No. 2, p. 21

Devasia, P. A., C. T. Thomas, and M. Nandakumaran. 1976. Evaluation of the nutritive value of jack leaves. (*Artocarpus integrifolia*) Kerala J. Vet. Sci., 7: 1.

Devendra, C. 1976a. Goat production on small farms in Southeast Asia. Report Food and Agriculture Organization Expert Group meeting on Livestock Programs for Small Farmers and Agricultural Laborers, 31st May – 6th June, 1976, Bangkok, Thailand. Vol 11, p. 176.

Devendra, C. 1976b. Productivity from goats and sheep in Malaysia. 1. The potential contribution from goats. Bull. No. 144, 29, Ministry of Agriculture, Kuala Lumpur, Malaysia.

Devendra, C. 1978a. The digestive efficiency of goats. Wld. Rev. Anim. Prod., 14: 9.

Devendra, C. 1978b. A model for the integration of goats with cropping systems in the ASEAN region. Proc. Seminar on Integration of Animals with Plantation Crops, 13–15 April, 1977, Penang p. 84.

Devendra, C. 1979a. The potential of sheep and goats in world food production. J. Anim. Sci. (In Press).

Devendra, C. 1979b. Goat and sheep production potential in the ASEAN region. Wld. Anim. Rev. (FAO). (In Press).

Devendra, C. 1979c. The nutritive value of cassava (*Manihot esculenta* Crantz) leaves as a source of protein for ruminants in Malaysia. MARDI Res. Bull., 7: 112.

Devendra, C. 1979d. Milk production in goats compared to buffalo and cattle in the humid tropics. J. Dairy Sci. (In Press).

Devendra, C. 1980. Goat production in the Asian Region: current status, available genetic resources and potential prospects. Int. Sheep and Goat Res. (In Press).

Devendra, C. and M. Burns, 1970. Goat production in the tropics. Tech. Commun. No. 19, Commonwealth Bureau of Animal Breeding and Genetics Commonwealth Agricultural Bureau, xii + 184 pp.

Devendra, C. and C. V. Raghavan. 1978. Agricultural by—products in Southeast Asia: availability, utilization and potential value. Wld. Rev. Anim. Prod., 14: 11.

Devendra, C. and Y. K. Chee. 1978. The utilization of cultivated pigeon pea (*Cajanus cajan*) forage by goats and sheep in Malaysia. Proc. Symp. Legumes in the Tropics, 13–17th Nov. 1979 (In Press).

FAO. 1977. Production Yearbook, Vol. 31, Rome: Food and Agriculture Organization, 291 pp.

Holmes, W. 1970. Animals for food. Proc. Nutr. Soc. 29: 237.

Large, V. R. 1973. Factors affecting the efficiency of protein production. In: Jones, J. G. W. (Editor). The Biological Efficiency of Protein Production. Cambridge University Press, London.

Maheswari, M. L. and S. K. Talapatra. 1975. Stall feeding of Jamnupari goats with cowpea fodders. Indian Vet. J., 52: 30.

Majumdar, B. N. and S. A. Momin. 1960. Studies on tree leaves as cattle fodder. V. The nutritive value of gular leaves (*Ficus glomerata*). Indian J. Dairy Sci., 13: 16.

Mia, W. H., B. Sahai, B. N. Majumdar, and N. D. Kehar, 1960a. Studies on tree leaves as cattle fodder. IV. The nutritive value of bargad leaves (*Ficus religiosa*). Indian J. Dairy Sci., 13:1.

Mia, W. H., B. N. Majumdar, B. Sahai, and N. D. Kehar. 1960b. Studies on tree leaves as cattle fodder. IV. The nutritive value of pipal leaves (*Ficus religiosa*). Indian J. Dairy Sci., 13:9.

Saraswat, B. L., K. S. Singh, and K. K. Sachdeva. 1974. A study on the chemical composition of Shisham (*Dalbergia sissoo*) pods at different stages of maturity. Balwant Vidyapeeth J. Agric. and Scientific Res., 14: 12.

Singh, R. D. N., B. B. Mahapatro, and A. K. Pai. 1972. Volatile fatty acid production on certain Indian feeds. Indian Vet. J., 49: 984.

Spedding, C. R. W. 1968. The agricultural ecology of grassland. Agr. Progress, 44: 7.

Statistical Yearbook. 1976. New York: United Nations, 490 pp.

Thomas, C. T., P. A. Devasia., N. Kunjikutty, and M. Nadakumaran. 1976. Studies of feeding of goats. 3. Evaluation of the nutritive value of raintree (*Enterolobium saman*) fruit meal growth. Kerala J. Vet. Sci., 7: 13.

Thomas, C. T., P. A. Devasia., M. Nandakumaran, and M. V. Sukumaran. 1976. Evaluation of the nutritive value of raintree ((*Enterolobium saman*) fruit meal. Keralu J. Vet. Sci., 7: 7.

Tripathi, A. K. 1975. Effect of sal seed tannin and tannic acid on protein degradation in goat's rumen (in vitro). Indian Vet. J., 52: 195.

Upadhyay, V. S., A. Rekib, and P. S. Pathak. 1974. Nutritive value of *Leucaena leucocephala*(Lam,) De Wit. Indian Vet. J., 51: 534.

Wilson, A. D. 1977. The digestibility and voluntary intake of leaves and shrubs by goats and sheep. Aust. J. Agric Res. 28: 501.

APPENDIX 1

SOME IMPORTANT TREE LEAVES AND BROWSE PLANTS IN THE SOUTHEAST ASIAN REGION

Bangladesh, India and Pakistan

Anjan (*Handwicbia binnata*)
Ardu (*Ailanthus excelsa* Roxb)
Babul (*Acacia arabica*)
Banana (*Musa spp.*)
Bargad (*Ficus bengalensis*)
Beri (*Ziziyphus jujuba*)
Dhaincha (*Seshania aculeaton*)
Gular (*Ficus glomerata*)
Jackfruit (*Artocarpus heterophyllus*)
Jamun (*Engeinia jambolana*)
Khejri (*Phosopis cinararia*)
Khair (*Acacia catechu*)
Khanthal (*Artocarpus integrifelia*)
Mulberry (*Morus indica*)
Neem (*Azadirrachta indica*)
Pakar (*Ficus infectoria*)
Pipal leaves (*Ficus religiosa*)
Sainjan (*Moringa oleifera*)
Siras (*Albezzia lebbeck*)

Indonesia, Malaysia, Philippines and Sri Lanka

Banana (*Musa spp.*)
Canna (*Canna spp.*)
Cassava (*Manihot esculenta* Crantz)
Gliricida (*Gliricidia maculata*)
Hibiscus (*Hibiscus Rosa–sinensis*
Ipil ipil (*Leucaena latisiliqua* (L) Gillis)
Jackfruit (*Artocarpus heterophyllus*)
Lantana (*Lantana spp.*)
Pigeon pea (*Cajanus cajan*)
Singapore rhododendron (*Melastoma malabathricum*)
Turi (*Sesbania grandiflora*)

POULTRY PRODUCTION IN THE WET TROPICS

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SUMMARY

Broiler production experiments indicated that, of the factors studied, body weight and feed conversion were affected by dietary ME levels. The environment of the wet tropics appeared to have little or no effect on broiler production. The average feed conversion and final body weight of 2.05 and 1.90 kg/bird, respectively, for a nine week period were comparable to values in temperate zones.

The performance of Medium and Light strain hens were compared under wet tropical climatic conditions. In some instances, the Medium strain gave a better overall performance. The Lighter strain tended to be more sensitive to the climate. Eggs laid in this climate were slightly inferior in quality to those laid in temperate climates. Food and energy consumption by hens reared in wet tropics were significantly lower than those of hens reared in temperate climates.

The major diseases affecting poultry in the wet tropics are: Chronic Respiratory Disease Complex (CRD), Coccidiosis, Infectious Bronchitis (IB), Leucocytozoonosis, Newcastle Disease (ND) and Salmonellosis.

Key Words: broiler production, egg production, poultry diseases, breeder management, wet tropics.

INTRODUCTION

Poultry production is expanding at a very rapid pace in Southeast Asian nations, mainly because developed technology from the West was easily applied to local conditions. This paper describes the performance of poultry in the wet tropics, based mostly on results obtained under Malaysian conditions. Where possible, these results are compared to those derived from temperate regions.

BROILER PRODUCTION

Feed Intake

Data on the effect of dietary metabolizable energy (ME) level on feed and energy consumption are presented in Table 1. The results (Wolf et al. 1976, Raghavan et al. 1978 and Muhamad et al. 1979) indicated a trend toward reduced feed intakes with an increase in the dietary metabolizable energy level. Dietary metabolizable energy levels and feed intakes appeared to be inversely correlated. ME consumption was similar for all treatments in the three experiments. The effects on feed and energy intakes at comparable dietary metabolizable energy levels were inconsistent because the experiments were conducted over different periods of time.

TABLE 1 Effect of Dietary Energy Levels on Feed and Metabolizable Energy Intake

ME levels (kcal/kg)	Feed intake (kg)	ME consumed (kcal/h/d)
Wolf et al. 1976		
2800	4.98[a]	245[a]
3000	4.45[a]	238[a]
3200	4.22[b]	241[a]
Raghavan et al. 1978		
2800	3.92[a]	196[a]
3200	3.60[b]	206[a]
Muhamad et al. 1979		
3104	4.77[a]	277[a]
3211	4.61[b]	274[a]
3308	4.44[c]	274[a]

[a,b,c] Mean with same superscript do not differ significantly at ($P < .05$).

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Wolf et al. (1976) showed that increasing the dietary crude protein level from 18 percent to 26 percent resulted in increased protein consumption (Table 2). There was a slight tendency toward a reduced feed consumption at the higher dietary crude protein levels, but the difference was not significant.

TABLE 2 Effect of Dietary Crude Protein Levels on Body Weight and Feed Conversion

Dietary crude protein (level 90)	Feed intake (kg/h)	Crude protein intake (g/b/d)	Final body weight (g/b)	Feed conversion
18	4.08[a]	12.3[a]	1308	3.13[a]
20	4.26[a]	14.1[bc]	1384	3.09[a]
22	3.97[a]	14.0[bc]	1464	2.72[b]
24	3.88[a]	15.8[ab]	1452	2.67[b]
26	3.76[a]	16.6[a]	1480	2.55[b]

[a,b,c] Means with same superscript do not differ significantly at P <.05.
Source: Wolf et al. 1976.

Results from these studies clearly indicate that dietary energy is the dominant factor in regulating feed intake. Although Hill (1962) and Morris (1968) found that laying hens had some ability to regulate their feed consumption, but it was not clear if the same was true for growing poultry. In broiler production, feed intake is not often estimated as broilers are supposed to consume sufficient feed to meet maintenance and growth requirements. The effects of dietary energy levels were, therefore, not thoroughly studied. Results from current trials illustrated that growth requirements for energy are rather specific for broilers when feeds of varying energy levels were offered, the quantity consumed was adjusted to maintain a constant energy input. Feed intakes were not affected by dietary crude protein levels.

Metabolizable Energy Requirement

The amount of ME consumed is dependent upon dietary ME concentration and the amount of feed consumed. It is shown in Table 3 that ME intake significantly affected final body weight of broilers. With an intake of 163 kcal/bird/day, final body weight at ten weeks was 1411 g. But birds having an intake of over 190 kcal/day, reached final body weight of over 1500 g. The improved body weight was attributed to an increase in efficiency resulting from higher ME consumption. The improvement in feed conversion efficiency appeared to be linear to ME consumption. At an intake of 103 kcal ME/bird/day, the feed conversion efficiency was only 2.88. The value was significantly reduced to 2.29 when the intake was 193 kcal ME/bird/day. One group of broilers (Noraini 1975) was unable to equalize ME consumption because of the high crude fiber content in the diet.

TABLE 3 The Effect of ME Intake on Body Weight and Feed Conversion on Ten Week Old Broilers

ME intake (kcal/d)	Final body weight (g)	Feed conversion
163[a]	1411[a]	2.89[a]
191[a]	1700[b]	2.63[b]
193[a]	1845[c]	2.29[c]

[a,b,c] Mean with same superscript do not differ significantly at P <.05.
Source: Noraini 1975.

It has been demonstrated (Wolf et al. 1976, Raghavan et al. 1979) that broilers regulated their energy intakes rather efficiently. Final body weights and feed conversions improved at higher levels of dietary energy (Table 4). This means that dietary ME was utilized more efficiently as its level in the diet increased.

TABLE 4 Effect of Dietary Energy Levels on Body Weight and Feed Conversion

ME intake (kcal/d)	Final body weight (g)	Feed conversion
Muhamad et al. 1979		
3104	1.594	2.23
3211	1.665	2.10
3307	1.670	1.98
Raghavan et al. 1978		
2800	1.620	2.42
3200	1.886	1.91

Protein Requirement

The data in Table 2 are condensed from a study made by Wolf et al. (1976). With increased dietary protein levels, feed consumption appeared to decrease, but the differences observed were not statistically significant. The consistency in feed consumption resulted in increased protein intake at higher dietary protein levels, and absolute protein intake appeared to be linearly related. For every change of one percent dietary protein level, the protein consumption was affected by 0.44 g/bird/day.

The differences in protein intake also resulted in a significant change in final body weight and feed conversion efficiency. There was a gain of about 172 g/bird in final body weight for broilers consuming 16.6 g/bird over those consuming 12.3 g/bird with an increased level of ruminant floor space. This explained the change in final body weight though feed consumed was similar for all treatments.

Table 5 summarizes the interaction effects of ME levels and floor space on broiler production. Increasing ME levels and floor space resulted in significant gains in live weight and feed conversion. No interaction was detected for feed intake (Table 5).

TABLE 5 Effect of Metabolizable Energy Levels and Floor Space on Broiler Production

Item	d.f	Sum of square	Mean square	'F' value
Feed intake	6	0.15	0.03	2.05
Live weight gain	6	73574	1226.2	4.9[a]
Feed conversion	6	0.024	0.004	9.88[a]

[a] Significant at $P < 0.01$.

Broilers provided with large (1488 sq. cm) floor space generally grew faster (Table 6). Individual body weight was lowest at 209 sq. cm and highest at 1488 sq. cm floor space. When the body weight gains were compared on a unit space basis, maximum output was derived from birds reared on 709 sq. cm floor space. These birds, therefore, produced the highest net income (Table 7).

Increasing the metabolizable energy in the diet and decreasing the per bird floor space resulted in an increase in rectal temperature of broilers. These effects are illustrated by Figure 1.

TABLE 6 Effect of Floor Space on Feed Intake, Growth Rate and Feed Conversion

Space/ bird (sq. cm)	Feed consumed (g/d)	Feed conversion	Final live wt. (g)
700	73.14[ns]	2.19	1613.5[ns]
930	73.13[ns]	2.14	1623.7[ns]
1145	73.13[ns]	2.07	1662.7[ns]
1488	73.22[ns]	2.02	1673.2[ns]

ns = not significant.

TABLE 7 Relative Income Level at Different Spacing Rate

		Birds Marketed				
Space/ bird	No. birds	No.	%	Weight (kg)	Income (sq. m)	Income per bird
709	189	175	92.5	279.8	186.7	4.81
903	144	135	93.8	220.7	147.3	4.84
1140	117	109	93.2	182.1	121.5	4.96
1488	90	85	94.4	142.1	94.8	4.99

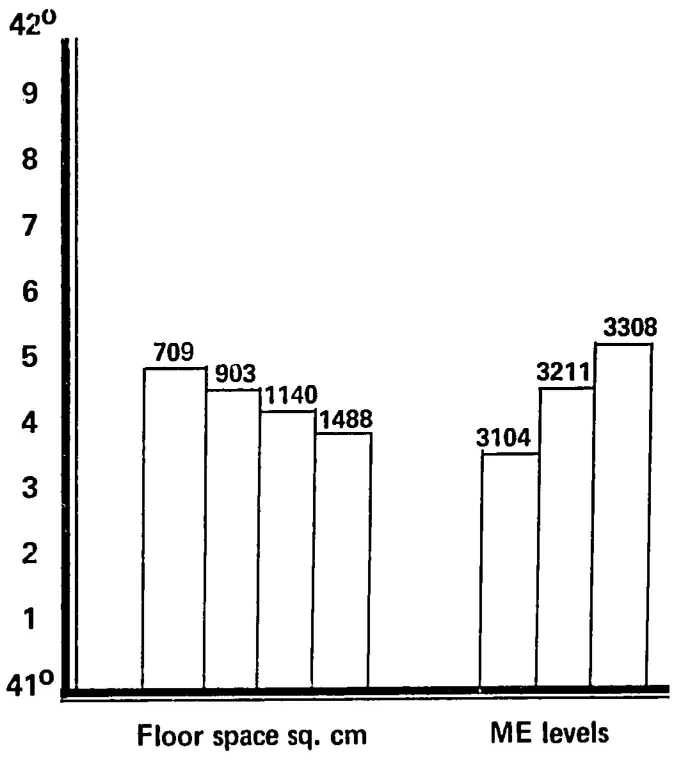

Figure 1: Rectal temperature of broilers reared on different floor space and ME level.

CALORIE: PROTEIN RATIO

Data on the effect of calorie: protein ratio on growth of broilers from 0–4 weeks of age are presented in Table 8. The results clearly illustrate that reducing the ratio from 136:1 to 126:1 and lower produced more body weight gain and improved feed conversion efficiency. It is also evident from Table 8 that a calorie:protein ratio lower than 126 had no significant effect on both body weight gain and feed conversion efficiency.

TABLE 8 Effect of Calorie:Protein Ratio on Growth of Broiler From 0–4 Weeks Old

	Calorie:Protein ratio		
	136	126	116
Feed intake g/b/d	25.6[b]	25.6[a]	29.6[a]
Body weight gain g/b/d	13.1[b]	15.6[a]	15.9[a]
ME intake kcal/b/d	77.4[b]	83.1[a]	82.9[a]
Protein intake g/b/d	5.7[c]	6.6[b]	7.1[a]
Feed conversion	1.81[b]	1.74[a]	1.75[a]

[a,b,c] Means with same superscript do not differ significantly at $P < .05$.

Strains Effect

Performance results using five hybrid strains of broilers are summarized in Table 9. These broilers were reared with common diet and environment. The results indicated that the strains responded differently. In terms of body weight, strain B had the highest value. On the other hand, strain D had the best feed conversion ratio at 2.61.

TABLE 9 Production Performance of Five Strains at Eight Weeks of Age

Strain	Body weight (kg)	Feed consumed (kg)	Feed conversion
A	1.46	4.05	2.76
B	1.47	4.21	2.88
C	1.36	3.91	2.88
D	1.35	3.52	2.61
E	1.46	4.21	2.90

Source: Wolf et al. 1976.

The results in feed consumption, body weight gains, and feed conversion were compared for broilers fed comparable diets and reared under natural Malaysian conditions (Table 10). Final body weight and feed conversion ranged from 1.67 to 2.32 kg/bird and 1.84 to 2.23 with means of 1.90 kg/bird and 2.05, respectively.

TABLE 10 Performance Data of Broilers on Comparable Diets Under Equatorial Environment (value on single bird basis)

Source	Body weight (kg)	Feed consumed (kg)	Feed conversion
OH, B.T., 1978	1.88	4.19	2.23
Mohd., C.P., 1978	1.93	3.69	1.91
Mohd., Y. M., 1978	2.32	4.25	1.84
Raghavan et al., 1978	1.71	3.67	2.15
Muhamad et al., 1979	1.67	3.50	2.10

Table 11 illustrates the breakdown of costs and profits of broiler production under Malaysian conditions. According to Muhamad et al. (1979), the net profit was in the region of M$1.57/bird.

TABLE 11 Economics of Broiler Production

Item	Raghavan et al. 1978	Muhamad et al. 1979
Final live weight kg.	1.886	1.642
Selling price M$/b[a]	5.60	4.90
Feed consumed kg	3.90	3.74
Cost of feed M$/b	2.24	1.98
Cost day–old chick M$/b	0.80	0.80
Gross profit M$/b	1.78	2.12
Other cost M$	-------	0.55
Net profit M$/b	-------	1.57

[a] b=bird

EGG PRODUCTION

Feed and Energy Intake

The Light Strain hens consumed an average of 99 grams of feed and 280 kcal ME per day, which were significantly lower values for similar birds than in temperate climates

(Table 12). In another experiment, similar observations were made of Medium Strain hens (Table 13). It can also be seen in Table 13 that the Light Strain hens consumed less feed compared to the Brown Strain hens.

TABLE 12 The Effect of Climate on Energy Metabolism of Light Body Weight Layers

	Temperate	Equatorial
Body weight	1702	1477
Feed consumed g/h/d	123	99
ME consumed kcal/h/d	348	282
Heat Production W kg $^{0.75}$	173	187

TABLE 13 Effect of Genetically Separated Body Weight Groups on Egg Production, Egg Weight and Egg Quality Traits in Lohman Superbrown Hens

Traits	Light		Medium		Heavy	
	E[a]	T[b]	E[a]	T[b]	E[a]	T[b]
Age at first egg (days)	167	164	168	169	167	167
Percent laying intensity (336 days production)	64.45	71.50	64.19	70.27	62.73	69.71
Egg size (g)	60.72	65.97	61.59	67.18	61.43	67.39
Feed consumption during laying	133	142	138	144	138	145
Breaking strength of eggs	2.64	3.13	2.54	2.97	2.75	3.09

[a] Equatorial
[b] Temperate

Egg Number

Egg production records from the Universiti Pertanian Malaysia (Figure 2) show that in a laying year of 12 months, the Medium Strain hens produced an average of 263 eggs. The number of eggs obtained from Light Strain hens was 259. A similar trend was observed from an experiment over a 336–day laying period (Table 14).

Egg Size

The average egg sizes from Medium and Light Strain hens in the Equatorial region was about 62 grams and 55 grams, respectively (Table 14). Hens in the Equatorial region produced significantly smaller egg size in all categories of body weight studied (Table 13).

TABLE 14 Summary of Performance of Medium and Light Strain Hens Reared Near the Equator

Item	Brown	White
Feed consumed per dozen eggs kg/h	2.2	2.1
Egg Production (336 days)		
Number/h	286	212
Percentage	85	63
Egg weight g	61.2	54.6
Breaking strength of eggs	2.64	1.87
Age at first eggs (days)	1.67	—

Age at First Lay

At the Equatorial region, the average age at first lay was about 167 days. This figure was comparable to those from temperate regions (Table 13).

Egg Quality

The data in Table 15 indicated that Brown Strain hens produced fewer cracks and broken eggs than did White strains in the Equatorial regions. The breaking strength of the eggs was determined and it was found that eggs laid in the temperate regions were generally stronger than those laid at the Equatorial environment (Table 13).

TABLE 15 Cracked and Broken Eggs From Brown and White Strain Hens

Item	Brown	White
Cracked eggs/1000		
Number	6.4	6.7
Percentage	0.62	0.67
Broken eggs/1000		
Number	0.4	0.6
Percentage	0.04	0.06

Body Weights

The average body weights of Light Strain hens are presented in Table 12. Hens in the Equatorial region with body weights of 1477 grams are significantly smaller than those grown in temperate regions.

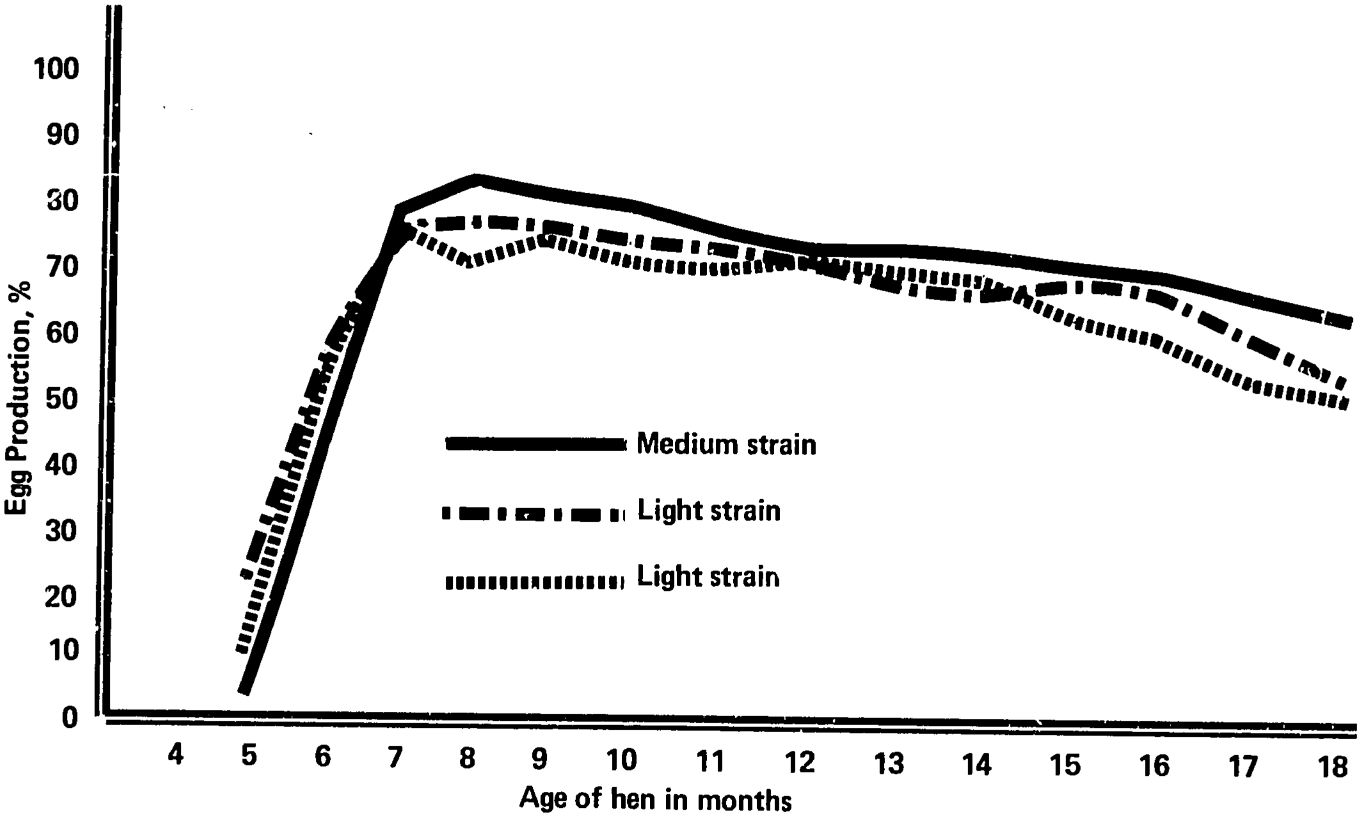

Figure 2: Egg production in the Wet Equator

Heat Production

Heat production is the difference between ME consumed and energy retained (body and egg). The estimates obtained for temperate and equatorial regions were 173 and 187 kcal/kg$^{0.75}$/d, respectively (Table 12).

BREEDER MANAGEMENT

Very little information is available on breeder management due to a lack of research. Breeders are normally managed only on commercial farms and their findings are often unpublished.

Supramaniam (1978) published a short communication on the performance of breeders over one laying year period (Table 16). The average egg production on a hen house basis was 52 percent and 40 percent respectively, for layer and broiler breeders. The hatching percentage was 4 percent higher for the layer strains than the broiler strains; 78 and 74 percent, respectively. Layer hens consumed slightly less feed (115 g). A mortality rate of 17 percent for layer breeders was 2 percent higher than broiler breeders.

TABLE 16 Summary of Breeder Performance in the Equator

Item	Broiler	Layer
Egg production %	40	52
Hatchability %	74	78
Feed intake g/d	118	115
Mortality %	15	17

Source: Supramaniam 1978.

DISEASE OCCURRENCE

Results from the four diagnostic laboratories: Universiti Pertanian Malaysia (UPM), Poultry Breeding Center (PBC), Veterinary Research Institute (VRI), and Regional Veterinary Diagnostic Laboratory (RVDL), indicate some differences in the percentage occurrences of diseases or conditions diagnosed (Table 17). This was to be expected considering the sources of the reports and the diagnostic facilities available at these laboratories as well as the natural variation of disease occurrence in different localities. (UPM and PBC cases were limited to their own farms. VRI and RVDL both had wider sources of cases and thus more variability).

TABLE 17 Diagnoses of Avian Cases From Four Diagnostic Laboratories in Malaysia

	U.P.M[a]				V.R.I.[b]		P.B.C.[c]		R.V.D.L[d]	
	Broiler 497 cases		Layer (+ pullets) 623 cases		All 223 cases		Breeder 663 cases		All 887 cases	
Diagnoses	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Aspergillosis	3	0.6	3	0.5	5	2.2	---	---	16	1.8
Avian encephalomyelitis	3	0.6	21	3.4	2	0.9	---	---	11	1.2
Avian leucosis complex	13	2.6	30	4.8	---	---	23	3.5	44	5.0
Chronic Respiratory disease complex	47	9.5	16	2.6	---	---	---	---	215	24.0
Coccidiosis	75	15.1	39	6.3	44	19.7	9	1.4	80	9.0
Colibacillosis	66	13.3	26	4.2	---	---	---	---	30	3.4
Coryza	---	---	---	---	77	3.1	---	---	----	---
Fowl pox	2	0.4	---	---	4	1.8	9	1.4	26	2.9
Helminthiasis	---	---	---	---	3	1.3	80	12.1	43	4.8
Infectious Bronchitis	23	4.6	77	12.4	32	14.3	---	---	57	6.4
Infectious Laryngo–tracheitis	7	1.4	4	0.6	1	0.4	---	---	20	2.3
Leucocytozoonosis	135	27.2	85	13.6	44	19.7	9	1.4	15	1.7
Newcastle disease	47	9.5	20	3.3	35	15.7	---	---	77	8.7
Plasmodium infection	---	---	---	---	17	7.6	---	---	8	0.9
Salmonellosis	2	0.4	4	0.6	29	13.0	---	---	91	10.3
Digestive tract disorder[e]	7	1.4	54	8.7	---	---	15	2.3	20	1.3
Reproductive tract disorder[f]	---	---	33	5.3	---	---	12	1.8	2	0.2
Respiratory tract disorder[g]	11	2.2	21	3.4	---	---	45	6.8	---	---
Systemic disorder[h]	---	---	25	4.0	---	---	83	12.5	31	3.5
Egg yolk peritonitis	---	---	31	5.0	---	---	41	6.2	---	---
Fatty liver syndrome	---	---	11	1.8	---	---	73	11.0	5	0.6
Gout	15	3.0	6	1.0	---	---	12	1.8	---	---
Nephritis/nephrosis	30	6.0	10	1.6	---	---	53	8.0	51	5.7
Miscellaneous	11	2.2	63	10.1	---	---	199	30.0	42	4.7

[a] Universiti Pertanian Malaysia, Serdang 1977/78 cases

[b] Veterinary Research Institute, Ipoh, 1977/78 cases.

[c] Poultry Breeding Center, Bukit Tengah, 1978 cases.

[d] Regional Veterinary Diagnostic Laboratory, P. Jaya 73/74 cases.

[e] Includes rupture, enteritis, hemorrhage, perforation.

[f] Includes ovaritis, salpingitis, cloacal impaction.

[g] Includes suffocation and pulmonary disorders.

Overall, six diseases occurred quite frequently: Chronic Respiratory Disease Complex (CRD), Coccidiosis, Infectious Bronchitis (IB), Leucocytozoonosis, Newcastle Disease (ND), and Salmonellosis.

CRD was diagnosed in nearly 24 percent of the cases submitted to RVDL. This disease is usually caused by several agents and indicates the presence of other primary diseases or stress factors. The primary disease could be viral, bacterial or parasitic. The stress factors include poor ventilation, poor sanitation, damp deep litter and over–crowding. Proper sanitation, medication and reduction of stress factors could help to control this disease.

Coccidiosis was commonly diagnosed at all four labora–tories and accounted for 20 percent of the cases submitted to VRI.

This disease usually occurs in chickens kept on poorly managed, deep litter. Over reliance on coccidiostats at the expense of proper management could be a predisposing factor. The role of drug resistance is not known. The main coccidial species involved are E. tenella and E. necatrix.

Infectious Bronchitis is a common respiratory disease and represents 14.3 percent of the cases submitted to VRI. A nephritis–nehprosis syndrome is thought to be associated with IB. Imported vaccines are being used to control the disease. Even though there are no reports of controlled or field trials to evaluate the efficiency of these vaccines, field observations indicate that proper vaccination could reduce the IB problem.

Leucocytozoonosis was very commonly diagnosed at UPM and VRI in 1978. It represents 27.2 percent and 19.7 percent of the cases submitted to these laboratories, respectively. The disease appeared to be predisposed by stress factors, which include concurrent disease, over–crowding, mishandling, and cannibalism. Prophylactic levels of sulfa drugs are used by some farms. However, over reliance on drugs at the expense of proper manage–ment could still result in disease problems.

Newcastle disease accounted for 15.7 percent of the cases submitted to VRI, 8.7 percent of RVDL cases, and 9.5 percent of UPM cases. This indicates that it still presents a major disease problem even though vaccinations are widely practiced. The disease outbreaks could be due to vaccination breakdown caused by mishandling of the vaccines or improper vaccination schedules.

Salmonellosis respresents 13 percent of cases submitted to VRI and 10.3 percent of cases submitted to RVDL. It is usually a disease of broilers originating from the local hatcheries. The national pullorum eradication program could help in the control of this disease.

REFERENCES CITED

Mohd., C. P. 1978. Unpublished

Modh., C. P. 1978. Unpublished

Muhmad, K. M. S., Z. S. Mohd, and A. J. Mustapa. 1979. A study on the effects of dietary metabolizable energy and floor spaces on the biological performance and economics of caged broilers under local condition, DVM dessertation, Universiti Pertanian Malaysia.

Noraini, M. K. 1975. Effects of varied levels of protein and energy in linearly programmed least–cost diets on per–formance of broiler chicks, B. Agric. Sc. dissertation, Universiti Malaya.

OH, B. T. 1978. The development of the poultry industry in Peninsular Malaysia, in: The Livestock Industry in Malaysia, pub. Faculty of Veterinary Medicine and Animal Science, Universiti Pertanian Malaysia, pp. 22–42.

Raghavan, V., R. I. Hutagalung and S. Jalaludin. 1978. Response of broilers to high density diets, 23rd Annual Conf. Mal. Vet. Assoc., Kuala Lumpur.

Salma, O. 1975. Energy and protein requirement for broiler starter, B. Agric. Sc. dissertation, Universiti Malaya.

Supramaniam, P. 1978. Economic performance of Ross boiler and Ross Ranger layer breeder parents imported from the United Kingdom, 23rd Annual Conf. Mal. Vet. Assoc., Kuala Lumpur.

Wolf, M., T. K. Mukherjee and S. Jalaludin. 1976. A study of the cost and revenue in the production of different strains of hybrid, Mal. Agric. Res., 5:155–162.

SWINE PRODUCTION IN SOUTHEAST ASIA

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SUMMARY

The importance of swine production in Southeast Asia is pointed out and comparative statements presenting the population and meat production of cattle, buffalo, and swine in some countries in the region is presented.

The status of swine production in Thailand, its recent history, development strategy, and the systems of production in the country are described.

The role of the small scale farmer in swine production is stressed. The need to support and develop small scale production is emphasized.

The status of swine production in some of the Southeast Asian countries (Malaysia, Singapore, Japan, Philippines, Burma, and Korea) is briefly stated.

The constraints to swine production in the country, like the recurring "hog cycle" are pointed out; the need to develop new feed resources and to utilize the nonconventional feedstuffs in swine diets is included; the necessity for organized feed distribution and marketing at the village level in order to benefit the small farmer is stressed.

The development of farmers' cooperatives, with direct control and complete involvement, is advocated as a practical approach that will benefit small farmers. The need to train farmers in the operation of farmers' cooperatives is emphasized.

FAO assistance for the development of swine production systems in the region is requested.

INTRODUCTION

Swine production in Southeast Asia and the Far East presumably dates back further than production of cattle or even buffalo, while over most of the region, except in the Indian continent, goat and sheep production have occupied a strategic position in subsistence farming and the subsistence economy of Southeast Asia's millions of farmers. They provide manure for crop production to fertilize the soil, serve as a reserve source for cash in times of stress and provide much needed animal protein for the farmers' family. Generally, swine contribute to better farm productivity at little cost since they are raised chiefly on available farm scraps and agricultural by–products under extensive production systems. In some countries, until recently, swine were the only domestic stock reared on farms. They even had achieved a status of socio–religious importance.

A glance at the population figures for cattle, buffalo and swine in the countries of Southeast Asia and the Far East (FAO 1979, Table 1) shows that in many of these countries pigs far outnumber cattle and buffalo. Among APHCA countries, Malaysia and the Philippines have twice as many pigs as cattle and buffalo; Singapore has 80 times more swine than other livestock; Papua New Guinea has nine times more; and Thailand has over 3 million pigs compared to 10 million cattle and buffalo, these latter being chiefly used for agricultural and allied operations. Their role in providing meat is a subsidiary one. Japan, Vietnam, Lao and Samoa have pig populations twice that of cattle and buffalo; Hongkong has 45 times and Tonga 15 times as many pigs as cattle and buffalo combined.

Even more important than the study of the relative numbers of animals is the study of pork production in these countries (FAO 1979, Table 2). In the Peoples' Republic of China, the Philippines, Vietnam, Japan, Korea, Singapore, Hongkong and Malaysia, more pork is produced than cattle and buffalo meat, while in Thailand, pork production from 3 million swine is nearly equal to the meat production from 10 million cattle and buffalo.

These figures testify to the importance of swine in the agricultural production system in Southeast Asia. The situation is not applicable in the countries of the Indian sub–continent or the Middle East, partly because of the longer tradition of cattle in their agricultural production

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TABLE 1 Livestock Population in the World and Some Countries of the Region (1978)[a]

	Cattle	Buffalo	Swine
	. . . 1000 head . . .		
World	1,212,021	132,591	732,410
Africa	169,199	2,324	8,588
Ethiopia	2,750F	---	17F
Kenya	10,110F	---	71F
Madagascar	9,000F	---	560F
Nigeria	11,566F	---	973F
South Africa	13,000F	---	1,450F
Sudan	16,567	---	8F
N C America	179,950	8	[illegible]
Canada	12,877	---	6,7[illegible]4
Cuba	5,700F	---	1,800F
Mexico	29,333	---	12,321
USA	116,265	---	56,584
South America	215,170	300	54,692
Argentina	61,280	---	3,800F
Brazil	89,000*	300	37,600*
Chile	3,492*	---	951*
Colombia	25,294	---	1,966
Peru	4,167	---	2,030
Uruguay	9,424*	---	445*
Venezuela	10,231*	---	2,057*
Asia	360,955	129,134	343,379
Bangladesh	27,007F	474F	---
Burma	7,865F	1,855F	1,915F
China	65,630F	30,621F	288,321F
India	181,651F	61,043F	8,834F
Indonesia	6,167	2,222	2,976
Iran	6,650F	130F	68F
Japan	3,891F	---	8,344F
Kampuchea DM	1,300F	580F	750F
Lao	534F	1,303F	1,576F
Nepal	6,753F	4,070F	353F
Pakistan	14,946	11,069	91F
Philippines	1,820	5,300F	9,700F
Thailand	4,660F	5,767F	3,202F
Turkey	14,540	1,012	14
Europe	134,926	441	166,908
Austria	2,547	---	3,694
Belgium–Lux	3,019	---	5,026
Bulgaria	1,736	61	3,[illegible]99
Czechoslovak	4,758	---	7,510
Denmark	3,095F	---	7,920F
France	24,133F	---	11,797F
German DR	5,549	---	11,757
Germany Fed	14,763	---	21,386

	Cattle	Buffalo	Swine
	. . . 1000 head . . .		
Hungary	1,949	---	7,850
Ireland	7,154*	---	1,031*
Italy	8,806F	78F	9,467F
Netherlands	4,990	---	9,172*
Poland	13,115	---	21,717
Romania	6,805*	221F	9,744
Spain	4,545*	---	9,230*
Sweden	1,892	---	2,600
Switzerland	2,024	---	2,115
UK	13,700F	---	7,840F
Yugoslavia	5,542	75	8,452
Oceania	39,132	1	4,529
Australia	29,379	---	2,219
New Zealand	9,129	---	546
USSR	112,690	383	70,511
Dev.ped ME	286,148	158	180,759
N America	129,142	---	63,298
W Europe	101,260	158	104,811
Oth Dev.ped	17,238	---	9,886
Dev.ping M E	707,699	98,226	117,551
Africa	137,315	---	7,115
Lat America	265,978	308	75,195
Near East	48,688	3,726	329
Far East	255,094	94,232	33,146
Oth Dev.ping	625	1	1,766
Centr plannd	218,174	34,167	434,100
Asian CPE	71,818	33,501	301,491
E Eur + USSR	146,356	663	132,608
Dev.ped all	432,504	824	313,367
Dev.ping all	779,517	131,767	410,043
****OTHERS**			
Malaysia	430	293	1,136
Mauritius	55	---	6
Singapore	9	3	1,100
Sri Lanka	1,542	814	41
Hongkong	10	1	465
Korea, DPK	900	---	1,900
Korea, Rep. of	1,492	---	1,482
Mongolia	2,388	---	21
Papua New Guinea	161	---	1,383
Samoa	24	--	52
Tonga	6	---	82
Vietnam	1,700	2,300	9,600

[a] FAO Monthly Bulletin of Statistics, Vol. 2, March 1979.

* Unofficial figure.

** Not included in the FAO Report.

F FAO estimate.

TABLE 2 Meat Production in the World and Some Countries of the Region (1978)[a]

	Beef and buffalo meat	Mutton and goat meat	Pork
	... metric ton	...	
World	48,162	7,323	48,875
Africa	2,718	1,150	335
Egypt	241F	49F	2F
Ethiopia	212F	131F	1F
Kenya	145F	31F	5F
Madagascar	106F	6F	21F
Nigeria	197F	106F	36F
South Africa	500F	154F	90F
Sudan	170F	123F	---
N. C. America	13,559	205	7,361
Canada	1,060	5	570
Cuba	143F	2F	63F
Mexico	562F	31	440*
USA	11,325	155	6,125
South America	7,061	339	1,515
Argentina	3,192*	137	211*
Brazil	2,250*	48F	850*
Chile	184*	26	38*
Colombia	431F	7F	110F
Peru	82	33*	70F
Uruguay	354*	35*	16*
Venezuela	282*	10	91*
Asia	4,863	2,565	17,160
Bangladesh	159F	30F	-----
China	2,237F	716F	14,064F
India	188F	393F	65F
Indonesia	182F	38F	108F
Iran	118F	243F	4F
Japan	364F	---	1,226F
Pakistan	331F	239F	---
Philippines	142F	6	387*
Thailand	211F	1F	152F
Turkey	240F	384F	1F
Viet Nam	93F	1,143	457F
Europe	10,186	1,143	17,136
Austria	185*	2F	317F
Belgium--lux	289*	5F	628*
Bulgaria	118F	67F	281F
Czechoslovak	393*	6F	815F
Denmark	240*	1*	790*
France	1,677F	160F	1,670
German DR	427F	15F	1,174F
Germany Fed	1,376F	23F	2,600F
Greece	104	119*	118F
Hungary	145F	6F	880F
Ireland	384*	40*	132*

	Beef and buffalo meat	Mutton and goat meat	Pork
	... metric ton	...	
Italy	1,102F	53F	920F
Netherlands	374*	16	1,053*
Poland	750F	18F	1,833F
Portugal	81*	26	144*
Romania	287F	72F	750F
Spain	445*	153	760*
Sweden	148*	5*	306*
Switzerland	150F	4F	263F
UK	970*	235*	800*
Yugoslavia	340*	61*	656F
Oceania	2,673	1,035	269
Australia	2,130	516	197
New Zealand	529*	519	41*
USSR	7,100F	885F	5,100F
Dev.ped M E	23,980	2,291	19,651
N America	12,385	160	6,695
W Europe	8,047	937	11,391
Oth. Dev.ped	890	158	1,326
Dev.ping M E	12,505	3,127	3,743
Africa	1,976	784	242
Lat America	8,236	384	2,181
Near East	963	1,222	24
Far East	1,496	736	1,266
Oth Dev.ping	15	1	30
Centr plannd	11,677	1,906	25,481
Asian CPE	2,437	814	14,637
E Eur + USSR	9,240	1,091	10,844
Dev.ped all	33,220	3,382	30,495
Dev.ping all	14,942	3,941	18,380
****OTHERS**			
Malaysia	7	9	55
Mauritius	1	---	1
Nepal	4	18	5
Singapore	---	---	43
Sri Lanka	13	6	1
Burma	78	16	74
Hongkong	30	---	158
Kampuchea	17	---	32
Korea, DPK	27	---	84
Korea, Rep. of	81	---	187
Lao	5	14	26
Mongolia	57	---	1
Papue New Guinea	3	---	---
Samoa	1	---	1
Tonga	---	---	1

[a]FAO Monthly Bulletin of Statistics, Vol. 2, March 1979.

* Unofficial figure.

** Not included in the FAO report.

F FAO estimate.

and partly because of the contrast in socio–religious attitudes. However, these areas also have appreciable swine populations. More than half of the population of this region depend on swine for much of the animal protein in their diet.

The vast majority of swine are raised in small farm environments which is so typically a feature of Southeast Asia's agricultural production; these holdings are often incredibly small. This is in glaring contrast to the mammoth commercial farms in the developed countries. Naturally the systems of production and management are widely different in the East and the West, a fact which must be taken into account by the policy decision makers when planning for the development of swine production in the region.

It is evident from this narrative that swine production should be emphasized in the animal production programs in Southeast Asian countries, so the region can achieve self–sufficiency in producing animal protein for human consumption. In many countries, over 60 percent of the meat consumed is pork. Available figures on per capita consumption of pork in some of the countries are: Malaysia 16 kg; Philippines 8 kg; Thailand 6.2 kg; Korea 3.3 kg; Japan 5 kg. Per capita consumption of pork in the Peoples' Republic of China, in Hongkong and in Singapore is presumably even higher than these figures.

Swine production in many countries of Southeast Asia has features common to production in Thailand though varying in degree and extent because it is influenced by differences in environment, land availability, patterns of agriculture, progress in technology, economic standards, social organization, industrial advancement and other factors. Because I am familiar only with swine production in Thailand, it would be presumptuous of me to attempt a critical assessment of the current swine industry and/or its future in other countries. It is, however, relevant for me to deal with swine production in Thailand and to make my personal observations about the situation in other countries, based on the rather limited extent of my knowledge.

Swine production is mainly undertaken by small farmers in Thailand as a complementary enterprise to cultivation of rice, the chief agricultural farm product. Small scale, subsistence backyard production is common: The farmer usually owns 2–3 sows. The three pigs (average farm) which he keeps at present is probably fewer than he can afford to maintain gainfully, provided he knows how to make full use of his farm resources and family labor and can obtain concentrate feeds regularly in appropriate quantities at an affordable price.

Nearly 90 percent of swine production is in the hands of small farmers. Even so, large scale production is occassionally seen, with herd size ranging from 50–1000 sows. Commercial large scale farms however, account for only an estimated three percent of the country's swine production.

The overall swine population over the past 16 years averaged about 4 million with a range between 3 and 5 million head (Table 3). The rise in human population and the increase in pork consumption may explain this in part, but a more potent cause is the "hog cycle," familiar to the swine industry all over Southeast Asia; this has seriously hampered the progress of small farm swine production. I shall go into detail on this subject later in my presentation.

Small scale swine production in Thailand is more popular in the rice growing provinces and in areas around the large cities (e.g. Nakhon Pathom near Bangkok). In rice growing regions, it benefits from the availability of by–products and the city population provide a readily accessible year–round market for pork. However, there is a perceptible change in this trend, and swine farming is increasingly found in rice producing areas indicating that rice cultivation is not necessarily a limiting factor for swine farming.

TABLE 3 Livestock Population in Thailand

Year	Buffalo	Cattle	Swine	Chicken	Duck
		(unit : number of head)			
1963	5,147,034	3,624,359	3,284,334	43,103	6,547
1964	5,220,249	3,752,913	3,493,315	45,014	6,548
1965	5,297,051	3,887,534	3,718,238	47,020	6,634
1966	5,377,534	4,028,553	3,960,473	49,126	6,697
1967	5,461,794	4,176,320	4,221,517	51,338	6,774
1968	5,549,933	4,290,256	4,503,005	53,661	6,867
1969	5,642,057	4,451,590	4,806,746	56,100	6,975
1970	5,734,500	4,666,969	5,132,244	58,791	7,109
1971	5,574,176	4,460,230	3,883,870	53,976	7,194
1972	5,361,338	4,484,962	3,982,133	52,782	7,281
1973	5,941,683	4,335,226	4,460,372	61,816	11,078
1974	5,946,715	4,432,385	3,515,559	47,805	12,697
1975	5,441,674	4,310,656	3,211,412	53,860	10,946
1976	5,678,678	4,546,814	3,019,487	49,889	11,683
1977	6,511,436	4,977,680	3,215,878	56,306	9,991
1978	6,561,575	4,705,580	4,942,695	65,324	9,013

Two factors are responsible for this trend: 1) the small farmer's need to increase the productivity of his small-holding, and 2) a developing feed distribution system that has been facilitated by several small and a few large animal feed milling concerns which are widely distributed over the country. These companies manufacture compounded feeds using a variety of feedstuffs: cassava, maize, sorghum and sweet potato, reducing the farmers dependence on rice and its by-products for feeding swine.

Small scale swine farming is, however, commonly a backyard production system in which the two or three head are maintained largely on farm left-overs and bulky crop residues and housed under the floor of the farmer's living quarters, thus enabling his family to take care of the animals while performing other household chores. Separate pigsties, farrowing pens, etc. are not provided.

PATTERNS OF PRODUCTION

Recently, small, medium, and large swine farms have cropped-up around more and more cities and large towns of Thailand. Previously these type farms were found mainly around Bangkok. The large farms adopt improved housing management, breeding practices, and the use of factory produced compounded feeds almost exclusively. The large commercial farms with modern housing and other facilities which are comparable to those found in developed countries, require a great deal of capital investment beyond what the average farmer can afford. His participation in this form of enterprise is presently impossible. It is open to discussion whether such "development" would help or hinder the small farmer's business. It is unclear whether development could be a viable tool for bringing about overall rural economic progress and the improvement of the quality of life of the small farmer. Integrated farming is a traditional feature of agriculture in the region and has been recognized as the best way to improve the resources and stability of small farmers. Swine raising has several advantages in the integrated farming system. Swine-chicken-duck-fish farming and swine-chicken-fish-rice farming are most popular in Thailand. Banana and other crops are included when the size of the farm permits.

Integrated farming needs no introduction to the knowledgeable group of agriculture production experts present here. It will, however, be relevant to mention it in this context because it provides some solutions to the problem of increasing animal feed resources in the developing countries. Swine wastes (manure and urine) contain about 60 percent of the nutrients found in the animals' feed. These can be recycled and fed back to the swine. Fermented pig manure has increased feeding value and at the same time it also eliminates the risk of transmission of intestinal parasites and other deleterious organisms, particularly salmonella. Further unicell protein (Chlorella species) can be cultured on a swine farm. These effluent substrates, adequately treated by adopting low cost technology, could be employed by suitably organized small community projects. The incorporation of Chlorella in pig rations (at 10 percent levels) has been reported to improve feed efficiency and weight gain. The production of biogas by utilizing swine manure, vegetable wastes and kitchen garbage has the potential to ease the "energy crisis" on farms, especially in Southeast Asia where swine raising is a popular farm activity. It is estimated that 20–30 kg of manure will be sufficient to produce one kg of carp (fish). The manure from 15 to 25 head of swine, when directly used to feed fish, will provide sufficient feed for a one hectare fish pond, increasing the availability of animal protein in the diet of the rural population.

The integration of swine production with traditional crop production practices so as to increase the availability of meat, diversify the food consumption of farm families, and obtain larger crops through increased soil fertility, is an FAO recommendation for Thailand (FAO Livestock Development Survey Team).

Animal waste recycling is practiced on a very limited scale in Thailand, and the situation in other countries is not very different. Benefits which accrue from swine production must be emphasized so that the farmer can realize the potential of swine farming for improving his standard of life and so that he becomes receptive to new ideas and improved farm technology.

PROGRESS IN SWINE PRODUCTION ACTIVITY

Among the major advances made in the field of swine production in Thailand over the last twenty years has been the improvement of the various breeds of swine raised. A Swine Breeding Center, started in 1957 with FAO assistance and government sponsorship, provided the cornerstone for this program. FAO made available the services of an expert consultant to assist in a center and developing a workable project. The use of exotic breeds for improving the local strains was begun, and this made an important contribution to swine production in Thailand. However, because of the absence of programs on "feeds and feeding", and the farmers' lack of knowledge about management of improved strains in their farm environment, the projects progress has not been spectacular. The Swine Breeding Center was followed in 1973 by the establishment of the National Swine Research and Training Center (NSRTC), with two stations: 1) the Swine Breeding and Improvement Station, located at Tubkwang in Saraburi Province, and 2) the Swine Research and Training Station at Kamphangsan, Nakhon Pathom, Thailand about 90 km. from Bangkok in a swine raising province.

The NSRTC is a joint project of the Kasetsart University and the Livestock Development Department of the Royal Government of Thailand. The breed improvement program, started by the Swine Breeding Center, has been enthusiastically promoted by NSRTC, and results have been good. The indigenous strains have been almost completely replaced by improved strains which have adapted to the local farm environment.

The breeding program of NSRTC has used mainly Landrace, Large White, and Duroc breeds. The farmers have shown a preference for Landrace and Large White. In addition to these three breeds, the large commercial feed mills have recently introduced two hybrids, Hypor and Seghers.

The hybrids are distributed to the small holders by the feed mills, who also provide swine feed. The farmers can sell hybrids they have raised only through these mills, therefore, the mills have a monopoly on marketing the hybrids in the cities. The impact of this system on raising small farmers' incomes from swine production must be assessed with reserve.

FEEDS AND FEEDING

The largest expenditure in swine production is for feed, particularly protein feed concentrates. The situation in Thailand, in respect to the availability of concentrate feeds for small scale swine production, has shown some improvement in the last five to six years. Several feed mills were established in the country with capacities ranging from 15,000 to 240,000 tons/year. There are some 60 registered feed mills and an undetermined number which have as yet not become registered. In addition to the feed mills, there are several fish meal factories and cassava milling and pelleting factories supplying feed ingredients. Many farms also have their own feed mill units to compound farm mixed feeds. The concentrated feed mixtures are bought by the farmers and added to the farm mixed feed made from locally available ingredients like cassava. This practice is popular and has resulted in the improvement of the quality of swine feed which has mitigated the problems of under–nourishment, poor feed efficiency, longer feeding periods for growing to market weight, poor carcass quality, and reduced mortality losses. The large commercial farms do not experience these problems because of their high standards of feeding and management. However, the small scale producer cannot afford the price of such feed concentrate mixtures. Therefore, ways must be found to make these feed concentrates available at a reasonable price.

NSRTC has conducted some pilot studies on the utilization of non–conventional feed resources for swine production with promising results. Cassava leaf silage and fermented cassava fed alone or mixed with dry poultry manure have been mixed in diets and fed to growing pigs.without any adverse effect on swine growth rate and feed conversion. Lactic bacteria fed to new born (day old) baby pigs for the first three weeks of life has produced higher growth rates and conversion ratios compared to those on conventional feeding systems used at the Center. Acid or alkali treated boiled soybean/soybean meal is known to enhance the growth rate of swine. The treated meal can be introduced easily in diets fed to swine raised for market on small farms with a saving in the cost of production.

Water hyacinth is fed to swine in Thailand. Boiled with rice bran and vegetable wastes, it makes a suitable swine feed. Chopped water hyacinth is included in swine diets in a similar manner as in other Southeast Asian countries, like the Philippines, China, Malaysia and Indonesia according to available reports. It can be used as silage, dried like hay, or fed as a meal.

Aquatic and semi–aquatic plants like water hyacinth, duck weed, water milfoil and others, which grow extensively and often interfere with the proper utilization of canal water, could be utilized for the production of animal feeds. Water hyacinth is comparable to many land forages in its crude protein content and probably is richer in methionine and lysine, two amino acids which are limiting factors in plant proteins. Their fiber content makes such weeds (submerged weeds have a lower fiber content than floating weeds) a potential substitute for hay and other roughages fed to ruminants.

Water hyacinth as a natural feed resource for all classes of livestock has great potential. Southeast Asian swine producers should test its potential. International organizations like FAO must provide assistance for developing a simple village technology for the treatment and storage of animal feeds based on water hyacinth.

MANAGEMENT

Except for the development in breed improvement and some progress in feeding practices, other management practices have changed little on the small scale swine farms of Thailand. In recent years, small farmers have become increasingly interested in improved production practices. Farmer groups frequently invite the personnel at the Research Center to their community to seek information and ask advice on improving their farm management programs. In response to the farmer's new attitude, the Center has been conducting swine farmer's training courses in rural areas in which 100–200 farmers participate. In addition, three week training courses have been organized annually at the Center to give farmers practical knowledge about improved methods of swine production. This course is attended by 60 farmers at a time and participants from large commercial swine production units also attend. Such training has helped bring about progressive thinking particularly among small scale producers.

Before looking at some aspects relating to future swine programs, I would like to briefly discuss the status of swine farming in some of the other countries in the region.

SWINE PRODUCTION IN OTHER COUNTRIES OF THE REGION

Swine production is a major livestock industry in Malaysia with an estimated annual turnover exceeding M$200 million. Integrated swine–rootcrop–aquatic fodder–fish production is popular. Abandoned tin mine pools serve as fish ponds with swine manure used to feed the fish. The indigenous South China/Canton breeds have nearly disappeared from the Peninsula, and the exotic strains, chiefly Landrace, Large White, and Duroc Jersey, and to a lesser extent, other breeds have replaced them. These indigenous breeds are known for their desirable reproduction traits but have declined because of their slow growth rate and carcass quality. Large scale farms, stocking 5000–8000 fish, following modern technology, many managing and operating their own feedmills, have been established. Artificial insemination is used extensively in large farms, but only on a small scale in the small holdings.

The market price of pork is erratic and frequently exceeds the cost c. production, acting as a severe deterrent to swine production.

Ninety–five percent of the swine production in Korea is undertaken by the small farmers who have access to arable land that is cultivated. Pork is the most popular meat in the Korean diet. About one million farm families raise pigs on their small holdings. As in Thailand, there is a greater concentration of swine production in the rice growing areas and around the large cities. Among the exotic breeds, Landrace is most popular, but other breeds like Duroc and Berkshire are also used.

The breeding program uses two way and three way crossbreds for pork production.

There has reportedly been a considerable increase in the number of large farms in Korea over the past ten years. Still, an estimated 53 percent of all hogs are produced by small farms with one or two animals. The country has an estimated M$14 million export trade in pork, chiefly shipped to Japan. This has produced an incentive for establishing more swine farms on a larger scale.

At the small farmer level, however, the "hog cycle" has left its mark and disturbed the production of swine.

In Burma, swine are raised on the backyard system. A large number of small farmers have taken to swine raising, making use of available household scraps, rice bran, grasses, weeds and other plant materials for rearing pigs to market weight. Under low cost conditions of rearing, the reported weight gain of 250 grams/day appears satisfactory.

Swine production in Singapore has semi–intensive and intensive trends. The government has a program to move the widely scattered swine farms to a single collective location of about 1200 hectares of land. Presently, feed is mostly farm mixed, and about 20 to 30 percent of the feed is produced in feed mills. A large percentage of feed ingredients, additives and supplements is imported. The feed companies in Singapore also provide a package service for the farmers covering health, breeding and extension.

With the implementation of the government's plan to locate swine production in a single area, facilities for genetic improvement of stock should improve. However, the dependence on imported feeds will probably continue. Efforts to utilize agro–industrial by–products have made some progress in Singapore. The situation in Singapore cannot, however, be applied to other countries because of the wide distribution of small farms and their relatively lower farm income.

From a little under one million in 1955, the number of swine in Japan rose to nine million in 1978, reflecting a pronounced rise in swine production in the country. The average number of pigs per farm is about 38. In addition to locally produced pork, the country imports frozen and chilled pork. About 47 percent of the farms have fewer than ten head per farm; 22 percent have 20–30; and only 1.3 percent have over 500 head. Large scale swine production has made some progress; integrated swine production is becoming increasingly popular. Owners of small herds raise swine in piggeries and make use of family labor for feeding and other chores. The larger farms have introduced modern management, feeding and breeding practices. Rearing pigs in windowless pigpens is reported to be common as is cage rearing in which fattening animals are reared. This type management program provides very limited space per animal.

Artificial insemination is widely used. In the last 20 years Landrace, Large White, Hampshire, and Duroc breeds and their crosses have come to account for the swine population with crossbreeds comprising nearly 70 percent.

It is generally recognized that one way to improve the performance of the swine industry is through a controlled breeding program. Collective breeding, three–way cross breeding, back cross breeding and rotatory cross breeding are employed, and testing for reproduction and meat productivity is widely used.

Currently, there is a program for the registration of breeding swine. Two classes of breeders, those breeding for meat production and those with selected animals used for reproduction are recognized by the Swine Breeder's Association of Japan.

Small scale producers make use of agricultural crops as feedstuffs for pigs. Vegetable garbage, potatoes, and rice bran are every popular. The more well–off farmers use, in addition, waste from food factories and formula feeds. Most large commercial farms use compounded feeds. Nearly a third of the total production of compounded feeds in Japan are used for feeding swine. The feed ingredients are mostly imported, so the feed cost ratio in swine production is high. The Japanese recognize the need to effect a more efficient utilization of formula feeds in the production of pork. There is a growing interest in the research and development of untapped new resources of animal feedstuffs. Treated swine manure is utilized for animal feeding. Collective pig raising is occasionally seen; these operators are moving to the less populated districts which provide more farm area so as to develop collective swine farms on a large scale.

In the Philippines, as in Thailand, or Korea, the concentration of swine farms is found around Greater Manila and in the maize growing regions. The bulk of pork production comes from backyard producers who buy weaners or keep a few sows. The government is encouraging small farmers and other small income families to raise swine and to organize farm cooperatives and associations. The large feed mills for rice and maize have integrated swine and poultry production into their operations.

Commercial farms maintain their own purebred boars and sows in addition to different crosses. The selection of high quality stock through performance testing is done on a limited basis. Small swine producers are generally misinformed concerning market prices. Therefore, they sell to a middleman, who in turn, resells the pigs to a second middleman or to a retail outlet. To help insure a fair price to the farmer, the farm cooperatives keep their members informed about price movements and relate pig prices to feed prices. Large swine producers are able to market their pigs directly to slaughter houses, thus receiving the maximum return for their swine.

DISEASES OF SWINE

The disease problems of economic importance to swine production are more or less common to all countries in the region: Internal parasites, swine cholera, swine influenza, FMD, swine erysipelas, transmissible gastroenteritis, enzootic pneumonia, neonatal colibacillosis, atrophic rhinitis, and brucellosis. Many of the more acute diseases of epidemiological importance have been largely controlled in Southeast Asia with adequate vaccination programs. However, economic losses from diseases like enzootic pneumonia and parasitism are considerable, but do not seem to have been actually assessed in terms of monetary loss. There is an urgent need for more swine disease research in the region.

THE FUTURE OF SWINE PRODUCTION IN THAILAND

Swine production, in Thailand as in most other countries, has five components recognized as necessary for its development. These are, breeding, feeding, nutrition, disease control management, and marketing. They are all linked to the different systems of production: backyard, small farmer level; integrated; semi–intensive and large commercial systems.

Appreciable progress in breed improvement has been achieved in many Southeast Asian countries and many parts of Thailand, but some specific things can be done to make the improved breeds more profitable. These include registration of breeding animals, boar performance testing, selection for meat and carcass quality, and growth and feed conversion efficiency.

These are not difficult to implement in the large farm set–up. The question is how best these can be adapted to the small scale production system. Breed development has been possible, but adapting the improved breeds to a small farm environment -- feeding, management, disease control, etc. still has a long way to go.

Feeding programs and the availability of suitable feeds and reasonable prices needs drastic improvement. No doubt the feed mill industry, as a supporting industry to swine production, has brought about some limited changes, but farmers find their prices still far too high, and the mills still have complete control of fixing the cost and setting the quality standard of feeds. The commissions paid when sales are made through agents affects the farmers costs of production.

The small farmers cannot compete with the large commercial farms and eventually, they will either have to go out of business or be satisfied to be the secondaries of large groups, buying and selling only through them.

The "hog cycle", a periodic high and low cycle in pork prices is a familiar occurrence in most countries bringing hardship for the small farmers, even though they represent the largest single source of supply. This situation arises because he has no control over the market, cannot coordinate production with demand, and is generally left to the mercy of the trader and middleman. Alone, he has neither strength or the means to fight the system.

The answer to many of the ills of the small farmer is to make him more self–reliant by organizing swine production cooperatives with farmers operating these associations. They would be supported by governmental departments in terms of services and credit. The establishment of the cooperatives in all swine production areas would build a pyramid with a large base of cooperative units, and an able body which will control 1) breeding and production; 2) feed mill operation and distribution of concentrate feed of uniform quality; 3) exert a direct influence on the market by regulating the supply; 4) ensure maximum returns for their members pigs; and 5) provide members with a package of proven swine technology allowing for the integration of pig farming into the overall agricultural production system and providing expertise by training or employing suitable trained people.

Small farmers' cooperatives are functional in many countries, and have been managed with spectacular success in the rural dairy sector in India, Bangladesh, and to a small extent in Thailand and Malaysia.

Some large commercial farms and some feed manufacturers have sponsored "swine cooperatives" for small holders while maintaining a monopoly over the feed supply furnished for the stock and buying the pigs from the farmers when ready for market. The farmers have no participation in operating these "cooperatives" and their role in improving the farmer's economic stability is open to question. In 1978, a small scale swine producers cooperative began in Thailand. To be successful, it will need support from government and banking organizations.

A cooperative, entirely owned, managed and supervised by the farmers will accomplish the following objectives:

- **Cooperative Breeding Centers:** members will receive their supply of weaner pigs with known improved production ability. The breeding centers with farmer participation will be able to make rapid improvement by stock–boar performance and progeny testing, selection based on environment and genotype, and improved management of breeding sows. All these can be introduced at the village level.

- The cooperative will own their own feed mills and feed mixing factories, buying local ingredients from the members and selling animal feed at no profit–no loss. The feeds will be of standardized quality, and the members will have direct control over their manufacture.

- Monitor the swine market and give members current market information.

- Buy swine from the farmers, undertake to regulate the supply sent to market, and provide measures to offset the rise or fall in demand. The number of swine a member could raise at one time could also be determined by the cooperative.

- The cooperative groups would eventually have their own cooperative slaughter houses for preparing meat for the market.

- The cooperatives will provide an efficient extension service system for their members.

- As is necessary for survival, small farmer cooperatives will be able to meet the challenge of the large commercial farms.

Small farmers cooperatives would naturally depend on good leadership from among the farmers for their success. Training of small holders in cooperative enterprise must now become an important objective. Countries which have achieved success in rural agricultural cooperatives can extend help and advice to others through the exchange of expertise and by organizing training programs for those who are able and interested.

A REQUEST TO FAO

An international organization like FAO should examine the possibility of organizing such training programs for small farmers.

Even though over the past few years a number of international workshops, seminars, exchange visits, expert consultations and other activities have taken place in the region on dairy production, poultry production, goat production, animal diseases and other areas of livestock production, there has been, to the best of my knowledge, little effort made to understand swine production. FAO has, I believe, a commitment and responsibility to assist the small farmers in achieving an improvement in their farm swine production.

I hope the Regional Animal Production And Health Officer (RAPHO) and Secretary of FAO/APHCA will give this matter due consideration in the light of his own long and creditable experience in several fields of livestock production in the region.

THE ROLE OF DAIRY ANIMALS IN SOUTHEAST ASIA AND THE PACIFIC

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In developing countries such as those in this region, the importance of milk for human nutrition is already well recognized. But in most cases, if not all, developing countries are slow in implementing a national action program to promote the dairy industry. In competition for financial and other resources, only those programs that produce rapid benefits to the economy and industry of a nation are given top priority. Many governments emphasize the production of basic foods. Such is the case with the relatively quick returns from poultry and swine production as compared to those from the dairy industry, particularly that from milk production which requires a large investment and a long lead time. Directly related to the present production systems are the customs or habits of the people. Although babies are fed breast milk and so are usually receiving an adequate supply of milk, older children often do not get enough milk to meet their dietary requirements for many essential nutrients. It is known that the milk supply from nursing mothers also has its physiological limit, hence, the need exists for more milk from dairy animals such as cattle, carabao (water buffalo), goats and other species to meet the nutritional requirements of the vulnerable age groups.

Published information from many countries in this region show that milk production is very low. Indonesia, Malaysia, Thailand, Philippines and others are still importing their milk requirements. The Philippines, for example, produces only about one percent and Sri Lanka produces about 49 percent of their daily requirements.

There is a definite need to increase milk production from the various species of dairy animals. Presently, dairy cattle are the major source of milk in this region, followed by water buffalo and goats in that order. A review of the literature shows that in Nepal (not of this region) 69 percent of the total milk production comes from buffalo, 30 percent from cattle, and goats, and 0.5 percent from yaks. In the milk collection program of the Dairy Training and Research Institute at the University of the Philippines, Los Banos, about 12 percent of the milk gathered from cooperators is from carabao and 88 percent coming from cattle. The Philippine Bureau of Animal Industry (BAI) collects carabao milk from the Sta. Maria, Bulacan areas. In this connection, it is doubtful if carabao or water buffalo milk will increase substantially because these animals are mainly used for work with milk production of secondary importance. Of course, the upgrading of carabao with a dairy type water buffalo will increase milk production substantially.

Besides the use of dairy animals for work, the culled animals and excess bulls and heifers are fattened and slaughtered for meat. Excess calves could be fattened for veal purposes. This will improve the beef supply and augment the income of dairy farmers. Another important role of dairy animals as a source of income is the production of breeding animals that can be sold at premium prices.

In addition to the advantages enumerated, there will be increased employment and development of rural areas since dairy husbandry is more appropriate in rural rather than semi–urban or urban areas.

THE PRESENT STATUS OF DAIRY FARMING IN SELECTED DEVELOPING COUNTRIES IN THIS REGION

Serious attempts to develop the dairy industry are now being made by many countries. An Indonesian expert expressed the opinion that this could be the key year for their dairy industry because of their plans to augment their dairy cattle numbers through importation. Perhaps a more appropriate phrase is "the decade of the dairy industry for ASEAN countries'"

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South Korea eclipsed our efforts with their phenomenal dairy development through the importation of Holsteins from Canada, the United States, Australia and New Zealand. In 1978, the dairy cattle population was 135,000 producing 321,000 tons of milk. In 1961, milk production was 2,600 tons.

Of the ASEAN countries, Malaysia is improving its milk production through a very concerted effort. In addition to the 70,000 Local Indian dairy cattle (approximate production per cow is 450–675 kg in 180–210 days), they are importing thousands of heifers which are cross-breds of dairy temperate breeds and Indian breeds in order to dramatically augment their dairy cattle population. In 1978–79, about 5,500 crossbred Holsteins X Sahiwal calves arrived and about 14,500 will arrive this year. Hopefully, Malaysia will attain 20 percent self-sufficiency by 1990. At present, it is producing about 5 percent of the milk it consumes.

Indonesia has about 85,000 head of dairy cattle nearly all of these being in Java and in a few large cities of Sumatra. But less than 40 percent are milking. These are high grade Holsteins based on original importations from the Netherlands and Australia. The average yield is about 1400 liters for small holders and 2,500 liters on commercial farms in 210–300 days. The government is now importing more dairy cattle.

In Sri Lanka, the Sinhala breed produces 270–450 kg milk per lactation while the Friesian X Sinhala cows produce 1800–2250 kg per lactation in the "up–country". The Jersey X Sinhala or Red Sindhi X Sinhala produces 1100–1350 kg in the lowlands. Importations of dairy temperate breeds were made to improve and increase the total number of dairy animals. Unfortunately, some reverses occurred. For example, 860 head of imported pregnant animals had a high percentage of mortality. Those that survived were unproductive. The country report stated categorically that pregnant animals should not be imported in the future.

Sri Lanka's cattle are raised in the hill country, the mid-country, the coconut triangle, and the dry zone. It is apparent that dairy production is successful because 49 percent of the country's consumption is locally produced.

Thailand has about 27,000 head of dairy cattle raised in the areas that surround large cities. Holstein (Red Danes, Brown Swiss, and Jerseys are also found) is crossed with Red Sindhi or Sahiwal to make up the main blood composition of their milk producing cows. The average daily production is 6–9 kg/day during a 6–9 month lactation period.

The Philippines recently has enacted into law "The Dairy Industry Development Act of 1979" which, hopefully, will aggressively promote the industry. The Philippine Dairy Corporation attached to the Ministry of Agriculture is to be created and will be the guiding government agency in providing direction. The Bureau of Animal Industry of the Ministry of Agriculture will play the major role in dairy development. At present there are about 3,600 dairy cattle in the Philippines. There is a National Artificial Breeding Center, a project administered by the Bureau of Animal Industry for the training of technicians in the skills of artificial insemination. There are about six training sessions per year. It also provides artificial insemination services to dairy farmers.

The Philippine government, through the Asian Development Bank–International Fund for Agricultural Development, has commissioned a team to look into the national dairy development program. The team submitted its interim report for Phase I to the Minister of Agriculture in December, 1979. Phase II will be studied starting next month (February, 1980).

The emphasis of the national dairy development program is to assist the small–holder dairy farmers to improve their production system and increase personal income, This will be coupled with a massive upgrading of local cattle and carabao stock. Artificial insemination and natural breeding will be utilized. A limited importation of dairy crossbreds (temperate dairy breeds X Sahiwal) as well as purebreds will be included. Furthermore, private commercial dairy herds will be encouraged and supported by the government. Hopefully, 20 percent sufficiency in milk in ten years will be attained. At this stage, it is quite definite that the government will not import pregnant animals.

The experience of the Dairy Training and Research Institute (DTRI) on these aspects although in a limited scale might be of interest. The Milk Collection Program, of the Dairy Training and Research Institute promotes herd improvement through artificial insemination and natural breeding. Originally, it relied solely on the former method but its success of about 18 percent among backyard farmers was discouragingly low. To ameliorate the situation, improved bulls from the Institute were distributed to the farmers. This resulted in about a 47 percent success in terms of calves born and cows exhibiting signs of pregnancy after rectal palpation. However, there are a few drop–outs among the bull caretakers because the share of the breeding fee was too low. This was corrected by the equal sharing of the increase in weight of the bull from the time the caretaker received the bull until the time it was withdrawn at about the end of the third year. The Institute pays the caretaker for his share of the live-weight gain made during this period. Furthermore, all the breeding fees were retained by the caretaker. But it appears these incentives are not enough since there are occasionally a few drop–outs. Some failures resulted from the improper care of the bull by the caretaker. One instance, the Institute overlooked the fact that one bull was chosen by a farmer for his attractive physical appearance. The semen quality of the bull was poor, however. After one year, none of the females bred became pregnant. This caused a great deal of dissatisfaction among the farmers in the barrio.

A cooperative action–research project undertaken by the Bureau of Animal Industry, the Development Bank of the Philippines, and DTRI was the importation of a plane load of pregnant Holsteins for ten semi–commercial farms located at about 1000 feet above sea level. Confirming the Sri Lanka experience, there were about 28 percent abortions and stillbirths in the first pregnancy. This, however, dropped to about 6.8 percent in the second pregnancy. In two years, the mortality was about 4.4 percent per year but none in the third year. In spite of these drawbacks, the cows produced an average of 8.3 kg milk/day in 335 days of lactation. Production for second calve heifers improved to 10.8 kg/day average during a 256 day lactation period.

The high abortion rate could be attributed to poor transport conditions and management. Although abortion can be drastically reduced, a considerable amount of risk is still there. Recently, however, (1979), the San Miguel Corporation imported 65 pedigreed pregnant heifers by plane without any abortion or mortality.

In DTRI's integrated dairy goat project, a cooperative undertaking of the Asia Foundation and the Heifer International, dairy goats were dispersed to farm cooperatives. There was about 55 percent mortality of the original stock due to the unfavorable weather in 1978. Four typhoons out of 20 hit the area. Some goat houses along the Laguna de Bay (lake) were submerged. Since some of the dairy goat farmers were also fishermen; goats were secondary in importance to fishing. When typhoons destroy fishpens, fishing becomes very lucrative because fish escape from the broken pens.

Through DTRI's extension program, farmers in cooperatives are encouraged to buy pregnant cull goats. Six out of 17 that finished their lactation, the average production per day was 6.11 kg at the farmers' level compared to 5.87 kg at the Institute. The personalized care and management given by the farmers could be an important factor.

In cooperation with the Bureau of Animal Industry's provincial veterinarian of Rizal, the Institute trained para veterinarians (barefoot veterinarians). In connection with this project, veterinary drugs donated by various companies and individuals are sold at cost to the farmers at the barrio pharmacy store managed by pharmacy aides.

NON–DAIRY CONCERNS FOR RURAL DEVELOPMENT

Along with dairy development strategies in the MCP are some projects designed to improve the quality of life of farmers in the depressed barrios of Jala–jala, Rizal. Among these are the nutrition project for pre–school children. There are also barefoot doctors (barrio health workers) and pharmacy aides in the barrios. The pharmacy in the barrio is also stocked with medicines donated by various organizations.

Sewing classes are conducted to help train the housewives. To improve potable water, ten plastic pumps were installed at Jala–jala, Rizal by the Institute of Small Scale Industries at the University of the Philippines with funds received from the International Development Research Center of Canada. The Institute of Small Scale Industries will test the feasibility of using PVC pipe and pumps.

Another non–dairy activity is the family planning project of the Milk Collection Program. At present, there are slightly over 200 tubal ligatees. About 45 of these were suggested by the ligatees themselves, not by the DTRI Training Associate. But in this area there are only two vasectomized males!

INTEGRATION OF ANIMAL AND CROP PRODUCTION IN SOUTHEAST ASIA

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SUMMARY

Most small farm holdings in Southeast Asia will continue to depend on animal power. Likewise, prospects for more intensive farming are complementary to increased live–stock production through the better use of crop residues and integration of fodder into cropping systems.

An example is the growing of Leucaena hedgerows, especially in upland and hilly areas. Traditional inter–cropping in selected areas of the Philippines, as borne out by experiments, shows that the Leucaena leaves used as fertilizer could sustain high yields of corn and other annual crops plus provide some left–over for supporting 10 goats per hectare. Even in home lots with limited space, Leucaena planted 8–10 cm apart could form a living fence to keep loose animals from other forage and/or vegetable crops. A 200-m hedge row yields 10 kg of fresh herbage if 3.64 linear meters are harvested daily. It will therefore be a self–perpetuating source, providing one–third the forage requirement for a 250 kg steer.

Even for traditional crops like rice, maize and tabacco, many annual legumes are suitable for intercropping to yield either or both grains and fodder. These are Vigna, Glycine, Dolichos, Phaseolus and Cajanus. One noted intercropping advocate at UPLB is anticipating wider use of irrigated and rain–fed rice fields after the second crop. Short–season rice varieties are making it possible to harvest a second crop after barely 200 days, leaving 165 more days for a third crop. These legumes and even fast–growing grasses merit study.

An integrated farming system involving coconut, fodder and ruminant livestock offers tremendous potential for increasing animal protein production and rural family income in the region.

Such a fodder–livestock integration need not be limited to cattle and commercial swine and poultry breeds. In fact, for the short–run, indigenous or native goats, chickens, pigs, and perhaps even ducks, might have a more immediately beneficial impact. This is because such native animals are adaptable and require less and cheaper feeds. Veterinary care would also have to be provided. Success with small animals is foreseen as a way to in–crease animal protein intake by the lower–income bracket of the populace.

INTRODUCTION

Subsistence crop farming still dominates agriculture in the developing countries of Southeast Asia. In most instances, livestock is only a minor component of the farming systems; the main source of livelihood is the growing of staples and other cash crops. Livestock serve the secondary roles as: farm power and transport, occasional sources of meat and milk, and liquid assets that can be disposed of for cash during times of need.

To increase livestock numbers on small farms, fodder crops should be grown as perennial stands and/or as annuals in rotation or intercropped with the traditional major crops. This would provide more nutritious forages to support more animals and thereby sustain a higher plane of livestock productivity.

A more intensive integration of fodder production, and therefore, livestock into cropping systems is desirable for a number of reasons:

- To augment the supply of badly needed farm power,

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- To make more efficient use of underemployed farm labor,
- To make more efficient use of farm by–products and crop residues,
- To make more efficient use of soil, water and sunlight,
- To moderate the risks associated with crop monoculture, and most importantly as a consequence,
- To increase rural family income.

There is another reason – to produce more meat and milk for better human nutrition. However, as long as the purchasing power of the broader base of human society, which in the developing countries are the farmers - producers themselves, is low, the meat and milk they produce will usually be sold for more needed cash and go to the more affluent sectors of the population or to the export market.

Increased consumption by the farmer's family is better assured when he is able to raise more goats, native chickens, swine and perhaps ducks. It is timely to devote increasing attention towards production of such indigenous or native animals. These "unimproved" animals thrive on farmyard left–over feeds and residues, weed seeds, and the like. Supplemental feeds like maize, rice grain, sorghum, cassava, etc. are minimal.

Adequate disease and parasite control could also substantially increase production. The same stimulus could also encourage small farmers to include more feeds and fodder into the farming systems.

LIVESTOCK AS SOURCES OF FARM POWER

In Southeast Asia, water buffalo and cattle are raised mainly for draft purposes, i.e. for land preparation and transport. Water buffalo are the preferred beasts of burden in lowland rice paddies, whereas cattle are preferred in upland or dryland farms.

The lack of farm power as a constraint to productivity in small farms has been pointed out by Swaminathan (1973) as cited by Lall (1976). "Inadequacy of power is one of the basic causes of our (India's) inability to improve the efficiency of farming through timely agricultural operations . . . . Animals contribute over 28 million h.p. of energy per day for agricultural operations in India. To produce a yield of two tons per hectare, the average power requirement would be about 0.75 h.p. per day. However, the current power availability including those provided by man, animals, tractors and power tillers comes to only 0.30 h.p. per hectare."

In the Philippines and Thailand, up to 27 percent of the farms having less than 2 hectares have only hand labor (Banta 1973). If we include all farms, 18 percent have no access to animal or machine power. The rationale, therefore, for the integration of forages and livestock in small farm systems could be justified even solely on the basis of a need for more livestock power to cultivate crops, especially as agriculture shifts to more intensive cropping patterns.

The non–availability and/or timeliness of labor is a limiting factor in the adoption of multiple cropping. Banta (1973) in an assessment of power sources for multiple cropping, pointed out that on an average sized Philippine rice farm, assuming three able–bodied men are providing labor, 78 percent of the land is in production on a year round basis. With three men and a carabao (water buffalo), the land in production increases to 84 percent; and when a hand tractor is employed, the amount of land in production increases to 93 percent.

It is certain that, for a long time to come, most of the very small farmers must depend on animal power. This is increasingly true when the bleak prospects for fossil–based fuel are considered. As one farmer puts it, "Our animals do not need spare parts and neither do they rust or eat oil."

Animal power should also be given more serious consideration among alternative energy sources. After all, aside from land cultivation, draft animals are still indispensable in developing countries, especially where roads are either lacking or poorly maintained and impassable by motor vehicles. In the Philippines, oxen–drawn carts are virtually irreplaceable for in–field transport of sugarcane during the rainy months. For coconuts grown on hillsides, native ponies are used to cart the harvest to assembly points where it is loaded into trucks. Such ponies use two rattan baskets hung from their backs.

In India, it is estimated that 15 million oxen are used to pull animal–drawn vehicles (Christian Science Monitor, 1979). Likewise, the estimate is that two–thirds of rural transport of goods is by animal drawn vehicles. Animal power can also be used to generate electricity. Even in the absence of workable animal–drawn generators, India's case is challenging. The Christian Science Monitor estimates that India's 80 million work animals provide approximately 40 million horse power. This is equivalent to roughly 30,000 megawatts, which is more than the presently installed electrical power capacity in India. Thus, utilizing even a fraction of such power to generate electricity has important economic implications for India and other Asian countries.

MORE EFFICIENT USE OF UNDEREMPLOYED FARM LABOR

Under–employment is a chronic problem in the countryside. For example, in a nationwide survey of maize growers in the Philippines, the average farm operator was idle on the average of 2.3 months each year. The farmer's wife and other family members likewise had plenty of time to spare (Table 1).

TABLE 1 Employment in Philippine Maize Farms (From Banta and Frio, 1974)

Item	Months/Year		
	On–Farm	Off–Farm	Idle
Farmer/Operator	8.2	1.5	2.3
Wife	4.5	-----	-----
Family labor	16.2	4.7	12.0

These hours could be gainfully employed in the gathering, cutting and hauling of fodders; tethering or pasturing; milking and other livestock chores. Since these activities are light work, children, older folks and women could easily perform these function. Moreover, the demand for labor for such activities is relatively uniform through–out the year, unlike the extremely seasonal requirements of cereals and other cash crops.

MORE EFFICIENT USE OF FARM BY–PRODUCTS AND CROP RESIDUES

Farm by–products and cropping residues are commonly available feedstuffs on small farms (Table 2). The available feed resources increase further with intensive cropping.

TABLE 2 Livestock Feeds From Various Crops (From Banta, 1972)

Crop	Product	Yield/ha
Sweet maize	Non-marketable ears	3,000–20,800 pieces
	Stovers	8.0 – 29.0 tons
Sweet potato	Non-marketable roots	1.8 5.8 tons
	Tops	13.0 – 31.2 tons
Cowpea	Vines	2.0 – 15.0 tons
Mungo	Vines	1.2 – 2.0 tons
Soybean	Hay	1.9 – 2.0 tons
Sorghum	Stalks	16.0 – 28.4 tons

The potential to use rather than waste these cropping residues was dramatically demonstrated in a study of 11 irrigated multiple cropping systems in the Philippines. On the average, 60 percent of the total digestible pro–tein and 64 percent of the total digestible non–protein nutrients produced by the different cropping patterns had no market value (Table 3, Banta, 1972). We must select or develop varieties with higher marketable indexes or utilize by–products more efficiently by some means such as feed for ruminant livestock.

TABLE 3 Non–marketable Digestible Nutrient Production From 11 Irrigated Cropping Systems (kg/ha) (From Banta, 1972)

System	Total Digestible Protein	Percent Non-marketable	Total Non Protein Digestible Nutrient	Percent Non-marketable
A	920	71	14,900	61
B	820	64	12,900	59
C	670	36	6,600	53
D	1,260	60	11,800	62
E	720	71	6,700	68
F	750	74	8,000	63
G	810	37	17,000	76
H	1,000	57	16,600	75
I	1,080	80	16,800	77
J	770	39	10,200	63
K	620	69	8,200	71
Avg.	856	60	11,791	66

MORE EFFICIENT USE OF PHYSICAL FACTORS OF AGRICULTURAL PRODUCTION

Fodders, particularly when planted as rotation crops, as relay crops and as intercrops, allow for a more efficient use of physical factors of agricultural production such as sunlight, moisture and soil fertility. Most cereal crops mature in 90 to 120 days. The crop canopy does not close in until 45 to 60 days after planting. Fast growing legume forages may be grown as intercrops during the first 45 to 60 days to exploit the available sunlight with–out adversely affecting the yield of the main crop.

In monsoonal climates, when the rainy season ends late, very often there is sufficient residual moisture in the soil to support an early maturing crop after the main season crop is harvested. Since forage crops are not grown for seed, the risk of crop failure is less. In fact with deep–rooted forage legumes, crop productivity is extended well into the dry season.

The incorporation of forage legumes in the cropping system raises the effective nitrogen level in the system, particularly if manure and urine are collected and plowed back. Moreover, the deep–rooted legume fodders are able to tap soil nutrients in the deeper soil profiles and help them recycle again as manure and urine.

LIVESTOCK AS A FORM OF FARM INSURANCE

Livestock and fodder crops could moderate the risks associated with monoculture cropping. Droughts, floods, typhoons, diseases, insect pests and price manipulation afflict farmers, big or small, all over the world. Income from livestock could cushion the effects of a major crop or price failure. In seasons when crops fail to flower or to fruit, they can be salvaged as livestock feed.

INCREASING RURAL FAMILY INCOMES

In the final analysis, the objective is to increase the income of rural families which in most developing countries represent the bottom economic half of society. Whether the income is obtained from crops, livestock, cottage industries or any combinations thereof, is secondary. In developing countries where rural dairy schemes are being implemented, a farmer may find it more advantageous to switch from cereals to fodder crops and milk animals. In fact, for landless laborers and farmers with very little land, dairying is the only way to make a living.

Livestock and fodder crops may compete with, complement, or supplement crop production. The relationship is determined primarily by yield factors and pricing. The optimum mix of crops and livestock will vary with time and place and from farmer to farmer. But other factors are also operating. We have shown in experiments that a rice farmer in the central plains of Luzon, Philippines, will make more money if he fattened eight steers on a hectare of aquatic paragrass than if he raises two crops of high yielding rice. It is doubtful if many farmers will take us up on that.

ANNUAL LEGUME FODDERS AS ROTATION CROPS AND INTERCROPS

Many tropical annual legumes are suitable fodder crops for rotation and intercropping. Species belonging to the genera Vigna, Glycine, Dolichos, Phaseolus, Cajanus, Stizolobium, etc. are being used to varying degrees. Unfortunately, present plant breeding programs more often emphasize grain or green pod yield than to herbage yield. An exception is at the Indian Grassland and Fodder Research Institute, where improvement programs are underway for forage cowpea, forage velvet bean and forage pigeon pea (Magoon et al. 1973, 1974).

Pigeon pea (Cajanus cajan) is a big seeded, fast growing legume being used both as a source of grain and fodder. A dual purpose, variety planted in the Philippines at a density of 500,000 plants/ha gave yields of 10, 20 and 78 tons green fodder/ha at 60, 90 and 120 days after planting (Table 4, Movillion et al. 1975). Crude protein and *in vitro* digestibility of the fodder obtained were sufficient to sustain high livestock production.

TABLE 4 Herbage and Crude Protein and Digestibility of Cajanus Cajan (Movillion et al. 1975)

Age at Harvest (days)	Fresh Herbage Yield (T/ha)	Crude Protein Yield Leaves (kg/ha)	Crude Protein Yield Stems (kg/ha)	Crude Protein Yield Total (kg/ha)	IVDMD Leaves (%)	IVDMD Stems (%)
60	10.3	356	104	460	64.2	46.9
90	20.3	477	224	701	60.3	46.0
120	78.3	1,731	836	2,567	57.4	45.9
Avg.	36.3	855	388	1,243	60.6	46.2

Soybean fodder intercropped with maize need not adversely affect the yield of the main crop either as green maize or as grain (Furoc et al. 1977; Furoc, 1978). In fact, in our experiments, the maize alone treatments had lower yield than the intercropped treatments.

In a green maize/soybean fodder experiment, we found an intercrop population of 400,000 plants/hectare and a harvest date of 40 days (from among a range of dates of 20, 40 and 60 days) to be a practical combination. The soybean fodder had a crude protein content of 33 percent on a dry basis, and an IVDMD of 64 percent. The outputs from a green maize/fodder soybean mixed crop is shown in Table 5. The green maize crop received 80-30-30 kg N-P_2O_5-K_2O/ha and the soybean intercrop, 35 kg P_2O_5/ha.

TABLE 5 Outputs From a Green Maize/Fodder Soybean Mixed Crop (Furoc et al. 1977)

Output (Tons/ha)	Wet Season	Dry Season
Marketable green maize	6.28	5.36
Non-marketable green maize	0.86	1.01
Fresh maize stover	12.1	16.1
Soybean fodder	9.4	3.41

Competition index, defined as the ratio of the yield of a species in a mixture and the yield of the species in a pure stand, is a measure of the effect of a companion crop on the main crop. If the index is greater than 1.0, the companion crop is beneficial to the main crop. At 30, 50 and 70 days to harvest of the soybean intercrop we obtained competition indexes of 1.35, 1.30 and 1.16 in a grain maize/soybean fodder experiment (Furoc, 1978).

FORAGES FROM PURE STANDS AND FODDER CROPPING PATTERNS

Tropical forages are capable of high herbage production when given sufficient moisture and fertilizers. In the Philippines, pure stands of napier, guinea and paragrass cut every 45 days and fertilized moderately with 200 kg nitrogen produce 15 to 20 tons dry matter/ha/year. Yields of 30 to 35 tons DM/ha/year are obtained with higher levels of fertilization and with irrigation during the dry season.

The fodder potential of the more productive fodder cropping patterns in India are Shown in Table 6 (Mannikar and Shukla, 1974). Given an average range of 1,000 to 2,800 quintals green fodder/hectare/year, these cropping patterns are capable of supporting 6 to 17 lactating cows throughout the year.

TABLE 6 Fodder Potential of Some of the More Productive Fodder Cropping Patterns in India (From Mannikar and Shukla, 1974)

Cropping Pattern	Green Fodder *(quintals/ha/year)
Berseem/Japan Sarson – Hybrid Napier/Cowpea**	2863 q
Berseem/Japan Sarson – Maize/ Cowpea – Fodder Sorghum/Cowpea	1746 q
Hybrid Napier/Maize/Cowpea –Hybrid Napier/Berseem/Mustard	2350 q
Hybrid Napier/Lucerne	2100 q
	Dry Matter (tons/ha/year)
Sorghum – Berseem – Bajra	42.95 T
Maize/Cowpea – Berseem – Bajra	32.10 T
Sorghum – Berseem – Maize/Cowpea	33.39 T

*Quintal = 100 kg.

**Berseem intercropped with Japan Sarson is the first crop; Hybrid Napier intercropped with cowpea is the second crop.

Leucaena Leucocephala

Leucaena leucocephala, a tree legume, is now widely distributed in Southeast Asia. It has many uses as fuelwood, fodder for livestock, leaf meal for poultry and swine rations, and its seeds have a place in native handicrafts. Strongly arboreal types from Central America are very fast growing and can produce high tonnages of fodder and wood.

The effect of cutting height and cutting frequency on the fodder yields of Leucaena planted in hedgerows three meters apart are shown in Table 7. There were no significant differences among frequencies of cutting. More tonnage was obtained with tall hedgerows (3.0 meters) than short ones (cut back to 15 cm).

We conceptualized a farming system in which Leucaena could be grown as hedgerows, and harvested at intervals for feeding to livestock, with the livestock manure recycled to maize planted in rows between the Leucaena hedge rows. The management factors that will most obviously influence the productivity of the system are spacing of hedgerows, cutting frequency, cutting height and fertilization.

TABLE 7 Dry Matter Yields of Leucaena, Harvested at Different Cutting Heights and Frequencies, tons/ha/year (Mendoza et al. 1976)

Stubble Height	Frequency (weeks) 8	12	16	Mean
0.15 meter	11.00	9.54	11.49	10.68
1.50 meter	17.82	14.34	15.18	15.78
3.00 meter	24.07	22.80	23.97	23.61
Mean	17.62	15.56	16.88	16.69

However, the labor required for manual harvesting of the tall hedgerows was excessive (Table 8). Moreover, the tall hedgerows restricted sunlight from reaching the maize intercrop. Cutting back the Leucaena to a low height (15 cm) was a more practical alternative.

TABLE 8 Labor Costs of Producing Leucaena Fodder as Affected by Cutting Height (Mendoza et al. 1976)

Height meter	Labor man-days/ ha/year	Dry matter tons/ha/year	Labor/Ton DM man-days/ton
0.15	70.0	10.68	6.55
1.50	363.0	15.78	23.00
3.00	617.6	23.61	26.16

The Leucaena branches were cut back with machetes. Only the leaves and soft stems with 5 mm. diameter or less were weighed. The material harvested had an average crude protein content of 20.0 percent and an IVDMD value of 71.2 percent.

A cut–back height of 15 cm averaged 1,972 kg of crude protein in the Leucaena herbage per hectare per year. Expressed in elemental nitrogen, this is equivalent to 315 kg N/ha/year available for green manuring. If the herbage is first fed to livestock and the manure returned to the land, the amount of nitrogen as fertilizer available should still be far more than the minimal 30 kg nitrogen/maize crop recommended by the Philippine maize program. In fact, most maize crops in the Philippines do not receive nitrogen.

If the hedgerows are planted along the contours, there will be long–term effects as far as soil and water conservation is concerned. Lastly, the Leucaena stumps could be a source of firewood for kitchen use.

In the work of Alferez et al. (1979), Leucaena were planted 8 cm apart either in single hedgerows 2 m apart or in triple hedgerows with 0.5 m between rows and spaced 4 m apart. Fresh herbage yield was 10–13 tons per ha per 3–4 months regrowth.

Maize plants between the Leucaena hedgerows were fertilized by the herbage at planting time and top–dressed with the Leucaena regrowth after one month.

The Leucaena is estimated to have incorporated into the soil 100–133 kg N per ha at planting time and 20–33 kg N as top dressing. Growth of the maize crop was comparable if not better than those fertilized at the rate of 90–40–40 NPK per ha. Yield data which still strongly supports the growth advantage are still being obtained as of this writing.

The workers have estimated that at 10–13 tons fresh herbage every four months, animals can be fed along with fertilizing the maize crop. For instance, 10 goats, consuming 1.66 kg of fresh Leucaena herbage plus grass roughage, need only two tons Leucaena per month. The remaining 8–10 tons could still provide 80–100 kg N to the corn crop.

As fertilizer for lowland rice, Leucaena, applied at 1.5 tons dry leaves/ha, produced grain yields equivalent to those fertilized with 60–120 kg N/ha from 6–12 bags of ammonium sulfate. The leaves were incorporated into the soil during land preparation prior to planting and at certain stages of the rice growth.

During the dry season, at the rate of 90 kg N/ha, rice varieties, IR–42 and IR–36, yielded from 5.5 to 7.28 tons/ha vs. 4.49 and 4.44 tons for the unfertilized plots (Table 9).

TABLE 9 Grain Yield of Two Lowland Rice Varieties as Influenced by Split Application of Ipil–Ipil Leaves Fertilizer at the Rate of 90 kg N Per Hectare, Dry Season, 1979

Split application of ipil–ipil leaves	Variety IR–42	Variety IR–36	Mean
	tons per hectare		
Control (without fertilizer)	4.49	4.44	4.47
2/3 at 2 WBT[a] and 1/3 at PI[b]	5.89	5.50	5.70
2/3 at 2 WBT[a] and 1/3 at 20 DAT[c]	7.28	5.57	6.43
2/3 at 0 DAT[c] and 1/3 at PI[b]	7.10	5.25	6.18
1/2 at 2 WBT[a] and 1/2 at 20 DAT[c]	6.38	5.30	5.84
MEAN	6.23	5.21	

[a] WBT - Weeks before transplanting
[b] PI - Panicle Initiation
[c] DAT - Days after transplanting

In the wet season, yield of Leucaena fertilized rice did not differ significantly from those of rice fertilized with ammonium sulfate (Table 10). The two rice varieties yielded from 6.81 to 7.32 tons/ha, vs. 7.16 tons for ammonium sulfate fertilized and 4.24 tons for unfertilized plots, respectively.

TABLE 10 Grain Yield (tons/ha) of Rice Varieties of IR–26 and IR–42 Plants as Affected by Time of Ipil–Ipil Leaf Application. Wet Season, 1979

Time of application	IR–36 60 kg N/ha	IR–36 120 kg N/ha	IR–42 60 kg N/ha	IR–42 120 kg N/ha	MEAN*
3 WBT	5.72	7.18	6.60	7.74	6.81[a]
2 WBT	5.24	6.39	8.64	8.53	7.20[a]
1 WBT	7.02	7.19	7.56	7.50	7.32[a]
0 DAT	5.73	6.20	7.70	8.72	7.08[a]
0 DAT (ammonium sulfate)	6.20	6.93	7.73	7.81	7.16[a]
0 control	4.00	3.47	4.94	4.56	4.24[b]
MEAN	5.65	6.22	7.20	7.48	

* a,b Means with different superscripts are significantly different ($P < .05$).

Translated to the limited space in a backyard, the Leucaena hedgerow could be planted as a living fence-line for the home lot and/or to keep stray animals from perennial forage grasses and legumes. Drilled at 8–10 cm apart and initially harvested after ten months, a 12 m hedge row at UPBL is yielding 2.75 kg of fresh leaves and pencil–sized twigs per linear meter per 60 day harvest without fertilizer. Thus, to provide 10 kg fresh herbage daily, 3.64 linear meters have to be harvested. This amount is enough to comprise 1/3 of the total ration for a 250 kg steer, consuming dry matter at 2.5 percent of its live weight. A 218 cm fence-line being harvested at a daily rate of 3.64 m will recover its growth every 60 days.

A pilot project in the villages being done by UPLB is attempting to encourage farmers to plant Leucaena, Cajanus, Centrosema, Siratro and Stylo. The most critical problem encountered was the need to protect the forage during seedling stage. From such experience, Leucaena should be established first, to form a living fence either for home lot or for a garden. Hedgerows or double rows may be drilled, or planted every 0.2–0.5 m or even farther apart. The first harvest should be made 8–12 months after planting in order to allow for good root development. Harvesting should be done at 1.3 m height from the ground, and branches cut back every subsequent harvest.

INTEGRATING CATTLE AND GOAT RAISING WITH COCONUTS

The main coconut producing countries in the region account for 4.6 million ha, including the Philippines (2.1 million ha), Sri Lanka (0.445 million ha), Thailand (0.272 million ha), West Malaysia (0.211 million ha), India (0.648 million ha) and Indonesia (1 million ha) (De Guzman, 1974). Traditionally, cattle, water buffalo and goats are raised under coconuts on a wide range of vegetation from small trees, shrubs, legumes and grasses. By introducing shade tolerant grasses like guinea and para, as well as legumes like centrosema and siratro, carrying capacity can be increased. Experience in Mindanao, Philippines, has made possible the grazing of two mature cattle (animal unit) per hectare.

The amount of light reaching the ground vegetation, and rainfall are the two important limitations. Santhirasegaram (1964), as cited by Appadurai, suggested that under a mature stand (coconut) planted 8 x 8 m, about 52 percent of the light reaches the ground. In a newly established plantation, little competition is offered by the young coconuts. Light decreases with increasing age of the trees up to 10 years, and thereafter increases again and is maximum after the plantation is about 20 years old.

Data from the Philippines also show that cultivation increases the yield of coconuts (Felizardo, 1971). Thus, pasture establishment is justifiable on the basis of the benefit derived from the cultivation alone.

TABLE 11 Effect of Cultivation on the Annual Yield of Coconuts

	Laguna		Quezon		
Treatment (years)	1	2	1	3	5
	nuts/palm				
Control	7	9	30	34	35
Dug or plowed	14	20	35	50	47

Little work is being done to document the profitability and competition for nutrients of coconut and cattle. One such project between the ASPAC–FFTC and the Applied Scientific Research Corporation of Thailand showed profitability of the integration. In Sri Lanka, 7–8 mature sheep or goats per hectare were grazed under coconut at Mahaberiatenne (Appadurai, 1968).

Half of the 4.6 million ha devoted to coconuts in the region could, when stocked at 1 A.U. per ha, carry 2.3 million A.U. which is about half the cattle and carabao population in the Philippines. Conservative estimates place carrying capacity under improved coconut pastures at 2 A.U./ha. The Development Bank of Philippines has also seen fit to finance so–called "coco–beef" projects under an IBRD financing facility.

Other intercropping approaches have identified suitable annual and perennial crops under coconuts. For instance, in Laguna and Batangas provinces, lanzon fruits yield a higher income than the "main" coconut harvest. Promising annuals include cassava, sweet potato, sorghum, ginger and peanuts. Residues from such crops would further support a limited number of livestock.

DEVELOPMENT OF YEAR–ROUND FEEDING SYSTEMS

Seasonal Distribution

The total feed potential, computed on an annual basis, is more than sufficient to double and perhaps even treble the existing livestock populations in most small farms. Fodder crops, particularly leguminous ones, could be integrated with existing cropping systems as intercrops, relay crops and rotation crops without unduly upsetting the regular cropping patterns. Crop residues such as rice straw, maize stover, non–marketable green maize, sweet potato vines, undersized or damaged root crops and empty legume pods are produced seasonally in abundance. Where cropping is not intensive, weeds from crop fields and fallowed land provide regular sources of feed. When regular sources fail, bananas, bamboos and other trees and shrubs could be utilized.

While total dry matter production is sufficient, many of the feeds are only seasonally available, farmers must find ways to economically conserve them. Rice straw, maize stover and empty legume pods are dry and could be stored without difficulty. Other feeds could be conserved by drying or as silage. Staggering the planting dates of regular crops could further help even out feed availability, but there are climatic and economic limitations to such practices.

Feed Quality

The other obvious problem is that of feed quality. Straws and stovers have low feeding value and have to be supplemented with high quality green fodders, hay, and concentrates.

Year–Round Feeding System in Batangas, Philippines

How are livestock fed year–round on small farms? The graph of Moog (1974) of livestock feeding practices in Batangas, Philippines shows one way (Figure 1). Weeds maize stover and Leucaena fodder are available practically all year round. Other feeds are seasonal. Not indicated are periodic supplies of rice bran from the farmer's rice mills and occasional purchases of molasses.

Rice Straw Based Feeding Systems

Readily available rice straw has been the subject of many feeding experiments in many countries. Studies in the Philippines, as elsewhere, show that a ration of rice straw alone or rice straw plus molasses–urea is unsatisfactory (Natural and Perez 1975). Urea alone cannot suffice as the source of nitrogen in a ration consisting of poor quality roughage and molasses. Copra meal, aside from being an energy feed, seems to partially meet the necessary requirements of a protein supplement for ruminants. Elsewhere, Preston (1972) demonstrated that fish meal is an excellent supplement for cattle on high molasses rations. But fish meal is expensive to feed to cattle in the Philippines and many other countries.

Most recent results indicate that a ration of 40 percent rice straw, 50 percent fresh Leucaena leaves (dry basis) and 10 percent rice bran/copra meal mixture could be a practical on–farm ration (Sevilla and Perez, 1976 unpublished results). Grade Zebu bulls on this ration averaged 0.70 kg liveweight gain per day and with a feed conversion of 8.5 kg feed per kg. liveweight gain.

The above ration, type of animal and performance are very acceptable at the present stage of development in a village production system. As the farmer gains experience, interest and incentives along with favorable marketing conditions, technology should likewise improve. If the genetic quality of the animal is improved better quality feeds would be needed and consequently, the economics of production would become a critical factor in the farmer's decision making.

The farmer might then have to increase the number of animals under his care, reduce the level of rice straw in the ration, and use more cheap by–product concentrates like rice bran, maize bran, copra meal, molasses, etc. utilizing all cereal by–products short of feeding the grains. Or he may adopt, if economically feasible under his conditions, one of the methods of improving the feeding value of rice straw such as alkali treatment, with or without urea spray. At such time he may even purchase valuable nutritional supplements to make the ration complete and more efficient.

Raising of Breeding Animals

The above system would apply to raising growing–fattening ruminants (cattle, carabao and goats). A similar system may have to be used to raise a cow or two and/or a few does in the backyard. Without this option, small farmers will be totally dependent on a supply of feeder stock from the large ranches or commercial farms. Availability and prices of such growing/fattening animals are a critical factor in the economic feasibility of the fattening operation.

Breeding cows/heifers (and does as well), however, cannot be fed high levels of Leucaena due to adverse physiological effects on reproduction. Less than 20 percent fresh Leucaena (dry basis) is acceptable. Rice straw, maize stover and young grasses should provide the bulk of the ration for these animals along with a little copra meal and/or other natural protein supplements.

Poultry and Swine in Small Farming System

One or two pigs, native or improved breed, usually fit in well with a small farmer's operation. The pig is a very popular animal in the Philippines. Pork constitutes at least 60 percent of the total supply of meat, and most pigs are still raised on small farms, despite the increasing number of large commercial piggeries in the country. The farmer will have to grow some rootcrops (sweet potato,

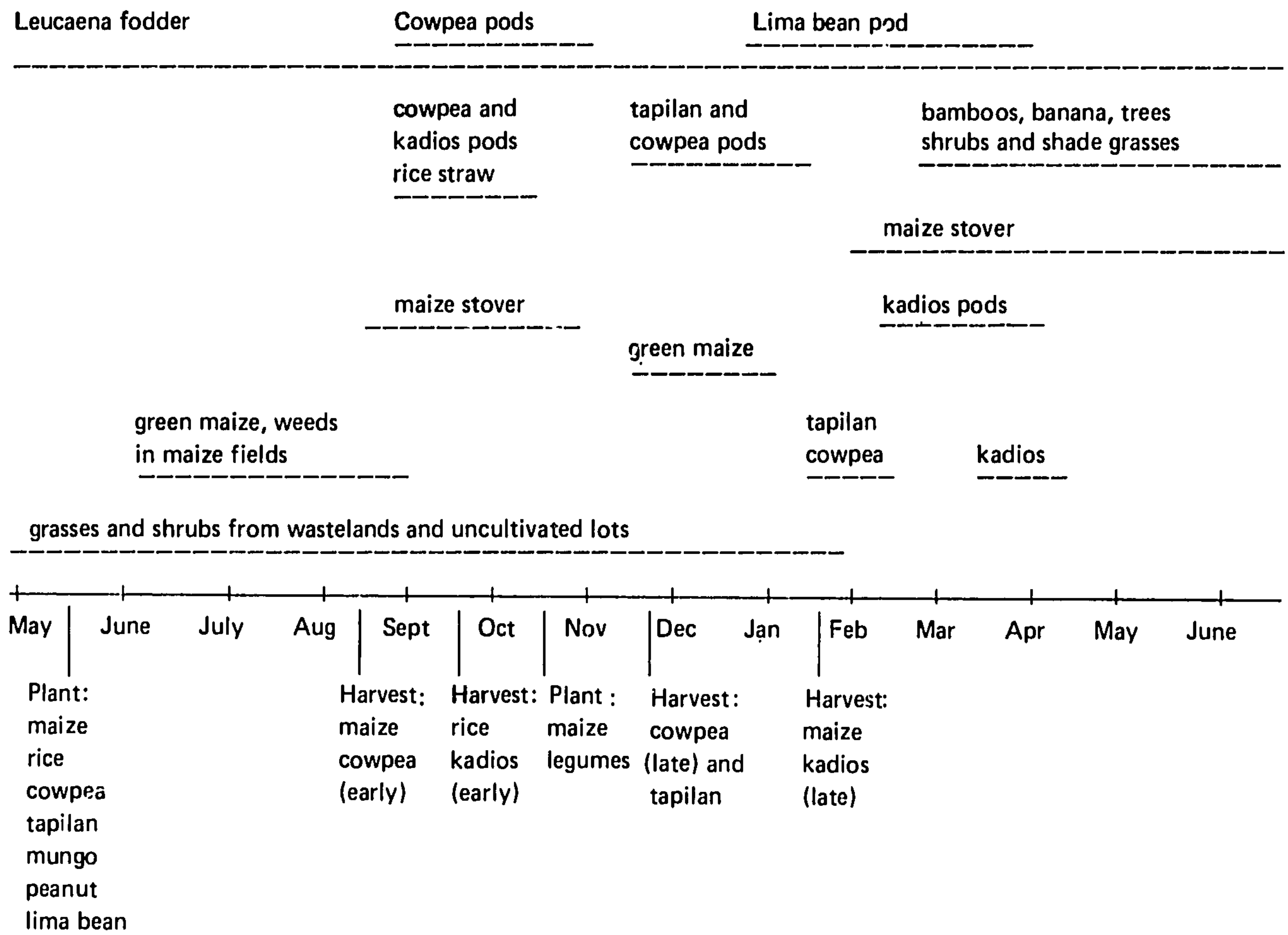

Figure 1: Existing year–round feeding scheme in Batangas, Philippines (Moog, 1974).

cassava) as hog feed and use kitchen refuse, cheap by–product concentrates like rice bran, maize bran, copra meal and rice middlings, some Leucaena leaves, and sweet potato vines.

In the same manner, a flock of native chickens (5–10 hens) can subsist mainly on the greens, worms, and insects on the farm plus supplements like rice bran, rough rice and/or maize grains. Live native chickens and eggs are preferred by buyers in many public markets. In addition, the farm family can be assured of eggs for better nutrition.

Small farmers need encouragement and support from Government for developing techniques for raising native chickens. They should provide an effective extension service as well as market assistance. All too often, the drastic introduction of modern breeds with the accom–panying high tecnnology are inappropriate in small farm situations.

The raising of ducks as part of a lowland rice farming system offers much potential and should receive some attention from research and extension specialists.

CONCLUSION

An intensive integration of livestock and forages into small farming systems has biological, economic and social justifications. Rural family incomes could be improved by integrating fodders into the cropping patterns to optimize utilization of crop residues, light, soil and water resources, and farm labor.

While ruminants seem to have an advantage in this village production system, non–ruminants have their place as well, depending on socio–economic and cultural factors. For non–ruminants, grain by–products and root crops will eventually find greater use.

REFERENCES CITED

Alferez, A. C., F. R. Alvarez, B. B. Mabbayad and M. B. Lao-lao Economics of Leucaena production and its integration into appropriate Research Project Annual Report, U. P. Los Banos, 1979.

Anon. "We're ignoring animal power in quest for energy sources." Christian Science Monitor in an article in Bulletin Today, Manila, February 27, 1979.

Appadurai, R. R. 1968. Grassland farming in Ceylon. T. B. S. Godamunne & Sons Ltd. Kandy, Ceylon.

Banta, G. R. 1972. "Economic evaluation of multiple cropping systems." IRRI Papers.

Banta, G. R. 1973. "Comparison of power sources in multiple cropping." IRRI Papers.

Banta, G. R. and A. L. Frio. 1974. "Preliminary findings on resource characteristics and their utilization corn farms in the Philippines." IRRI Papers.

De Guzman, M. R. 1974. Pasture and fodder production under coconuts. ASPAC Food & Fertilizer Technology Center, Taipei.

Felizardo, B. C. 1973. "Management of soils in pasture–coconut agriculture." Paper presented at the ASPAC Training Course on Pasture Production Under Coconuts. Davao City, Philippines.

Furoc, R. E., D. Z. Magpantay and E. Q. Javier. 1977. "Inter-cropping of fodder soybean (Glycine max (L.) Merr.) with green corn." Proc. Eighth Annual Convention Crop Science Society of the Philippines.

Furoc, R. E. 1978. "Integration of fodder production with a corn based cropping pattern." M. Sc. Thesis. University of the Philippines at Los Banos.

Lall, J. M. 1976. "Cattle production in India." In Integration of Livestock with Crop Production at Small Farm Level. Vol. II FAO No. RAFE 27 pp 44–64.

Magoon, M. L., A. Singh and K. L. Mehra. 1973. "Gene pool helps in improving fodder crops." Indian Farming 23(1): 5–7;

Magoon, M. L., A. Singh and K. L. Mehra. 1974. "Improved velvet beans for increased forage production." Indian Farming 23(12): 23–27.

Mannikar, N. D. and N. P. Shukla. 1974. "Fodder Crops and Cropping Patterns." Indian Farming 23(8): 11–12.

Mendoza, R. C., T. P. Altamarino and E. Q. Javier. 1976. Herbage, crude protein and digestible dry matter yield of ipil–ipil (Leucaena latisiliqua cv. Peru) in hedgerows." Phil. Jour. of Crop Science 1(3): 149–153.

Moog, F. A. 1974. "Backyard cattle raising in Batangas (Philippines) and its feeding systems." Unpublished.

Natural, N. G. and C. B. Perez, Jr. 1977. "Copra meal and liquid molasses–urea supplementation of rice straw for feedlot bulls." The Phil. Agric. 61(5 & 6): 176–185.

Preston, T. R. 1972. "Fattening of beef cattle on molasses in the tropics." World Anim. Rev. (FAO) 1:24.

Sevilla, C. C. and C. B. Perez, Jr. 1976. "Effect of ipil–ipil leaves supplementation to rice straw on feedlot performance of bulls." University of the Philippines at Los Banos. Unpublished.

APPLICATION OF FEED DATABASE IN ANIMAL PRODUCTION SYSTEMS

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SUMMARY

The availability of feed information in the world can easily be evaluated since the establishment of the International Network of Feed Information Centers (INFIC). Feed information in the developing countries (in general) is still minimal or lacking.

The main sources of feed in these countries are the waste or by–products of the production of human foods, and these need individual analyses, documentation and data organization.

The application of a common feed database assembled at a regional center may help the countries in the region to utilize their natural resources more efficiently through the different animal production systems in use. Some examples of applying a feed database for different animal production systems are discussed herein.

Key Words: feed database, availability, application, animal production systems.

INTRODUCTION

Many publications contain information on the nutritive values of feedstuffs, as well as on the nutrient require– ments of animals being fed under different production systems. Such information on applying a feed database to different animal production systems should help increase the production of animal products and reduce unit costs.

The purpose of this paper is to give a brief overview of the availability of feed information in the different regions of the world in the form of a feed database and discuss their possible applications in animal production systems.

FEED INFORMATION

Evaluating the availability of feed information in the world at the present has been facilitated by the establishment of INFIC. INFIC has organized at least ten centers, including centers in Australia, Canada, France, Italy, Germany, Africa, Latin America, the United Kingdom, the United States, and Syria and has a new center scheduled for the Southeast Asian region.

INFIC aims have been discussed elsewhere and, if all goes as planned, exchanges between existing data stores will be enhanced by organizing future inputs into a common database, utilizing a multilingual international feed voc– abulary (Harris and Kearl, 1976).

Efforts to establish new regional centers in developing countries should enhance the collection and documentation of feed composition information. The common database may then serve a particular region by distributing conven– tional feed composition tables, other forms of feed tables, replying to specific inquiries on factors affecting the nutritional value of feeds, and providing information relevant to the incorporation of feeds into diets and rations.

The degree of development of animal production in a country depends upon the extent to which it uses its natural local resources. Relatively little can be done to increase supplies of natural resources, but there are many ways, however, to improve their utilization. National and regional governments must give their primary attention to developing programs to efficiently use their resources. At present, developing countries in general lack basic data on the physical, chemical and biological values of the available feedstuffs. By–products from agricultural human food production and forages (mostly uncultivated native grasses, legumes and shrubs) are the main sources of animal feeds. Most of these need to be chemically and biologically eval– uated and the data entered into a databank.

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For instance, the available feed composition data in Indonesia are mostly collected by Animal Research Institutes, Animal Husbandry Faculties at several universities, and some private feed mills. Most of these data are still limited in number and quality, no common nomenclature is used to describe feeds, and no formal cooperative programs exist among the institutions.

APPLICATION OF A FEED DATABASE

Data stored by INFIC (Harris and Kearl 1976) are of particular importance to those involved in:

- Research and education
- Planning and development
- Feed industry
- Practical animal production

The benefits of a feed database are clearly stated in the USA National Academy of Sciences, Committees on Animal Nutrition (Cunha 1976), a series of publications on Nutrient Requirements of Domestic Animals, including rabbits; mink and foxes; trout, salmon and catfish; livestock and poultry. The USA National Academy of Sciences and National Research Council Committee on Animal Nutrition have been producing these reports for 50 years, providing valuable guidance for the feed and animal industries and also governmental agencies all over the world. Another example of useful feed data is the information published by the IFAS University of Florida (1974) as the Latin American countries. Those tables are intended to be used by manufacturers, research specialists, teachers, students, extension specialists, farmers and others concerned with formulating livestock and poultry diets in Latin American countries and by anyone interested in feed composition, especially that of tropical feeds.

The numerous publications on Feed Composition found in the literature are valuable to the above–mentioned professions and to policy makers. They may be applied to the different species of animals and to the different systems of production. These tables are beneficial to those interested in increasing animal production efficiency through the application of improved nutrition.

The systems of animal production that may benefit most from a feed database are the intensive production systems; such as commercial modern poultry operations, feed–lot operations, dairy farms, and swine operations. Most of these utilize the tables of feed composition to create Least Cost or Maximum Profit diets. The calculations are mostly done with the help of computers, however, the use of small electronic calculators is also practical and is popular in developing countries (Mason 1976, Butcher 1976).

The other system of animal production still dominant in developing countries is the small–holder, traditional village production system. A good example is the feedbase in Indonesia where with the exception of the cattle ranching sector and pre–urban commercial dairy farms there is practically no cultivation of forage crops on arable land. To maintain the ruminants or scavenging pigs and poultry, the by–products from food or cash crop production is needed as roughage. Grazing on wasteland or around households also provides needed roughage. The bulk of locally available concentrates are rice bran, peanut meal, coconut meal, and cassava chips. The feed industry has made rapid progress during recent years, but it still caters mainly to pre–urban, intensive poultry production. These feed mills utilize modern automated, computerized equipment, however, they are concerned about the continuous rise in prices of local ingredients. They also find it difficult to regularly obtain quantities and qualities of ingredients required to offer concentrate mixtures of standardized nutrient contents and palatability. The government will also benefit from the feed database for planning and policy making purposes. It will assist them to more easily estimate the causes of the rise and fall of population numbers, and of mineral deficiency problems. They will be able to estimate carrying capacity of native grasslands, and regional planning program development will be made easier. Government extension workers may also utilize a feed database for making general feed formulas for village production systems utilizing the available feed composition data. It can be concluded that the application of a feed database would be a valuable tool for all concerned and should result in an improvement in the production of meat, milk, fiber and work.

REFERENCES CITED

Butcher, J. E. 1976. "Simple diet formulation." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris, and L. C. Kearl) Utah Agr. Exp. Sta., Utah State University, Logan, Utah.

Cunha, T. I. 1976. "The organization and function of Animal Nutrition Committees." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl) Utah Agr. Exp. Sta., Utah State University, Logan, Utah.

Harris, L. E. and Leonard C. Kearl, 1976. "The International Network of Feed Information Centers." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris and L. C. Kearl) Utah Agr. Exp. Sta., Utah State University, Logan, Utah.

IFAS University of Florida. 1974. Latin American Tables of Feed Composition (Abridged). University of Florida, Gainesville, Florida.

Mason, T. R. 1976. "Formulation of diets by hand." First International Symposium, Feed Composition, Animal Nutrient Requirements and Computerization of Diets. (Edited by P. V. Fonnesbeck, L. E. Harris, and L. C. Kearl) Utah Agr. Exp. Sta., Utah State University, Logan, Utah.

PRODUCTION PROBLEMS FACING SMALL–HOLDERS IN SOUTHEAST ASIA

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SUMMARY

Small–holders play a very important role in current livestock production in Southeast Asia. Animals are raised mostly for manure and draft purposes as well as for investment purposes. Consequently, the output of meat, milk and eggs is low because of a primitive production system. Without adequate selection criteria, the livestock tend to have low genetic potential. Feeding systems revolve around a cropping pattern, with rations consisting of native grasses and crop residues, considered to have low nutritive values. In addition to poor management and feeding techniques, diseases appear to cause severe losses in production.

Small holders have the following production concerns: a lack of credit, difficulties in obtaining good breeding stock, a fluctuation of feed supply and inadequate health services and technological assistance. A good program to increase livestock productivity can be achieved through an integration of production and marketing.

Key Words: small-holders, traditional husbandry.

INTRODUCTION

Livestock production in Southeast Asia is predominantly operated by small–holders. In Indonesia, 99 percent of the large ruminants, 100 percent of the small ruminants and about 80 percent of the pigs are raised by small–holders using traditional methods. In Malaysia the situation is similar, while in the Philippines 98 percent of buffalo and 75 percent of cattle are found on small farms (Eusebio 1979). Scavenger chickens have been gradually replaced by imported breeds. In Singapore, scavenger chickens no longer exist, while in Malaysia, Thailand, Philippines, and Indonesia, they are still important to the poultry industry. For example, in Indonesia the scavenger chicken still provides about 90 percent of the poultry meat and 40 percent of the eggs (Kingston 1979).

As part of the subsistence farming, animal production systems are greatly influenced by the background of the people (Kristanto 1978). Farmers do not appear to have the capability to develop commercial–type operations without outside assistance. The income of this sector of society is low and its production system is weak, so the farmers find themselves in a hopeless situation. External help must be provided in order to make significant changes.

The purpose of this paper is to discuss the traditional production systems and the problems faced by the farmers. Understanding these problems will make it easier to ameliorate them.

TRADITIONAL PRODUCTION SYSTEMS

As livestock are integrated into a farm management system, they play important roles in maintaining the agricultural and ecological balance. Animals in the traditional system are maintained under minimal cost conditions and are kept primarily for draft and manure. In addition, livestock serve as a means of savings, and they may be used for religious ceremonies, or as status symbols. In a survey of West Java and Indonesia, Atmadilaga (1974) found that 100 percent of the participating farmers used their cattle and buffalo in the farm management system, while 100 percent of farmers considered small animals as a savings account (Table 1). However, this situation depends on the region and type of farming. A study in Yogyakarta (Wiguna et al., 1979b) revealed a difference in percentage of male and female cattle associated with non–irrigated and irrigated areas. In the non–irrigated areas, 95.7 percent of the cattle were females, indicating that the farmers use the cattle for breeding as well as to provide power and manure. In contrast, in the irrigated areas where only 42.6 percent were females, the animals are used primarily for land cultivation, and meat production

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is of secondary importance. In South Sulawesi, Kristanto (1978) found that the percentage of females was 78 per–cent and that the animals were used mainly for field cultivation or transportation. Farmers realize that the use of female cattle as draft animals is beneficial since they can produce offspring in addition to power and manure.

TABLE 1 Reasons for Maintaining Livestock in West Java[a]

Livestock	In farm management	Saving	Religion	Hobby	Others
Large animals	100	70	0	44.3	52.9
Small animals	88.6	100	55.7	57.1	40
Average	94.3	85	27.9	50.7	46.5

[a] Atmadilaga (1974).

The main motivation for raising livestock is for labor, and this may cause low reproduction rates. Farmers emphasize the necessity of land cultivation, thus they don't breed the animals during the work seasons. If the animals show signs of estrus before or during work, farmers are not willing to mate the cows before the work is finished. The annual calf crop in Southeast Asia is reported to be about 50 percent (Annon 1977a). In a study in Yogyakarta (Hardjosubroto et al., 1979), it was found that the annual calf crop was only 43.4 percent. The total livestock population in Indonesia decreased at an annual rate of 0.91 percent during the last five years, while in the Philippines, they increased by 0.8 percent from 1977 to 1978 (Eusebio, 1979).

Farmers consider their livestock important as a savings account since animals can be sold anytime when cash is needed. In contrast, other property under their command have limited immediate market value. Sales of livestock are usually mediated by middlemen: the first collects the animals from farmers, while the second operates within the markets. The total commission received by both middlemen average 7.4 percent for cattle and 8.9 percent for small animals (Wiguna et al. 1979a), thus it is consid–ered to be an efficient marketing system. Unfortunately this is not always true, especially in regions where trans–portation is difficult.

Usually there are no selection criteria applied when animals are to be culled and sold. Because of this, the good–looking and bigger animals are in greater demand by the buyers and therefore they are removed from the village leaving only the smaller animals behind. Therefore, the system exerts a negative effect on the selection of animals for breeding purposes. For example, in 1970, the average girth measurement of adult male Bali, Ongole, and Madura cattle in Indonesia were 193.5, 168.1 and 158.7 cm, respectively, whereas in 1976, these were reduced to 182.0, 153.5 and 151.7 cm (anon. 1978). Unfortunately, pregnant females are not excluded from the sale transaction. It was estimated that 16.8 percent of the cattle slaughtered in Indonesia are productive females (Harmadji 1976).

The milk marketing systems are more complicated due to the nature of the product. Farmers received 39 percent of the retail price of milk through a milk collecting center in Malaysia (Anon. 1979b). In Indonesia, farmers received between 34 percent (Boyolali) and 45 percent (Bandung) of the retail price (Soekoharto, personal communication).

Small–holders tend to be poor, and thus, they are unable to invest capital to improve their feeding, management, or health control technology. Farmers who live in remote areas and especially those with soil of marginal fertility, tend to depend more heavily on their livestock as a source of income. A study in Yogyakarta (Wiguna 1979b) showed a negative correlation between the size of a land holding and the income from livestock sectors (Table 2). This finding agrees with an evaluation by Kristanto (1978) in South Sulawesi.

TABLE 2 Size of Land Holdings and Percentage of Income From Livestock Sector, Yearly Basis[a]

Land holdings ha	Average number livestock farmer	Income: Agricul-tural sector Rp.	Income: Livestock sector Rp.	% income from livestock
Non–irrigated				
More than 0.60	1.67	130,237	24,324	18.7
0.31 – 0.60	1.53	79,251	24,739	31.2
0.10 – 0.30	1.53	45,115	31,210	69.2
Irrigated				
More than 0.60	1.87	325,318	17,436	4.9
0.31 – 0.60	1.60	155,813	13,733	8.8
0.10 – 0.30	1.87	85,584	22,056	26.1

[a] Wiguna et al. 1979.

Feedstuffs supplied to livestock are composed of road–side grasses, either grazed or cut, leaves from trees, and crop residues. The feeding systems revolve around cropping patterns, which are dependent upon climatic conditions, as shown by Moog in Batangas, Philippines

(Javier 1975). Results of a similar study in Yogyakarta (Lebdosukoyo et al. 1979) showed that native grass constituted only 27.8 percent of the ration in the agricultural areas, whereas in the mountainous regions the native grass constituted 78.7 percent of the ration. Analysis of the rations and observations of animal intakes show that the nutrient content, as well as the monthly dry matter consumption, fluctuated significantly. Levels of energy and phosphorus were marginal, especially during the dry season. Due to the availability of crop residues, the nutritive value of the rations in the intensively farmed areas were better than those in the mountainous regions. Protein and calcium appeared to be sufficient in both areas, due to the availability of leaves from legume trees such as *Luecaena spp.* and *Sesbania spp.*, which constituted about 12.5 percent of the diet dry matter. Under these circumstances, the farmers are doing a fair job of feeding their animals. They are obtaining gains of 0.35 – 0.50 kg/day for Bali cattle and 0.12 – 0.30 kg/day for Ongole cattle (Anon. 1975). However, when Moran (1978) fed animals a ration having a high nutritive value, he obtained daily gains in Bali, Madura, Grade Ongole, Holstein, Carabao of 0.66, 0.60, 0.75, 0.90, and 0.73 kg, respectively. It appears that farmers could obtain economical gains somewhere between these figures.

Poor farm management, nutritional deficiency and disease appear to cause severe losses in livestock production. In Asia, mortality was reported to be about 10 to 15 percent in young animals and 5 percent in mature animals. Major diseases that are still uncontrolled include foot and mouth, anthrax, brucellosis, haemorrhagic septicaemia, and blood parasites, as well as internal and external parasites.

THE SMALL–HOLDER'S PROBLEMS

Being in a status of equilibrium with the environment, small–holders are not aware of the problems of increasing production, which would necessitate their increased involvement with the problems of capital, breeding and reproduction, feed, and services.

Capital

Money is in short supply for most small–holders, and credit is difficult to obtain, because they do not have the necessary collateral, and are not yet familiar with procedures used by the banking system. Therefore, they easily fall into the grasp of irresponsible money lenders, or they have to market their animals to meet critical economic needs. For example, when there is a shortage of feed, its price increases, thus the small scale swine producers have to sell their animals, since they do not have sufficient cash to purchase the necessary feed to finish their pigs to the desired market weights. Borrowed livestock, for which the profits are divided between the owner and the farmer, are very popular because the farmer can keep the animals with little financial outlay or risk. If credit was easily available at a reasonable rate of interest, farmers could achieve a more reasonable marketing system. In addition, mo re credit availability would allow for the expansion of the herd. However, to increase livestock numbers, two factors have to be considered: 1) the feed supply, and 2) the labor available in the family. However, if either of the inputs is not available, the expansion of a herd will not generate a sufficient amount of additional income to cover the additional expenses and return a fair profit (Kristanto, 1978).

Breeding and Reproduction

Even though the number of male animals is more than adequate for breeding, farmers have difficulty in obtaining the service of good quality bulls for their cows due to scattered locations. Most farmers do not care to own or maintain bulls since the cost is high, and there is no special incentive to keep them. Artificial insemination (A.I.) is available, but the constraints in using A. I. include the fact that inseminators can not reach the cows exhibiting estrus in time to insure a reasonable percentage of conceptions. This is due to the sparse population scattered over a large geographical area. These factors (breeding difficulties, low levels of nutrition and disease) contribute to a reproduction rate that is very low.

Cross breeding programs, in which local breeds are crossed to imported breeds, have merit. However, they will not be accepted by farmers unless the offspring are much better than the ones they already have in terms of their criteria, working ability and gentleness.

Feed

Observations indicate reproduction performance and weight gain are low. Inadequate nutrition is considered to be a major causative factor. A major problem with the native grasses and food crop residues is their low feeding value. This is usually due to their lower contents of crude protein, digestible energy and certain essential minerals. In order to balance diets, the nutrient values of the feedstuff should be known as well as the nutrient requirements of animals. Supplements (protein, mineral, etc.) should be provided to insure that the animals are receiving adequate amounts of all essential nutrients.

Farmers are not able to use large blocks of land to produce feed crops in densely populated areas like Java. Therefore, upright tree type forages are recommended. The provision of common pastures in an over populated area has not been very successful because they are not properly managed and soon become overgrazed. Fluctuation in the feed supply during the year is also a problem. During the latter part of the dry season, land is being prepared for the next planting, during this time feed is usually in short supply. Feed conservation technology, applicable to the conditions of small–holders, as well as low cost feed formulations built around the available crop residues in the village, is needed. This will be possible only after an in–depth nutritive evaluation of the crop residues are obtained and a thorough knowledge of the deficiencies for production–type rations is acquired.

Services

Animal health services are needed by farmers. These are not to be limited to infectious disease eradication, but must also include all factors that cause low production and fertility. One problem in providing services is the difficulty in reaching some villages because of great distances or poor road conditions. Also, the veterinarians are not always equipped with the necessary supplies, equipment, and facilities necessary to accomplish their work. Small–holders should not be expected to pay any fee; therefore, health services must be dependent on government subsidy. Good health services, alone, could bring about a 70 percent savings of the total value of the livestock (Armadilaga 1974).

In order to increase the present knowledge of farmers, extension services are essential. However, without an environment conducive to change, any new technology will not be adopted by farmers (Faber 1979). The farmer should be prepared in advance by the extension service for any changes in the feeding systems, breeding programs, health services, and marketing procedures.

Without access to markets and a favorable input/output ratio, any efforts to increase productivity of the live–stock system will not be successful. Whenever a marketing channel has been created, the farmers will require new production technology to reach a new equilibrium. Therefore, a good livestock program develcped to improve the welfare of all farmers must be based upon an integrated system of economical production and efficient marketing (Lee 1976).

REFERENCES CITED

Anonymous. 1975. Survey Quality Control Proyek PUTP di Nusa Tenggara Barat. Fakultas Peternakan Univ. Gadjah Mada, Yogyakarta.

Anonymous. 1977a. Potential of livestock production in Asia. Asian Livestock II. 6:12.

Anonymous. 1977b. Milk production in Malaysia. Asian Livestock II. 8:6.

Atmadilaga, D. 1974. Prospek Perkembangan Peternakan di Indonesia Ditinjau dari Beberapa Segi Sosial–Ekonomi. Fakultas Peternakan Univ. Gadjah Mada, Yogyakarta.

Eusebio, A. N. 1979. Animal genetic resources in the Philippines. First SABRAO Workshop on Animal Genetic Resources, Tokyo.

Faber, D. C. 1979. Problems and possibilities of introducing appropriate technology. Workshop on Bioconversion of Lignocellulosic and Carbohydrate Residues in Rural Communities sponsored by the United Nation, Univ., Denpasar.

Hardjosoebroto, W., S. P. Atmodjo, Kustono and M. Murdhike. 1979. Base line data on native cattle in the Special District of Yogyakarta (DIY). In: Beef Cattle and Goat Production Report No. 2. Faculty of Animal Husbandry, Gadjah Mada Univ., Yogyakarta.

Harmadji, Ngadiono and G. Sudiono. 1979. Sapi potong betina produktif yang dipotong di RKP dan kemungkinan penanggulan–gannya. Proc. Seminar on Res. and Development of Traditional Husbandry. Animal Husbandry Res. Inst., Bogor.

Javier, E. Q. 1975. Fodder crop in village livestock production systems in Southeast Asia. Inaugural lecture. SEARCA, College, Laguna.

Kingston, D. 1979. The role of scavenging chicken in Indonesia. Proc. 2nd Poultry Science and Industry Seminar. Center for Animal. Res. and Development, Bogor.

Kristanto, Kustiah L. S. 1978. Prospect of developing cattle small–holders in South Sulawesi. A case study in Bone and Pinrang. Ph.D. Diss. Hasanuddin Univ., Ujung Pandang.

Lebdosukojo, S., S. Prijono, R. Utomo and S. Reksohadiprodjo. 1979. Nutrition status of cows Cangkringan and Playan, Yogyakarta, Proc. Seminar Res. and Development of Traditional Husbandry. Animal Husbandry Res. Inst., Bogor.

Lee, C. Y. 1976. Constraints on the development of small farmers idnetified. Asian Livestock 1.2: 1.

Moran, J. D. 1978. Comparative performance of Indonesian beef cattle. Seminar on Ruminant. Center for Res. and Development, Bogor.

Wiguna, M. A., Soekoharto, M., Soegeng, and Kusno. 1979a. Market channels which farmers use in selling livestock. In: Beef cattle and Goat Production Report No. 2. Faculty of Animal Husbandry, Gadjah Mada Univ., Yogyakarta.

Wiguna, M. A., Soekoharto, M. Soegeng, and Winarno. 1979b. The importance of cattle and goat to farmers. In: Beef Cattle and Goat Production Report No. 2. Faculty of Animal Husbandry, Gadjah Mada Univ., Yogyakarta.

Feed Industry and Government Services

A brief discussion of the problems faced by feed manufacturers in production, credit, quality control, and dependable sources of raw ingredients and the role of government in regulating quality standards of feeds offered for sale

THE COMPOUND FEED INDUSTRY: ITS ROLE AND RESPONSIBILITY

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The success attained by the poultry and swine industry of the country is the result of combined efforts not only of feed millers, but of livestock raisers, breeders, pharmaceutical and veterinary products industry, and government.

If we look back at the 1950s, up to the first few years of the 1960s, we can measure the state of the poultry and swine industry by the time it took farmers to raise their livestock to a marketable age.

The project study of the Rizal Economic Development Council premised that chickens take 10 to 12 weeks to grow to a kilo weight and pigs take 12 months to grow to 80–85 kilo market weight.

The feed milling industry existed in the 1950s but it was only in the last few years of the decade when larger capacity feed mills (5 to 10 tons capacity) were set up.

Each enterpreneur entering the business had his own reasons for venturing this investment. From our point of view, the presence of available base material in viable quantity was a crucial factor in the decision. It was at this period when bran and pollard became available with the establishment of the flour milling industry, maize bran and grits became available with the establishment of bigger maize and starch mills. This was also the period when Filipinos started to become major beer consumers.

The characteristics of the material supply during the period of investment vs. the previous period were:

- Availability in quantity within a specified location,
- uniformity of quality, and
- reasonable expectations that quantity and quality can be produced in subsequent periods, thereby allowing for some form of planning.

It may, therefore, be inferred that grain by–product utilization served as a strong base for the industry although immediate concern was shown for the need to develop a complementary protein source for the compound feed industry.

The initial period of marketing compound feeds on a large scale during the 1960s brought the industry face–to–face with the existing realities of the poultry and swine industry. How much value was there to a farmer to have a standard feed compound when it was to be fed to non–standard livestock breeds? How relevant was our capability to supply feeds on a regular basis if the livestock population was uncertain?

Equally disturbing were the variability of livestock management practices and the limited funds available to the livestock raisers.

Responding to this problem, the feed millers had to allocate substantial funds for credit and hired veterinarians to incorporate veterinary and livestock management services in the selling process.

In the promotion area, the millers prepared and disseminated brochures on project management studies both to broaden the information source of existing raisers and to entice new enterpreneurs to the business.

Meanwhile, the government was already performing the task of importing boars and distributing these boars for service in every province. Very little was done on poultry breeds and enterprising livestock farmers, recognizing the need for breeder stocks, moved to import small lots of breeding stock. A major western breeder later introduced a broiler breed.

While this evolution was slowly taking place, the feed mill capital investments were already made and the industry shared in the agony with losses in accounts which could not be collected due to business failures at the farm level.

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The economic losses were substantial enough to force some feed millers to enter the poultry industry in order to ensure an outlet for its products and to expand consumer demand of the farm output via a more competitive product unit cost.

The 1970s, therefore, saw the entry of the major compound feed producers in the business of breed production, initially parent stock and later GP stock. It also saw the entry of the industry into actual poultry and swine production. This was also the decade where the system of contract growing started, fully mechanized poultry dressing plants operated and when the feed millers participated in the marketing process of the poultry and swine industry.

We in the compound feed industry see our role as a catalyst and an instrument in the very important transition process of the industry from the traditional to the modern. This modernization process is ongoing as only a part of the industry has fully modernized.

We also see our role as that of pioneers in studying new ways by which the industry can become more efficient because the 1980s will surely be years of increasing costs of raw material and transportation.

We will continue to strive for the standardization of materials and products and finally, we will take the responsibility to ensure the increased capability of the industry to supply the needs of a population which is growing and improving its standard of living.

We recognize that with the growth of the industry, compound feed milling can no longer depend on by-products but rather on basic grain materials. Right now, researchers are working to obtain the minimum nutrient requirements needed for formulating diets adequate to meet the animals needs.

In order to increase industry capability, there must be greater participation of more entrepreneurial risk-takers, of more farmers, of more fishermen and the invaluable support of government policy.

I believe all industry participants have a joint responsibility to the consuming public to increase the production capability to meet demand through the most efficient production system possible under the existing economic order.

FEED MILLING INDUSTRY IN THE PHILIPPINES

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Feed milling as an industry in the Philippines as in other countries, is vitally linked with the production of swine, poultry, and other livestock, the large–scale raising of which is possible only when good quality mixed feeds are available in sufficient quantities and at reasonable prices.

Feed milling in this country has grown over the past three decades or so hand in hand with the growth of livestock raising to become a multi–million–peso enterprise.

At the forefront of the industry is an eleven–member organization, the Philippine Association of Feed Millers, Inc., or PAFMI for short, which was formed in 1951. The largest of the PAFMI member–firms (San Miguel Corporation, Vitarich Corporation, General Milling Corporation, Universal Robina Corporation, and RFM Corporation) are engaged in integrated operations involving the production, processing and marketing of poultry and livestock. Other organized feed millers' groups include the Central Luzon Feed Millers Association with eleven members.

CREDIT

To meet the financing requirements of their operations, feed millers have to rely on their owners' resources as well as on funds borrowed from the banking and financial systems and the money market. They have to compete with other industrial and commercial enterprises in need– of outside financing, and thus are subject to the uncer–tainties of liquidity in the fund sources and to the instability of interest rates.

Although feed milling is an activity directly involved in food production, it does not as yet enjoy the preferential terms of credit and related incentives extended to, say, poultry, hog and cattle raising projects, which may be integrated in various government–supported financing schemes, and may include cooper tion with international lending organizations.

In cases of large–scale poultry and swine projects, how– ever, government–supported financing would include feed milling operations; but feed milling per se on a commercial basis is not as of now a beneficiary of this form of financial assistance.

PRODUCTION

There were 92 registered commercial mixed feed manu– facturers in the country as of December, 1979 (Table 1). Of this number, 75 are located in Luzon, nine in Visayas and eight in Mindanao.

TABLE 1 Number of Commercial Feed Millers in the Philippines, December, 1979 by Region

	Total	Percent to total	PAF-MI mem-bers	Non-mem-bers
Total Philippines	92	100.0%	10	82
Total Luzon	75	81.5%	9	66
Region I. Ilocos	2	2.2	0	2
Region II. Cagayan Valley	1	1.1	0	1
Region III. Central Luzon	22	23.9	2	20
Region IV. National Central	45	48.9	7	38
Region V. Bicol	5	5.4	0	5
Total Visayas	9	9.8%	1	8
Region VI. Western Visayas	2	2.2	0	2
Region VII. Central Visayas	7	7.6	1	6
Region VIII. Eastern Visayas	0	0.0	0	0
Total Mindanao	8	8.7%	0	8
Region IX. Western Mindanao	1	1.1	0	1
Region X. Northern Mindanao	2	2.2	0	2
Region XI. Southern Mindanao	4	4.3	0	4
Region XII. Central Mindanao	1	1.1	0	1

Source: Bureau of Animal Industry, Animal Feed Registration Division.

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The number of registrants for the purpose of engaging in the feed milling business has generally been increasing since 1971, when there were only 40 commercial feed millers. By 1976, the number had doubled.

The industry turns out seven types of poultry rations, eight types of hog feeds, and feed for cattle, horses, fish, pigeons and rabbits. The ratio of poultry feeds to swine feeds produced in the country, volume–wise, is four to one.(Table 2).

TABLE 2 Annual Production of Total Poultry and Swine Commercial Feeds of PAFMI–Member Companies (1975–1978)

Year	All feeds	Poultry feeds Amount	Poultry feeds %	Hog Feeds Amount	Hog Feeds %
		. . . in metric tons . . .			
1975	583,085	444,240	76.2	138,845	23.8
1976	628,150	485,940	77.4	142,210	22.6
1977	645,510	511,765	79.3	133,745	20.7
1978	703,890	558,445	79.3	145,445	20.7

Source: PAFMI Secretariat; based on information provided by nine PAFMI–member companies.

Commercial poultry feeds are generally manufactured on a standard formulation basis, with very little, if any, custom mixing.

For the four–year period 1975–78, the production volumes of commercial feeds in the Philippines were:

1975: 711,766 metric tons
1976: 781,749 metric tons (9.8 percent increase)
1977: 829,799 metric tons (6.2 percent increase)
1978: 960,656 metric tons (15.8 percent increase)

PAFMI accounted for an average of 78.5 percent of the annual production for this period.

Latest figures show that the Philippines has a total feed milling capacity of 1,714,902 metric tons, based on a 16–hour, 26–day/month labor year, of which PAFMI's share is 794,377 metric tons or 46 percent (Table 3). Actual production output of PAFMI members was 711,365 metric tons in 1978 (Table 4).

According to projections made by the Development Bank of the Philippines for the ten–year period starting 1975, assuming no increase in the number of feed mills in the country up to 1977, existing mills could still provide the feed requirements of livestock and poultry up to 1985 by operating at 95 percent of their aggregate rated capacities instead of the present 70 percent.

The feed millers' contribution to the country's animal production efforts could extend when management techniques improve sufficient to cope with a number of problems besetting the industry, considering that it has the existing and potential capacity to expand production so as to supply the total requirements of the livestock raising industries.

Most serious among these problems is the chronic shortage of reasonably priced feed ingredients, whether coming from abroad or purchased locally. Factors affecting this problem are the domestic scarcity of protein–rich grains and feedstuffs; relatively low productivity and an unreliable supply of locally available feed ingredients; lack of storage facilities throughout the country; and an inadequate domestic shipping fleet for transporting feedgrains and other feedstuffs from the growing areas to the production centers.

Arising from the chronic problem of shortages of raw materials, the industry's high dependence on imports, particularly of protein sources, (Table 5) the generally rising prices of imported as well as locally bought ingredients, (Table 6) and under–utilization of exising capacity.

In addition, the selling prices of mixed feeds are subject to government–set ceilings while raw feed ingredient prices are not. Feed millers, therefore, find it increasingly difficult to keep their gross income within levels that will cover production costs and provide a fair return on investments. The feed millers and the government authorities concerned are nevertheless engaged in a continuing dialogue aimed at seeking effective remedies to the difficulties and problems cited above.

MARKETING

Commercially mixed feeds are sold either directly to animal raisers and retailers or through wholesalers within a dealership network organized by the millers. The bigger companies hire salesmen who make regular inland deliveries to retailers and end–users and occasionally deliver feeds to large–volume buyers.

Shipments are also made by boat from Luzon, where most of the mills are situated, to the various islands of the Visayas and Mindanao. Feed inventories are generally stored in warehouses where wholesalers may withdraw them for delivery to retailers and ultimately to the animal

TABLE 3 Annual Feed Mill Capacity of the Philippines by Regional Location of Mill, 1978[a]

	Total Production Capacity (in metric tons)			Regional Capacity Shares (% of totals)		
	All mills	PAFMI	Non-PAFMI	All mills	PAFMI	Non-PAFMI
Total Philippines	**1,714,902**	**794,457**	**920,525**	**100.0%**	**46.0%**	**54.0%**
Total Luzon	1,441,092	744,457	696,635	84.0%	43.4%	40.6%
Region I. Ilocos	22,460	----	22,460	1.3	0.0	1.3
Region II. Cagayan Valley	----	----	----	0.0	0.0	0.0
Region VIII. Central Luzon	351,620	187,200	164.420	20.5	10.9	9.6
Region IV. National Central	1,052,652	557,257	495,395	61.4	32.5	28.9
Region V. Bicol	14.360	----	14,360	0.8	0.0	0.8
Total Visayas	179,710	49,920	129,790	10.5%	2.9%	7.6%
Region VI. Western Visayas	15,600	----	15,600	0.9	0.0	0.9
Region VII. Central Visayas	164,110	49,920	114,190	9.6	2.9	6.7
Region VIII. Eastern Visayas	----	----	----	0.0	0.0	0.0
Total Mindanao	94,100	----	94,100	5.5%	0.0%	5.5%
Region IX. Western Mindanao	6.240	----	6,240	0.4	0.0	0.4
Region X. Northern Mindanao	2,496	----	2,496	0.1	0.0	0.1
Region XI. Southern Mindanao	10,484	----	10,484	0.6	0.0	0.6
Region XII. Central Mindanao	74,880	----	74,880	4.4	0.0	4.4

[a] Based on 16–hour days/26–days/month.

Source: Ten operating PAFMI members; and Bureau of Animal Industry, Animal Feed Control Division, for non–PAFMI–member figures.

TABLE 4 Annual Production Capacity and Utilization Rates of PAFMI–Member Companies, 1978 (in metric tons)

Company	Production Output	Total Production Capacity[a]	Percent Utilized Capacity[b]	Unused Amount	Capacity (%)
Far East Agricultural Supply Company, Inc.	10,920	31,200	35.0	20,280	65.0
General Milling Corporation	101,060	62.400	162.0	----	0.0
Liberty Flour Mills, Inc.	2,275	9,385	24.2	7,110	75.8
Philippine Feeds Milling Company	6,410	62.400	10.3	55.990	89.7
R F M Corporation	59,815	84,864	70.5	25.049	29.5
San Miguel Poultry and Livestock Feed Plant	257,490	224,640	114.6	----	0.0
Universal Robina Corporation	131, 095	124,640	105.0	----	0.0
Virginia, Inc.	2,310	7,488	30.8	5,178	69.2
Vitarich Corporation	139,990	149,760	93.5	9,770	6.5
Total PAFMI–Member Companies	711,365	756,937	94.0%	123,377	16.3%

[a] Total production capacity figures o' the individual PAFMI members are based on a single 16–hr day/26–days/month labor shift.
[b] Percent utilized capacity exceeds 100% in the following companies since more than one shift was normal during 1978:
– General Milling Corporation .... 1.5 shifts.
– San Miguel Poultry and Livestock Feed Plant .... 1.5 shifts.
– Universal Robina Corporation .... 1.5 shifts.

Source: PAFMI Secretariat; based on information provided by nine PAFMI–member companies.

TABLE 5 Comparative Imported Raw Materials Purchased by PAFMI–Member Companies in 1975 to 1978.

Feed Ingredients	1975	1976	1977	1978
Fish meal	16,100	12,200	8,900	6,500
Meat meal	35,800	30,600	36,800	51,000
Pollard	100	-----	-----	-----
Soybean meal	36,800	59,800	87,700	80,500
Sorghum	14,000	2,300	-----	-----
Yellow maize	83,000	92,500	109,600	102,600
Vitamin supplements	390	500	1,300	1,200
Other ingred.	5,500	7,500	6,400	4,600
Total	191,690	205,400	250,700	246,400

Source: PAFMI Secretariat; based on information provided by nine PAFMI–member companies.

TABLE 6 Comparative Prices of Major Feed Ingredients Paid by PAFMI–Member Companies in 1975 and 1978

Feed Ingredients	1975 Domestic Source (Average Price)	1978 Domestic Source (Average Price)
	. . . pesos per metric ton . . .	
Copra meal	510.00	680.00
Maize bran	790.00	860.00
Fish meal	1,680.00	3,200.00
Ipil–ipil meal	670.00	740.00
Limestone	60.00	100.00
Meat meal	1,650.00	1,900.00
Molasses	270.00	420.00
Pollard	470.00	720.00
Rice bran	710.00	740.00
Salt	380.00	490.00
Soybean meal	1,830.00	2,220.00
Yellow maize	1,100.00	1,140.00
	Imported Source (Average Price)	Imported Source (Average Price)
Fish meal	2,610.00	4,200.00
Meat meal	1,790.00	2,600.00
Soybean meal	1,800.00	2,200.00
Yellow maize	1,150.00	1,160.00

NOTE: The import prices reflect CIF costs.

Source: Based on detailed 12–month purchase statistics provided by nine PAFMI–member companies.

raisers. This is both time–consuming and costly as various charges have to be added to the manufacturers' basic price.

San Miguel Corporation and Universal Robina Corporation, two of the country's biggest feed millers, have established new mills in the Visayas with capacities of 20 metric ton/hour and 7.5 metric ton/hour, respectively, to help provide feed support to livestock enterprises in that region. Vitarich Corporation, another major feed miller, has set up a smaller mill in Davao.

At present, wholesale poultry feed prices range from P82.65 to P105.20 per 50–kg bag, depending on type, while swine feeds are sold at from P78.80 to P90.90 per bag. Corresponding profit margins are allowed to dealers and discounts are granted for volume purchases.

About 90 percent of all feeds produced by commercial millers are delivered in bags. About 10 percent is delivered in bulk mostly to large integrated farms.

Although the feed millers' selling prices for commercial mixed feeds are not formally under government control, a "gentlemen's agreement" entered into by the feed millers and the swine and poultry raisers' associations with the Ministry of Agriculture prohibits them from raising the prices of their products without prior consent from the Ministry.

Continual increases in the prices of fuel oil in recent years have added substantially to the cost of marketing mixed feeds, just as in the case of many other commodities.

FUTURE OF THE INDUSTRY

The future of feed milling in the Philippines is, however, not altogether gloomy. There are several indications that the situation in the years immediately ahead can be much better for the industry than the present.

Maisan 77, a comprehensive feedgrains program launched by the government two years ago, has resulted in reduced importation of yellow maize from about 190,000 metric tons in 1971–72 to only 56,000 metric tons in 1978–79. Self–sufficiency in white maize was attained earlier. The program aims to achieve self–sufficiency in feedgrains by 1980 and to start exporting yellow maize and sorghum to the lucrative markets of Japan, Taiwan and Korea. Through this program, high–yielding varieties of maize have been developed, and it is expected that yields will increase to over three tons per hectare, as compared to the national average yield of .88 ton per hectare in 1977.

The Philippines became self–sufficient in rice in 1975–76 and began exporting the cereal in 1977. This should mean a markedly increased availability of rice by–products at lower prices for use in animal feeds production.

A P426–million soybean processing complex of Phil–Asia Foods Corporation in Batangas province, which is the first large–scale soybean processing center in the ASEAN region, is set to begin commercial production in January, 1981 with an initial capacity of 500 tons per day, 20 percent crude soybean oil and 80 percent soybean meal. The plant will eventually have an output of 1,000 tons daily of which 20 percent will be crude soybean oil, 20 percent soybean meal and 40 percent edible soy products. Considering that soybean meal represents some 30 percent of the composition of swine and poultry feeds, Phil–Asia's operations will greatly alleviate the millers' supply problem regarding this major feed ingredient.

There is also increasing interest in the intensified growing of the ipil–ipil tree, which is widely used in this country for feeding cattle, and also as an ingredient in leaf meal form for swine and poultry feeds.

We in the feed milling industry look forward to brighter days in the near future so that we may be better able to continue contributing to our country's food production program.

SAFEGUARDING OUR FEED USERS

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The importance of feed quality control in the development of a country's livestock and poultry industry can not be over–emphasized. It is axiomatic that without a strong feed control program, the future of animal production in the Philippines would be gloomy and hazardous to any investor in livestock and poultry production. Among the major problems in the production of food of animal origin, poor quality mixed feeds and adulterated feed ingredients stand out as two of the most critical and therefore, deserve our utmost attention. Feed is a crucial factor in successful animal raising for it affects both the performance of animals, as well as the profitability of the business enterprises. About 70 to 80 percent of production costs in livestock and poultry raising can be attributed to feeds alone.

The Bureau of Animal Industry (BAI) through its Animal Feed Control Division oversees the importation, manufacture, distribution, advertising and sale of livestock poultry feeds, feed ingredients and additives.

To effect a rapid growth of the feed milling industry, the government has carried out programs and has taken steps to support feed production. In line with the implementation of Republic Act (R.A.) 1556, otherwise known as the Livestock and Poultry Feeds Act, as amended by Presidential Decree No. 7, a ten–year program has been launched. This program will provide maximum opportunity for the feed milling industry to serve animal raisers. Government agencies like the BAI, UPCVM and UPLB will also backup the program by introducing systems in feed collection and feed analysis. The assistance of the International Bank for Reconstruction and Development (IBRD), popularly known as the World Bank, has been included in this ten–year program to provide the government with feed analysis laboratory facilities for Metro Manila as well as for the various regions of the country. Manpower training and staff development for personnel in the private and public sector of the industry, is a part of this medium–term program.

STATUS OF THE CENTRAL FEED ANALYSIS LABORATORY

With the purchase and installation of three million pesos worth of laboratory equipment and materials (obtained from an IBRD loan under the Second Livestock Development Project), we can be assured of effective and efficient feed control services from our Central Feed Analysis Laboratory in Diliman, Quezon City. Before the end of this year, this laboratory will be capable of analyzing amino acids in protein sources such as soybean oil meal, fish meal, meat and bone meal and ipil–ipil leaf meal collected from commercial feed suppliers or submitted by poultry and swine producers for quality control purposes. We will also be capable of detecting the presence of antibiotic or pesticide residues and mycotoxins (e.g., aflatoxin) in animal feeds. Vitamin assay will be conducted in this laboratory to upgrade the quality of feed supplements being sold in the market.

At present, our Central Feed Analysis Laboratory can handle 100 samples per day for crude protein, 100 samples per day for fat, 50 samples per day for crude fiber, 50 samples per day for moisture, 5 samples per three days for calcium, and 5 samples per three days for phosphorus. Feed microscopy, toxicity, toxicological and microbiological tests for feed quality control purposes can also be conducted in this laboratory.

To maintain good quality feeds and to provide relevant information on animal nutrition and feed information, BAI has set up four regional laboratories with a capacity of more than 15 samples per day. Four more regional feed laboratories are scheduled for completion this year.

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Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

Suppliers of Substandard Feeds Have Been Closed

BAI has tightened supervision of the manufacturers in view of complaints from livestock and poultry raisers about substandard feeds and feed ingredients. Four feed ingredient suppliers were ordered closed by BAI last year for adulteration of products.

Manpower Training and Staff Development

In line with the emphasis to fully develop and improve the livestock and poultry industry, the Fish Meal Manufacturers Association of the Philippines (FIMAP) and BAI jointly sponsored the Third Regional Seminar on Fish Meal Production, Quality Control and Marketing on March 16, 1979 at the Zamboanga Plaza in Zamboanga City. Some 150 fishermen, fish suppliers and driers, fish meal manufacturers, livestock and poultry raisers, agricultural teachers, government planners and technicians attended the day–long seminar.

Research on Feed Substitutes

The increasing demand for and prohibitive cost of commercial feeds is one of the biggest problems of the livestock and poultry industry. The situation has prompted livestock raisers as well as feed millers to look for less expensive but nutritious feed ingredients.

Lately, much interest is focused on Ajinomoto's Fermented Mother Liquor (FML), a by–product from the manufacture of monosodium glutamate (a food additive). In a study conducted jointly by BAI and Union–Hikari Fertilizer Industries, Inc., FML was found to be a good substitute for cane molasses in broiler rations. FML is cheaper by 20 to 30 percent than cane molasses and contains higher percentages of crude protein, minerals and some of the essential amino acids. It also contains sugar to improve the palatability and to provide the necessary energy in the ration.

The new feed substitute is being tested now among layers at the BAI Alabang Stock Farm in Muntinlupa, Metro Manila.

Registration and Licensing Services

BAI maintains a registry of approved importers, feed manufacturers, distributors and retailers together with their registered feed mixtures and/or mashes. There are a total of 246 firms registered with BAI as of May last year; 186 of these are considered mixed–feed producers and 60 mills are feed ingredient manufacturers. Of the 186 mixed–feed producers, 80 mills are operating on a commercial scale while the rest produce for their own consumption.

The provision of a strong regulatory, research and development service for the burgeoning feed milling industry will directly benefit thousands of swine and poultry producers. An improvement in feed quality will result in a more efficient production system, and will likely raise the income of thousands of poultry and swine raisers. Improved efficiency in the production of poultry, eggs and pork will benefit millions of consumers by reducing the per unit cost of production, and this should be reflected in stabilizing or lowering the retail prices of these products.

A strong feed quality control program administered by the government will have a great economic impact, considering the fact that 70 to 80 percent of the cost of producing poultry, eggs, or pork is spent to purchase feed.

THE ROLE OF GRADES AND STANDARDS IN QUALITY CONTROL OF FEED INGREDIENTS AS APPLIED IN THE PHILIPPINES

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SUMMARY

Standardization is the establishment and application of rules in order to regulate activities in a particular field for the benefit and with the participation of all interested parties and, in particular, in order to achieve the greatest possible over–all savings while observing functional and safety requirements. Based on the combined results of science, technology, and practical experience, standardization lays the basis for future as well as present development and must keep pace with progress.

Standardization and quality control are, therefore, indispensable and effective measures in the feed milling industry. Without these measures, this vital industry will never be able to achieve success. Reliable standardization, together with a strong government regulatory agency as well as a strong research and development service, the burgeoning feed milling industry will directly benefit thousands of swine and poultry producers. It will benefit millions of consumers, too, if the prices of poultry, eggs and pork will remain stable, or possibly, go down when efficient production is attained.

Quite recently, the various feed standards were revised by the government and the feed milling industry in order to provide the livestock and poultry producers with a uniform feed quality.

The feed standardization and quality control program will have a great economic impact if we consider the fact that feeds represent 70 to 80 percent of the cost of producing poultry, eggs or pork.

Key Words: standardization, quality control mixed feeds, feed ingredients, feed laboratories and research.

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INTRODUCTION

Man has been endowed with the power, limited though it may be, to achieve order out of chaos. The development of our modern civilization depends greatly on the use of this important faculty, and one of the principal tools enabling man to apply it to the best advantage is the process known as standardization.

It has been said that man is a social being. It is obvious that people live in association with one another. In a very primitive society, one man will do everything for himself, but as communities and societies develop, different types of work, production and service are undertaken by different individuals, and no man remains self–sufficient. Therefore, there must be an interchange of goods and services among men for civilization to be orderly and successful. When goods and services are exchanged, there is a compelling necessity for the parties involved to speak a common language, to agree to criteria by which to judge the value of the goods and services, to agree on the yardsticks by which the criteria are to be measured, and to formulate the methods by which the goods and services will be put into use and be maintained in use.

The Advantages of Standardization

Standardization can be defined as the establishment and application of rules in order to regulate activities in a particular field for the benefit and with the participation of all interested parties and, in particular, in order to achieve the greatest possible overall savings while observing functional and safety requirements.

It is based on the combined results of science, technolgy and practical experience. It lays the basis for future as well as present development and must keep pace with progress.

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The possible benefits of standardization and its influence on the economy are limitless. Some advantages are:

To consumers –

Assurance of quality.

Marks of identification enable consumers to buy the product again and again or avoid purchasing them in the future.

Standards are commonly set in accord with the needs of the buyers, thus minimizing wasteful spending.

To producers and manufacturers –

Stabilizes production and employment.

Eliminates indecision both in production and utilization.

The study of needs has influenced manufacturers to change their products to conform to requirements and has influenced growers of farm products to plan their production.

To traders –

Reduce costs.

The reasons for sampling, inspection, classifying and grading is to prepare goods so that a common standardized nomenclature can be utilized in bringing about an understanding between seller and buyer.

To commerce and industry –

Promotion of fair dealing in domestic and foreign trade.

Joint efforts for standardization within and between industries leads to better understanding and to cooperation towards the integration of industry.

Creation of a rational basis of understanding in countries.

Feed Standardization and Quality Control

We can readily see that standardization and quality control are indispensable and effective measures in the feed milling industry. Without these measures, this vital industry will never be able to achieve progress. The provision for a reliable standardization program, together with a strong research and development service, for an expanding feed milling industry will directly benefit thousands of swine and poultry producers. An improvement in feed quality will result in efficient production, and will likely raise the income of thousands of poultry and swine raisers. It will benefit millions of consumers, too, if the prices of poultry, eggs and pork remain stable or goes down when efficient production is attained.

The Bureau of Animal Industry (BAI) is the main government agency that implements policies, rules and regulations regarding animal feed standardization and production. They act on the recommendations of the Animal Feed Control Advisory Committee. Through its Feed Control Division, BAI oversees the importation, manufacture, distribution, advertising and sale of livestock and poultry feeds, feed ingredients and additives.

Quite recently, the various feed standards were revised by the government and the feed milling industry with the intention of providing livestock and poultry users with uniform quality feeds. Tables 1–4 show the nutrient standards of various classes of livestock and poultry. As can be seen, the measures of quality are crude protein, crude fiber, crude fat and moisture. These can be determined through chemical analysis. Although the proximate analysis does not define the nutrient content of feeds, it can be used as an index of nutritive value because the fractions that it determines are correlated with some of the properties of feeds that have nutritional significance.

In these nutrient standards imposed by BAI, the various types of feeds are named according to the different stages of growth of the animal to which it is being fed.

Let us take a look, for instance, at swine feeds. A starter mash is made available for pigs 2–4 weeks old and a weanling mash is fed to 5–8 week old pigs. Young pigs require a high protein diet to improve their growth performance. It should be noted that a minimum level of 22 percent protein is recommended for pigs of 2–4 weeks of age. As the pigs grow, their nutrient requirements shift from high–protein to high–energy levels. Hence, a seven–month old pig requires a feed containing a minimum of 13 percent protein. At the same time, the energy (fat) content may far exceed the 4 percent minimum set by BAI.

Lactating and gestating swine require special feeding to reduce embryo mortality and to assure the birth of healthy young pigs. Minimum crude protein levels have been set at 15 percent and 14 percent in feeds fed to lactating and gestating sows, respectively.

Poultry feeds, on the other hand, do not vary significantly from swine feeds in terms of the ingredients or raw materials used. Only the formulation is changed to meet the minimum nutrient requirements of the different types of birds.

There are two basic types of poultry feeds. One type is fed to broilers or chickens reared for meat purposes. Broiler feeds are further subdivided into broiler starter and broiler finisher mashes. As the name implies, a

TABLE 1 Nutrient Standards for Poultry Feeds

Kinds of Feeds	Crude protein NLT[a] (%)	Crude fiber NMT[b] (%)	Crude fat NLT[a] (%)	Moisture NMT[b] (%)	Ash NMT[b] (%)	Mineral NMT[b] (%)
For–broilers (meat–type chickens):						
Broiler starter mash/crumble/pellet	21	8	4	13	To be supplied by the feed manu–facturer	If more than 5% the maxi–mum per–centage of calcium or (Ca) or phosphorus (P) shall be indicated
Broiler finisher mash/crumble/pellet	18	9	4	13		
For egg–type chickens:						
Chick starter mash/crumble/pellet	19	8	4	13		
Chicken grower mash/crumble/pellet	16	10	4	13		
Chicken layer mash/crumble/pellet no. 1	18	10	4	13		
Chicken layer mash/crumble/pellet no. 2	16	10	4	13		
Pigeon feeds pellet	18	10	4	13		
For Turkeys:						
Turkey starter mash/crumble/pellet	28	8	4	13		
Turkey grower mash/crumble/pellet no. 1	20	10	4	13		
Turkey grower mash/crumble/pellet no. 2	16	10	4	13		
Turkey breeding mash/pellet	15	10	4	13		
For Ducks:						
Duck starter mash/crumble/pellet	19	8	4	13		
Duck grower mash/crumble/pellet	16	10	4	13		
Duck layer breeder mash/crumble/pellet	16	10	4	13		
Duck finisher/crumble/pellet	16	10	4	13		

[a] NLT = Not less than
[b] NMT = Not more than

TABLE 2 Nutrient Standards for Bovine and Bubaline Feeds (Cattle – Buffalo – Carabao)

Kinds of Feeds	Crude protein NLT[a] (%)	Crude fiber NMT[b] (%)	Crude fat NLT[a] (%)	Mositure NMT[b] (%)	Ash NMT[b] (%)	Mineral NMT[b] (%)
Milk replacer	20	6	4	13	To be supplied by the feed manu–facturer	If more than 5% the maxi–mum per–centage of calcium (Ca) or phosphorus (P) shall be indi–cated
Calf starter mash/crumble/pellet	18	6	4	13		
Dairy concentrate mash/crumble/pellet	16	---	4	13		
Beef concentrate mash/crumble/pellet	13	---	4	13		

[a] NLT = Not less than
[b] NMT = Not more than

TABLE 3 Nutrient Standards for Equine Feeds

Kinds of Feeds	Crude protein NLT[a] (%)	Crude fiber NMT[b] (%)	Crude fat NLT[a] (%)	Moisture NMT[b] (%)	Ash NMT[b] (%)	Mineral NMT[b] (%)
Race horse feed mash/crumble/pellet	13	---	4	13	To be supplied by the feed manu–facturer	If more than 5% the maxi–mum per–centage of calcium (Ca) or phosphorus (P) shall be indi–cated
Draft horse feed mash/crumble/pellet	13	---	4	13		
Range horse feed mash/crumble/pellet	13	---	4	13		

[a] NLT = Not less than
[b] NMT = Not more than

TABLE 4 Nutrient Standards for Swine Feeds

Kinds of Feeds	Crude protein NLT[a] (%)	Crude fiber NMT[b] (%)	Crude fat NLT[a] (%)	Moisture NMT[b] (%)	Ash NMT[b] (%)	Mineral NMT[b] (%)
Pig pre–starter mash/crumble/pellet	22	5	4	13	To be supplied by the feed manu–facturer	If more than 5% the maxi–mum per–centage of calcium (Ca) or phosphorus (P) shall be indicated
Pig starter mash/crumble/pellet	18	8	4	13		
Pig grower mash/crumble/pellet	16	10	4	13		
Pig breeder mash/crumble/pellet	14	12	4	13		
Pig lactating mash/crumble/pellet	15	10	4	13		
Pig fattener–finisher mash/crumble/pellet	13	10	4	13		

[a] NLT = Not less than
[b] NMT = Not more than

broiler starter is given to chicks of up to four weeks of age. Based on BAI standards, a broiler starter should have a minimum crude protein content of 21 percent. On the other hand, the broiler finisher which is fed to broiler chickens more than four weeks old should contain at least 18 percent protein.

Of all the measures indicated in the above tables, the most useful is the standard on percentage of moisture allowed. A high level of moisture (more than 13 percent) in the diet not only reduces the quality of the feed mixture but may also induce the growth of harmful organisms, particularly molds and other pathogenic bacteria.

It is a fact, that feed manufacturers cannot mix good quality feed products if the quality of raw materials or if the ingredients are of poor quality. Computer people have a phrase, actually an acronym, 'GIGO . . . Garbage in, garbage out!" If one puts substandard ingredients into a mixer, substandard mixed feeds will be the result. To upgrade the quality of animal feeds, BAI has therefore, issued Animal Industry Administrative Order No. 40, series of 1976, setting forth rules and regulations governing the quality standards of commercial feed ingredients.

Article I of the order defines the terms used in the manufacture and distribution of feed ingredients. Based on their nutrient sources, Article II classifies feed ingredients into energy, protein and mineral sources. Energy feeds are concentrates with less than 20 percent crude protein while protein feeds are those concentrates containing 20 percent or more crude protein.

Examples of feeds classified as energy sources are brown rice, camote meal, rice bran, sugar, vegetable fat, and ground grain sorghum.

Protein sources include blood meal, fish meal, ipil–ipil leaf meal, peanut oil meal, and copra meal. Bone meal, calcium carbonate, oyster shell powder, and sodium chloride are examples of mineral sources.

Order no. 40 lists quality standards of commercial feed ingredients as well as the minimum nutrient requirements for the different classifications of feed ingredients.

The labeling provisions of the Livestock and Poultry Feeds Act (Republic Act No. 1556, as amended by Presidential Decree No. 7) require that any container or package of feed or feed ingredient shall be conspicuously labeled, giving the brand or trademark of the feed or feed ingredient, the name and address of its manufacturer or importer, its weight (metric), a complete list of its ingredients (for mixed feeds), a guarantee that the contents are pure and unadulterated, and the percentages of crude protein, crude fat, crude fiber, moisture, ash and minerals (calcium and phosphorus). When the feed or feed ingredient is sold in bulk, this information must be furnished to the purchaser on a printed card or on the invoice.

Regulations also require special cautionary labels for feeds containing urea and ammonium salts (permitted in feeds for ruminants only), medicated feeds, and feeds containing hormones. These cautionary labels must include such information as the species and age of animals for which the feed is intended, the time before slaughter when a feed is withdrawn, and similar instructions based on research and recommendations from the government regulatory and research agencies.

By enforcing the use of these feed standardization and labeling requirements, the regulatory service can assure the quality of mixed feeds and feed ingredients in the market. The aforementioned order can be a handy guide in determining whether or not a certain ingredient used in the manufacture of animal feeds is of good quality.

Feed Laboratories, A Vital Support to Standardization

With increasing competition, demands for quality feed and government regulations and inspection, quality control and standardization must be reviewed from time to time. New procedures, new ingredients and new drugs require constant review and revision of control measures to assure that feed will perform as expected. Hence, the need for the establishment of feed analysis laboratories –– both for the government regulatory agencies and private feed mills.

BAI, with the assistance of the International Bank for Reconstruction and Development (IBRD), has expanded its Central Feed Analysis Laboratory in Diliman, Quezon City, to a capacity of 100 samples per day. Also, there are four regional feed laboratories to provide relevant information on animal nutrition and feed formulation for the rural areas. These laboratories are a great asset not only to livestock raising, but also in the field of feed standardization. We are now in the process of drawing up standard methods to analyze mixed feeds and feed ingredients and to establish permitted analytical variations (PAV) in the chemical analyses of commercial mixed feeds and feed ingredients. We are being assisted in this vital undertaking by the private feed laboratories.

Research is constantly bringing to light new materials, new practices, new discoveries. Regulations on standardization and quality control must not hamper progress, but they must be based on sound, impartial scientific research. In the first flash of enthusiasm for new discoveries, farmers and the feed industry sometimes ask for changes to be made that have not been adequately tested in all their aspects. But the regulatory bodies and control officials are guided by the cautious hand of science because their first obligation is to safeguard the feed users.

THE APPLICATION OF RESEARCH KNOWLEDGE THROUGH EXTENSION WORK

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SUMMARY

The salient areas of knowledge arising from research in the fields of feeds, nutrition, and production of livestock are briefly reviewed. Different factors involved in translating this knowledge for the farmers acceptance and utilization are discussed. Particular emphasis is given to various types of extension communication. Some problems in the extension channel are identified, (e.g., packaging the research results, educating and training extension practitioners, effective communication and information dissemination, background of the target group, and socio-economic relevance).

Key Words: research, application, extension

INTRODUCTION

Initially research referred to a search for academic truth whether for the proof of an assumed hypothesis or as an answer to the fallacy of a dogma or principle. Gradually, the investigative approach made increased use of the experimental method in the search for truth in the expanding horizon of man's relation with his environment. The impulse for environmental activity and relationship encompass such areas as biology, health, sociology, economics, food, human ecology, water resources, energy needs, etc.

At no time has research been given its due recognition more than in this present century of human survival when we hear about population growth, dwindling international food reserves, and escalating costs for goods and services.

The need to increase food production and various developmental programs especially aimed at improving the standard of living of the rural poor requires immediate attention.

Mankind has continuously benefited from the results of research in various disciplines affecting his existence, and research continues to supply man with a continuous stream of knowledge from which he can find answers to his questions now and in the future.

RESEARCH IN THE SCIENCES OF ANIMAL PRODUCTION

As a result of the continuing demand that all mankind be supplied with food of sufficient quantity and quality, scientific investigations have been undertaken, that are aimed at increased productivity through genetic improvement, improved cultural practices, better management and care, control of pests and diseases, improved technology in processing, utilization and preservation, and in other ways. These approaches apply to both animal and plant food resources.

The different disciplines in animal production contributed to the mass of reserach data available through the years. These data respresent experimental results and studies that can lead to improved livestock and poultry production through the use of improved breeds, better nutrition, successful control and prevention of livestock pests and diseases, and efficient farm management practices.

Within the context of the theme of this workshop, it is relevant to examine some of the fruits of research on feedstuffs and the feeding of livestock in different countries in the Southeast Asian region, a few of which may be listed under the following categories:

- Formulation of least cost rations for swine and poultry.

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Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

- Utilization of agro–industrial by–products for animal feeding.

- Treatment of rice straw to enhance its feeding value for ruminants.

- Varietal improvement in cereal crops like maize, sorghum, and soybean.

- Studies on toxicity and detoxification of some feedstuffs.

- Studies on the improvement of the "shelf life" of some unstable feedstuffs.

- Propagation of local and exogenous plants for imported feedstuffs substitution.

- Analysis and feeding trials using indigenous plants and feedstuffs like roots, tubers, vines and pulses.

- Propagation and utilization of non–conventional plants with potential feeding values like the wingbean.

- Agronomic studies on forage crops and pasture improvement.

- Improved systems of management, breeding and feeding.

- Economical production of milk, meat, and eggs.

A mass of technical knowledge on various aspects of animal production which can be used for extension work is available. As exemplified by the preceding list, this may involve the introduction of new technology or the adoption of a package of technology. Successful adoption of this technology however, requires the development of a distinct approach and not merely the dissemination of information about the new technology.

EXTENSION APPROACH

In bringing the research knowledge to the end–user or the farmer for his benefit, four elements are of major concern: 1) what to extend, 2) who will extend, 3) how to extend, and 4) to whom to extend.

Research should be regarded as the fountain of ideas and results that can be harnessed to promote the agricultural development of any country in fulfilling the national requirements for food, particularly the protein–rich varieties, ensuring an additional income to the rural population, and increasing employment opportunities in general. For research to be useful for extension, it must be coordinated with government programs to fulfill the national needs. These programs should be developed and implemented with the knowledge and support of the industry and/or the end–user.

The extension aspect of agricultural development should maintain communication between researchers, the government, and the farmers. The pivotal contact in this channel is the extension worker who should act as the listening post for the policy–makers and the researchers in identifying the problems, the needs, and the goals of the farmer producer. It should be noted that a system must be properly organized to serve the rural farmers who have to be advised and encouraged to undertake various aspects of production in line with the program of development. The extension worker must develop the ability to guide rural farm families in developing the skills to become self–sufficient by helping them to adopt the desired attitudes and to establish goals and long–term objectives. These tasks call for credibility on the part of the extension worker.

Training of program implementors, supervisors and technicians, including those already in extension service, must be given special consideration. Perhaps not all officers from the administrator downward have sufficient knowledge of extension methodology and the expertise to transfer this information down to the farmer. In–service training should be required for all officers, including those of the higher level as well as those who will be assigned as farm technicians. Extension education, principles, and techniques (covering both crop and livestock production) should be included in all training programs. Ideally, in animal and veterinary science courses, adequate time must be alloted for extension education.

One problem with extension agents that may be common in a number of countries, is the inability of some workers to communicate both literally and technically with the people at the village level. This may hinder their acceptance by the public amongst whom they have to work. One solution to this is to develop a broad based pyramidal organization with large numbers of trained village workers who actually come from their base village. The top portion of the pyramid should include professional personnel who have been trained and who have a desire and an aptitude for work in the rural farming areas.

The usual practices employed by extension workers are farm visits, seminars, farmers' meetings, method or result demonstrations, and mass communications. The farm visits take the form of dialogue with the farmers/end–users or groups of farmers. The same is true in the case of seminars and farmers' meetings, which usually include lectures, problem discussions and solutions. Techniques, methods, and results of experiments or new technology can be demonstrated in the farm communities or at experimental/demonstration centers located at research stations, government farms and colleges. Seminars, lectures, meetings and workshops should include the use of visual aids. The usual communication media employed are radio, television, and printed information.

The preparation of extension information assumes importance if we consider its relevance to the processing of research knowledge so that it can be easily understood by extension personnel and be readily applied by the farmer/end–user. If research results are to be spread effectively the following should be considered:

- The research write–up should be suitable to the medium of dissemination.
- The knowledge resulting from research should be translated into simple language, avoiding technical terms as much as possib .
- Releases for TV coverage should be accompanied with comprehensible visual support.
- The interpretation of the results of reserach to service the media can best be aided by subject matter specialists.
- Lines of communication between researchers and media must be maintained.
- The media personnel and the extension worker documentation service should be accessible to researchers thereby shortening the time lag before the results of research can be applied by the farmer.

The target audience for the transmittal of research benefits and adoption of the improved technology is composed of two groups, the organized industrial concern and the single farmer–producer. Usually, no difficulty is encountered in the delivery of extension technology to organized industry. Many factors, however, may be encountered in successfully transmitting the information to the small–holder. Important among these is each farmer's cultural background and his traditional set–up. The extension mechanism should be geared to work through extension service workers supported by sufficient local barrio or village workers. Efforts should preferably concentrate on groups rather than with individuals, or through farmers' associations, cooperatives and other units involved in spreading extension information horizontally at the village level. Of course, the other alternative is to work through the media.

SOCIO–ECONOMIC RELEVANCE OF RESEARCH AND EXTENSION

Undoubtedly, research results benefit the farmer/end–user not only as a direct impact on solving principal problems of his farm productivity, but also by minimizing the ill–effects of unexpected changes in his environment. An example is the introduction of the cultivation of *Leucaena leucocephala*, which provided not only a valuable feed ingredient that increases the feed supply and reduces the dependency on imports, but later proved to be useful as a dendro–thermal source of energy in our search for a supply of energy from nonconventional sources.

But there is always the problem of overemphasizing research for technological development while ignoring sociological problems. Research should not be under–taken for the sake of satisfying the whims and inquisitive–ness of the research investigator, but for the benefit of the community and mankind.

The rural population should be encouraged to transform their farm holdings into an integrated crop and livestock production system, as well as incorporating other practices into the system, thereby increasing the income level at all segments of the agricultural community. As a develop–mental strategy, strengthening the training and education of farmers through vocational and non–formal training programs as well as through support for an effective and adequately constituted extension service with in–depth penetration to the barrio/barangay (village) level should have top priority. This would motivate the farmers to accept new ventures and practices implementing those into their production systems.

The focus of these approaches should be the small farmers. It is note–worthy to take stock of what Dr. D. L. Umali, Assistant Director–General and Regional Representative of FAO for Asia and the Far East stated at the 12th FAO Regional Conference for Asia and the Far East at Tokyo in September 1974. "FAO is currently trying to evolve a new development strategy in which the great mass of small farmers, peasants, and landless farm workers can be viewed as human capital. This we have in abundance as assets of the poorer countries for development. What is needed is an effective way of liberating their enthusiasm, energy and creativity. This can be done by a small farmer action program implemented through the grass–root groups in the villages, thereby providing opportunity for involvement to the low–income small farmer and landless laborers in the planning and implementation process, developing a sense of comm–unity and thus acquiring a sense of identification with and accountability to their own program."

Special Reports

These reports emphasize the general need for mineral supplementation and major problems that must be overcome for efficient animal production

MINERAL DEFICIENCIES AND TOXICITIES FOR GRAZING RUMINANTS IN THE TROPICS

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SUMMARY

In tropical countries, mineral imbalances are a major limitation to ruminant livestock production. Often grazing livestock do not receive mineral supplementation and must depend largely upon forages to supply their requirements. Only rarely, however, can forages completely satisfy all of the mineral requirements. Borderline or deficient levels of certain elements were noted for many forages in the 1974 Latin American Tables of Feed Composition: Co, 43 percent; Cu, 47 percent; Mg, 35 percent; P, 73 percent; Na, 60 percent; and Zn, 75 percent. The most widespread mineral deficiency for livestock is that of P. Twelve reports from tropical countries illustrate the dramatic increase in calving percentage when breeding cattle were supplemented with P. Copper and Co deficient areas are widespread in tropical countries. Mineral deficiencies are often more prevalent during the wet season.

The University of Florida, with assistance of a grant from the United States Agency for International Development, is cooperating with Latin American, Asian and African institutions to initiate and establish mineral research. A systematic mapping technique, based on animal tissue and forage concentrations, can be employed to predict where mineral deficiencies or toxicities will occur. Data from research in Brazil indicate that positive correlations among soil and forage mineral concentrations for Mg, Cu, Fe, Mn, Na, Mo, and Zn were low or nonexistent. Attempts to raise livestock productivity in tropical countries will be unsuccessful unless the nutritional environment, including adequate mineral nutrition, is likewise elevated. Mineral supplementation is a least cost input to improvement of livestock production.

INTRODUCTION

Undernutrition is commonly accepted to be the most important limitation to ruminant livestock production in tropical countries. For grazing livestock, forages are, and will continue to be, the major source of the essential nutrients of energy, proteins, vitamins and minerals. The present discussion will be mainly limited to minerals. Where possible, mineral research in tropical Asian countries will be noted. Nevertheless, research data from Latin America will be emphasized since only a small amount of mineral research has been carried out in Asia.

VITAMINS

Because of microbial synthesis and normal abundance in plants, only vitamin A of the vitamins is generally considered important as a dietary component for grazing livestock. Vitamin E, under conditions of low selenium intake, can sometimes be important since it is known to have a sparing effect on the requirement of this mineral.

Vitamin A deficiency occurs only when grazing animals have to exist on mature, dry herbage for long periods, or in intensive dry seasons, since the green plant provides abundant carotene and enables large amounts of vitamin A to be stored in the body. The important question that remains unanswered is how long this vitamin A storage will last when animals graze poor quality forage inadequate in carotene. Geographical locations where vitamin A deficiency might be expected would therefore, be regions where there are extensive dry seasons. Many tropical regions in Africa, Asia and Latin America routinely have dry seasons of six months or longer in duration. Under conditions in India, it has been reported (Ray 1963) that fair grazing is possible for only three months of the year. With the cessation of the monsoon rains, the grasses mature rapidly, with a large drop in carotene content. The value has been found to decrease from 100–200 mg per kg on dry matter basis in mid–rainy season to as low as 0.5 to 1 mg per kg in the summer months. As a result, symptoms like night blindness, blindness in newborn calves and birth of weak calves have been reported from all parts of India.

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ENERGY-PROTEIN DEFICIENCIES IN RUMINANTS

Many instances of energy and protein deficiency arise from the poor quality herbage which, unfortunately, is often the only feed available to ruminants during a long dry season. The availability of energy and protein, as measured by their apparent digestion by sheep and cattle, declines rapidly with advancing maturity (Butterworth 1967). As they advance beyond a few weeks growth, most tropical forages have a characteristically high lignin content, which influences both digestibility and the amount the animals will eat. Lignin must be considered as the primary structural inhibitor of quality in tropical grasses within a given species (Moore and Mott 1973). These researchers noted that tropical forages have a lower maximum intake and digestibility, and this may be due to higher cell wall contents (CWC) in tropical forages than in temperate forages at comparable stages of growth.

Low digestible energy and protein content of the diet imposes a severe physical restriction on the amount of feed an animal is able to consume. Data by Smith (1962) from mature *Hyparrhenia* pasture showed that *Bos indicus* steers ate dry matter equivalent to 1.2 percent of their body weight when the herbage contained 50 percent digestible organic matter (DOM) but, as the dry season progressed, intake of forage fell to 0.8 percent of body weight when DOM dropped to 38 percent.

Many publications have supported the conclusion that tropical grasses are inherently of low quality in comparison to temperate grasses. Crude protein is often the main limiting nutrient for livestock in the tropics, with approximately seven percent crude protein as the minimum level required for positive nitrogen balance in mature grazing animals (Milford and Haydock 1965). Cohen (1975) notes that tropical forages are largely devoid of legumes and have a low crude protein content, a factor which is almost invariably associated with low organic matter digestibility. Additions of legumes to a grass pasture improves the quality of the feed, especially during the dry season when the protein content in mature grass (standing hay) is extremely low. Even a small percentage of legume in the sward increases roughage intake by cattle.

The most devastating economic consequence of energy and/or protein deficiency in the lactating cow is frequently a failure to conceive during the normal breeding season, which coincides approximately with the third month of lactation. Ward (1968) has shown that, with few exceptions, lactating cows do not calve two years in succession under Zimbabwe conditions. Young (1968) observed the same type of calving histories on native pastures in northern Australia. The effects of lactation on pregnancy were striking in the llanos of Colombia (Stonaker 1975) where only 9 to 13 percent of the nursing cows and heifers were pregnant versus 51 to 54 percent of the dry cows and heifers in the 40 llanos farms studied.

MINERALS

Mineral disorders, including deficiencies, toxicities and imbalances, are severely inhibiting the livestock industries of many countries. At least 15 mineral elements, including calcium (Ca), chlorine (Cl), magnesium (Mg), phosphorus (P), potassium (K), sodium (Na), sulfur (S), cobalt (Co), copper (Cu), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se) and zinc (Zn), are nutritionally essential for ruminants. In specific areas toxic concentrations of Cu, fluorine (F), Mn, Mo or Se limit grazing livestock production. Additional toxic elements (arsenic, lead, cadmium, mercury and aluminum) for ruminants, as well as the possible significance of newly discovered essential elements (chromium, vanadium, nickel, tin and silicon), have been reviewed (McDowell et. al. 1978b)

Factors Influencing Mineral Requirements

Many factors affect mineral requirements, including nature and level of production, age, level and chemical form of elements, interrelationship with other nutrients, mineral intake, breed and animal adaptation. Mineral requirements are highly dependent on the level of productivity (NRC 1976; NRC 1978). As an example, a young pregnant beef cow during her first lactation would have substantially higher mineral requirements than a mature, dry cow, since the former would still be growing and also producing milk and a fetus. Improved management practices that lead to improved milk production and growth rates for livestock will necessitate greater attention to mineral nutrition. Mineral deficiencies perhaps only marginal up to this time are likely to become of importance, and previously unsuspected nutritional deficiency signs may occur as production level increases (Long et al. 1969; Thorton et al. 1969).

Specific mineral requirements are difficult to pinpoint since exact needs are dependent on chemical form and numerous mineral interrelationships. The chemical form of mineral elements varies greatly in the amount of dietary miner[illegible]ed and in biological availability (Ammerman and Miller 1972). Examples of the numerous mineral interrelationships which affect requirements include Ca–P, Ca–Zn, Cu–Mo, Cu–Fe, Se–As, Se–S, Fe–P, Na–K, and Mg–K. Under practical conditions in swine, Zn deficiency might not have been discovered had it not been for the excessive Ca that was included in the diets. In addition to mineral interrelationships, vitamins D, E, and B_{12}, goitrogenic substances, and chelates such as oxalic acid and phytic acid each influence specific mineral requirements.

Adequate intake of forage by cattle is essential in meeting mineral requirements. Factors which greatly reduce forage intake, such as low protein content (< 7.0%) and increased maturity, lignification, and stem to leaf ratios, likewise reduce the total minerals consumed.

On the basis of low tropical forage mineral concentrations during the dry season, it is logical to assume that cattle would most likely suffer mineral inadequacies during this time. On the contrary, many world reports, including those of Kenya (Hudson 1944), Brazil (Correa 1957), and the Union of South Africa (Van Niekerk 1975), noted specific mineral deficiencies more prevalent during the wet season. Grazing cattle were more prone to develop Co or P deficiencies, and the clinical signs were severest after the rains, when pastures were green and plentiful. From Africa, Van Niekerk, (1975) noted that the beneficial effect of P was entirely during the wet season, although the P content of the grass is at its highest during this time. In Colombia, large growth responses were obtained by complete mineral supplementation, but only during the rainy season (CIAT 1973). Increased incidence of mineral deficiencies during the wet season is less related to forage mineral concentrations than to the greatly increased requirements for these elements by the grazing animal. During the wet season, livestock gain weight rapidly since energy and protein supplies are adequate. Associated with rapid growth during the wet season, mineral requirements are high, while during the dry season, inadequate protein and energy result in animals losing weight, thereby greatly limiting mineral requirements.

There are notable exceptions as to the season of the year when mineral supplementation is most critical. In the wet llanos of Venezuela, northern Colombia and Bolivia, as the water recedes in the dry season, cattle enter the lowlands to graze a great variety of plant species. For this reason, breeding and calving in these areas are more frequent during the dry season than in the rainy season (Stonaker et al. 1974). Under these conditions, incidences of mineral deficiencies would not be expected to be more prevalent during the wet season. Van Niekerk (1977) reported incidence of Zn deficiency for grazing cattle in South Africa during the dry, but not the wet, season.

Data from two regions of Thailand suggest the dry season as the time of greatest response to mineral supplements. In Central Thailand (Tumwasorn et al. 1980) during the wet season, cattle are limited to small areas due to the rice planting period. However, during the dry season, cattle have much greater access to forages and by–products. In Northern Thailand (Falvey 1980) toward the end of the dry season, forage burning is practiced, with subsequent regrowth due to adequate soil moisture. Thus, energy and protein supplies become adequate, following poor forage quality, and minerals now become the critical limitation. Therefore, from both regions, even though minerals are most required in the dry season, the requirements are once again related to adequacy of energy and protein supplies.

Important differences in mineral metabolism can be attributed to livestock breed adaptation. The effect of breed differences on mineral requirements has often been observed in livestock (Phillips 1956; Correa 1957; Weiner and Field 1969). In Brazil, *Bos indicus* exhibited clinical Co deficiencies when fed forage containing 0.08 ppm, while *Bos taurus* were not affected until the Co level dropped to 0.05 ppm or lower (Correa 1957). It is not unusual for imported livestock to show deficiency signs, while indigenous breeds that are slow–growing and late–maturing do not exhibit the deficiencies to the same degree (Allman and Hamilton 1949). Payne (1966) suggests the possibility that unacclimatized cattle of the temperature type that sweat profusely and lose saliva and mucus from the mouth may lose significant quantities of minerals, particularly in the arid tropics.

Factors Affecting Forage Mineral Content

Forage mineral concentrations are greatly affected by soil types, plant species, stage of maturity, yield, pasture management and climate. Most naturally occurring mineral deficiencies in cattle are associated with specific regions and are directly related to soil characteristics. The content of an element in soil would seem the most important. However, availability factors, including soil pH, texture, moisture content and organic matter are often more limiting than soil content. As soil pH increases, the availability and uptake of Fe, Mn, Zn, Cu, and Co decreases, whereas Mo and Se concentration increase (Williams 1963; Miller et al. 1972).

Large variations in mineral content of different plant species growing on the same soil have been reported. It is a generally accepted view that herbs and legumes are richer in a number of mineral elements than are grasses (Fleming 1973). For most minerals, "accumulator" plants exist which contain extremely high levels of a specific mineral (Schutte 1964). As plants mature, mineral contents decline due to a natural dilution process (Fleming 1973) and translocation of nutrients to the root system (Tergas and Blue 1971). In most circumstances, P, K, Mg, Na, Cl, Cu, Co, Fe, Zn, and Mo decline as the plant matures (Underwood 1966; Gomide et al. 1969).

Climate, forage management and yield influence plant mineral composition. Cattle grazing pressures will influence the species of forage predominating and also change the leaf/stem ratio radically, thereby having a direct bearing on the mineral content of the sward. Increasing crop yields remove minerals from the soil at a faster rate so deficiencies are frequently found on the most progressive farms (Schutte 1964). Overuse of N and K fertilizers increases the incidence of grass tetany (Kemp et al. 1961), with K also dramatically reducing forage Na content in plants (Underwood 1966).

Sources of Minerals to Grazing Livestock

With the possible exception of salt, many producers in tropical countries do not supplement livestock with minerals. Thus, livestock depend largely upon forages to supply their mineral requirements. However, only rarely can forages completely satisfy each of the mineral requirements for grazing animals. Table 1 summarizes the mineral concentrations of 2615 Latin American forages (McDowell et al. 1974). Borderline or deficient levels of certain elements were noted for many entries: Co, 43 percent; Cu, 47 percent; Mg, 35 percent; P, 73 percent; Na, 60 percent; and Zn, 75 percent.

Livestock obtain some minerals from water and soil. Although highly variable, all mineral elements essential as dietary nutrients occur to some extent in water. Animals sometimes consume appreciable amounts of soil, but this is also highly variable. From New Zealand, annual ingestion of soil reached 75 kg for sheep and 600 kg for dairy animals (Healy 1974).

TABLE 1 Mineral Breakdown and Concentrations of 2615 Latin American Forages (Dry Basis)[a]

Element	Percentage of forages with entries[b]	No. of entries	Requirement[c]			
Calcium	42.9	1123	0.18–0.60%	Concentrations, %	0–0.30	over 0.30
				% of total	31.1	68.9
Cobalt	5.4	140	0.05–0.10 ppm	Concentrations, ppm	0–0.10	over 0.10
				% of total	43.1	56.9
Copper	9.0	236	4–10 ppm	Concentrations, ppm	0–10	over 10
				% of total	46.6	53.4
Iron	9.8	256	10–100 ppm	Concentrations, ppm	0–100	over 100
				% of total	24.1	75.9
Magnesium	11.1	290	0.04–0.18%	Concentrations, ppm	0–0.20	over 0.20
				% of total	35.2	64.8
Manganese	11.2	293	20–40 ppm	Concentrations, ppm	0–40	over 40
				% of total	21.0	79.0
Molybdenum	5.1	133	0.01 ppm or less	Concentrations, ppm	0–3	over 3
					86.4	13.6
Phosphorus	43.2	1129	0.18–0.43%	Concentrations, %	0–0.30	over 0.30
				% of total	72.8	27.2
Potassium	7.6	198	0.60–0.80%	Concentrations, %	0–0.80	over 0.80
				% of total	15.1	84.9
Sodium	5.6	146	0.10%	Concentrations, %	0–0.10	over 0.10
				% of total	59.5	40.5
Zinc	6.8	177	10–50 ppm	Concentrations, %	0–50	over 50
				% of total	74.6	22.4

[a]Latin American Tables of Feed Composition (McDowell et al. 1974; McDowell et al. 1978a).
[b]Less than 1% of the other minerals were included.
[c]N.R.C., 1976, 1978, and A.R.C., 1965.

Incidence of Mineral Deficiencies and Toxicities in Tropical Countries

Table 2 combines more recent reviews on the reported incidence of mineral deficiencies or toxicities in developing tropical countries (Fick et al. 1978; McDowell 1976). The extent of affected areas is not generally appreciated, and it is inevitable that reports of mineral inadequacies will greatly increase as more tropical countries undertake mineral research and thereby improve their methods of detection. These reviews include confirmed, as well as highly suspected, geographical areas of mineral deficiencies and toxicities in ruminants.

Calcium and Phosphorus

A Ca/P ratio of 1:1 to 2:1 is usually recommended, with a close ratio most critical if P intake is marginal or inadequate. While Ca deficiency can easily be produced in young growing animals and lactating dairy cows fed native forages supplemented with concentrates, the deficiency has not been reported in grazing beef cattle even during lactation (Loosli 1978a). In India, Ca deficiency is reported for cattle fed straw due to the large amounts of oxylates in this feed (Ray 1963). In cattle, the most common mineral deficiency in the world is lack of P. In most livestock grazing areas of tropical countries, soils and plants are low in P. Many grass species containing over 0.3 percent P during early stages of growth are available to grazing cattle for only short periods. For the greater part of the year, mature forages contain less than 0.15 percent P. In many tropical countries, high amounts of soil Fe and Al accentuate a P deficiency by forming insoluble phosphate complexes.

The most devastating economic result of P deficiency is reproductive failure, with P supplementation dramatically increasing fertility levels in grazing cattle from many parts of the world (McDowell 1976). In many tropical areas, the effects of undernutrition on fertility are apparent. With few exceptions, lactating cows calve about once in two years. In P deficient areas, if a calf is produced, cows may not come into regular estrus again until body P levels are restored, either by feeding supplementary P or by cessation of lactation.

Cobalt

With the exception of P and possibly Cu, Co deficiency is often the most severe mineral limitation for grazing cattle in tropical countries. Approximately 43 percent of 140 Latin American forage entries were either deficient or borderline to deficient (< 0.1 ppm) in Co. Of the total liver samples analyzed from 12 beef cattle ranches in the San Carlos region of Costa Rica, 27 percent were borderline to deficient in Co (Kiatoko et al. 1978). Incidence of Co deficiency can vary greatly from year to year, from an undetectable mild deficiency to an acute stage. In five years at Glenroy, Australia, flocks of sheep were unaffected, whereas in another eight years, symptoms of variable severity of Co deficiency were encountered (Reuter 1975). Cobalt deficiency has been reported in Malaysia (Mannetje et al. 1976; Braithwaite, B. 1980; personal communication), with animals responding to vitamin B_{12} or cobalt pellets.

Copper and Molybdenum

Throughout extensive regions of the tropics, lack of Cu is the most severe mineral limitation for grazing cattle, with the exception of P and possibly Co (Table 2). Copper deficiencies in cattle, as with Co, occur mainly under grazing conditions, with gross signs of the deficiency rare when concentrates are fed. The majority of reports are concerned with a "conditioned" Cu deficiency, and usually occur when forage Mo exceeds 3 ppm and the Cu level is below 5 ppm (Cunha 1973). Clinical signs of Mo toxicity are similar to Cu deficiency, with both Mo toxicity and Cu deficiency generally corrected by Cu supplementation. In severe Mo toxic areas, injections of Cu compounds are often the preferred method of administration, since the primary site for Cu x Mo interaction is in the gut.

For the past five years, ICA researchers have been analyzing liver, blood and forage samples throughout Colombia (Gil et al. 1977). Their results indicate that vast areas of Colombia, including Puerto Boyaca, Montilonia, Obonuco, Caribia, El Nus, Palmira, Turipana, Coloso, San Jose del Nus and Caucacia, are seriously deficient in this element. Certain areas of El Salvador are reported to be likewise deficient in Cu (Perla et al. 1978). Data from the northern coast of Honduras showed Cu deficiencies, with 60 percent of 48 cattle liver samples containing less than 20 ppm Cu (Pate and Crockett 1977). Of cattle livers analyzed in Costa Rica 23 and 40 percent were borderline to deficient in Cu from 12 San Carlos (Kiatoko et al. 1978) and 15 Guanacaste (Lang et al. 1975) ranches studied, respectively. Over 80 percent of 90 forage samples from Canas, Costa Rica contained deficient Cu levels of less than 4 ppm (Murillo Bravo 1977). Low to deficient Cu concentrations were reported from Cartago, Costa Rica. Seventy-five percent of 64 forages contained less than 10 ppm Cu, while eight out of ten liver samples were below 75 ppm (Palmer Francis 1977). The majority of forage Cu concentrations from San Marcos, Huehuetanango and Suchitepeque, Guatemala were low, less than 5 ppm

TABLE 2 Geographical Locations of Mineral Deficiencies or Toxicities for Ruminants in Developing Tropical Countries[a]

Required Elements	
Calcium	Argentina, Brazil, Colombia, Costa Rica, Guatemala, Guyana, India, Mexico, Panama, Peru, Philippines, Senegal, Surinam, Uganda, Venezuela.
Magnesium	Argentina, Brazil, Chile, Colombia, Costa Rica, Guatemala, Guyana, Haiti, Honduras, Jamaica, Kenya, Peru, Surinam, Trinidad, Uganda, Union of South Africa, Uruguay.
Phosphorus	Antigua, Argentina, Botswana, Brazil, Ceylon, Chile, Colombia, Costa Rica, Cuba, Ecuador, Egypt, Ghana, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Jamaica, Kenya, Malagasy Republic, Malaysia, Mexico, Nicaragua, Nigeria, Panama, Peru, Philippines, Puerto Rico, Senegal, Somalia, Southern Zimbabwe, Surinam, Tanzania, Uganda, Union of South Africa, Uruguay, Venezuela, Zaire.
Potassium	Brazil, Haiti, Panama, Uganda, Venezuela.
Sodium	Brazil, Chad, Colombia, Guatemala, Kenya, New Guinea, Nigeria, Northern Rhodesia, Panama, Philippines, Senegal, Surinam, Thailand, Uganda, Union of South Africa, Venezuela.
Sulfur	Brazil, Ecuador, Uganda.
Cobalt	Argentina, Brazil, Colombia, Costa Rica, Cuba, Egypt, El Salvador, Guyana, Haiti, India, Katanga, Kenya, Malaysia, Mexico, Nicaragua, North Africa, Peru, Philippines, Surinam, Uganda, Union of South Africa, Uruguay, Zaire.
Copper (or Molybdenum toxicity)	Argentina, Brazil, Colombia, Costa Rica, Cuba, Guyana, Haiti, India, Kenya, Malaysia, Mexico, Panama, Peru, Zimbabwe, Senegal, Sudan, Surinam, Tanzania, Trinidad, Union of South Africa, Uruguay.
Iodine	Worldwide
Iron	Brazil, Costa Rica, India, Indonesia, Panama.
Manganese	Argentina, Brazil, Burma, Costa Rica, Panama, Uganda, Union of South Africa.
Selenium	Bahamas, Brazil, Costa Rica, Ecuador, Guyana, Honduras, Indonesia, Mexico, Paraguay, Peru, Uganda, Union of South Africa, Uruguay.
Zinc	Argentina, Brazil, Costa Rica, Guyana, India, Indonesia, Panama, Peru, Philippines, Puerto Rico, Uganda, Venezuela.
Toxic Elements	
Fluorine	Algeria, Argentina, Guyana, India, Mexico, Morocco, Saudi Arabia, Tanzania, Tunisia,Union of South Africa.
Manganese	Brazil, Costa Rica, Peru, Surinam.
Selenium	Argentina, Brazil, Central African Republic, Chad, Chile, Colombia, Ecuador, Honduras, India, Iran, Kenya, Madagascar, Mexico, Nigeria, North Africa, Peru, Puerto Rico, Sudan, Union of South Africa, Venezuela, Upper Volta.

[a]McDowell (1976); Fick et al. 1978; Arroyo–Aguilu and Coward–Lord (1974 P deficiency Puerto Rico); Tartour (1975 Cu deficiency Sudan).

(Flores, J. A., M. T. Cabezas, B. Murillo and R. Bressani 1978, unpublished data). Forage analyses from the state of Goias, Brazil indicate that about 50 percent of the forage samples have less than 5 ppm Cu (Lopes, E. 1978, unpublished data). The majority of forage samples from the eastern llanos of Venezuela contained between 1 and 4 ppm Cu (Velasquez, J. 1978, unpublished data). In Malaysia, 80 percent of surveyed cattle and buffalo were Cu deficient (Hill et al. 1962).

Iodine

Iodine deficiency is one of the most prevalent deficiency diseases that has been shown to occur in most tropical countries. Deficiency of I results in a lack of thyroxine and is manifested by general weakness, stunted growth or stillborn animals with goiter. Although I deficiency results primarily from low dietary intake of I, its incidence is greatly enhanced by intake of goitrogens that interfere with I utilization. The most effective method of goiter prevention is to provide I in the mineral mixture. Unstabilized potassium iodide is less effective under wet tropical conditions since I in this form is readily volatilized or leached. The incidence of deficiency has declined in many countries as a result of the widespread use of iodized salt. However, in many tropical countries of the world, endemic goiter remains an exceedingly serious problem for humans and livestock alike.

Sodium and Chlorine

The craving of livestock for common salt is well established. However, the evidence of a naturally occurring dietary deficiency of Cl, as distinct from Na, has not been established. Tropical forages low in Na have been reported in many tropical countries (Table 2). In a study of six ranches in northern Mato Grosso, Brazil, Sousa et al. (1978) reports a severe Na deficiency on each farm. The ranch forage Na means ranged from 84 to 194 ppm and would supply only 14 to 32 percent of the Na requirement. Of 125 forages analyzed throughout Colombia, approximately 90 percent contained less than the requirement of 0.06 percent Na (Gil, A. and Tritschler, J., 1977, unpublished data). Likewise from Thailand, Falvey (1980) found forage Na concentrations averaging 0.01 percent.

Sodium deficiency is most likely to occur 1) during lactation, due to secretion of Na in the milk; 2) in rapidly growing animals; 3) under tropical or hot semi-arid conditions where large losses of water and Na occur due to sweating and where pastures are low in Na; and 4) in animals grazing pastures heavily fertilized with K, which depresses herbage Na levels. Even after a prolonged severe deficiency, NaCl levels secreted in milk remain high. Thus, lactating animals suffer most from lack of salt in the diet (Loosli 1978b).

Magnesium

Grass tetany (hypomagnesemic tetany) generally occurs during early spring, or a particularly wet autumn, among older cattle grazing grass or small grain forages in cool weather. Grass tetany is most likely to occur when pastures contain less than 0.2 percent Mg. Slightly over one-third of 290 forages included in the 1974 Latin American Tables of Feed Composition contained 0.2 percent Mg or less (McDowell et al. 1978a).

Grass tetany or hypomagnesemia has been studied extensively in Argentina, where a considerable number of animals die annually due to this condition (Fick et al. 1978). Sporadic cases of grass tetany have been reported in Colombia and Costa Rica. Hypomagnesemic tetany responds favorably to Mg therapy. In Peru, Mg deficient cattle were treated successfully with intravenous or oral administrations of magnesium sulfate (Alvarado et al. 1970). In the southeastern U. S., a complete mineral mixture with 25 percent MgO (14 percent Mg) has been effective in preventing grass tetany in beef cattle (Cunha 1973).

Selenium

Consumption of feedstuffs containing both toxic ($>$5 ppm) and deficient ($<$0.1 ppm) concentrations of Se presents a worldwide problem for grazing livestock. In one review (Fick et al. 1978), Se toxicity was reported in Argentina, Chile, Colombia, Mexico, Peru, Puerto Rico, and Venezuela, while Se deficiency was suspected or confirmed in the Bahamas, Brazil, Costa Rica, Ecuador, Guyana, Honduras, Mexico, Paraguay, Peru and Uruguay. Lang et al. (1975) reported borderline to deficient Se concentrations in 33 percent of the livers analyzed from beef cattle slaughtered in Guanacaste, Costa Rica. Hall (1977) reports undocumented evidence of Se deficiency in southern Brazil and northern Uruguay on the basis of typical symptoms (i.e., muscular dystrophy and incoordination) and low forage Se levels (0.045 ppm). Exudative diathesis, a Se – vitamin E deficiency in poultry, has been established with locally grown feeds in Indonesia (Edwardly, J. 1978, unpublished data).

Fluorine

Chronic fluorosis is generally observed under three conditions: 1) drinking water high in F (3–15 ppm or more); 2) continuous consumption of high F mineral supplements; and 3) grazing F contaminated forages adjacent to industrial plants which emit fluorine fumes or dust. The more common incidence of fluorosis results from consumption of high F mineral supplements or contaminated forages near industrial plants. Toxicity of F is a reflection of amount and duration of ingestion, solubility of fluorides ingested, age of animal, nutrition, stress factors and individual animal differences. Cattle are less tolerant of F toxicity than other grazing live–stock, and general undernutrition enhances the deleter–ious effects of F toxicosis. Only defluorinated phos–phates should be fed to cattle and fertilizer rock phosphates should be avoided.

Manganese, Zinc, Iron, Potassium and Sulfur

Lang et al (1975) reported approximately 21, 63 and 24 percent of the total cattle livers examined in western Costa Rica were low in Fe, Mn and Zn, respectively. In a region of Costa Rica characterized by volcanic soils, high Mn forages have been observed, resulting in low reproductive rates of cattle (Fonseca and Davis 1968; Lang 1971). Clinical signs suggesting a Mn deficiency have been observed in Costa Rica (Lang, C. 1977, personal communication) and Mato Grosso, Brazil (Mendes 1978).

Legg and Sears (1960) found a parakeratosis skin dis–order in cattle of Guyana which were consuming forages containing 18 to 42 ppm Zn. Low levels of serum Zn were noted in cattle from Andahuaylas, Huancayo, Arequipa and Oxapampa, Peru (Ancasi et al. 1973). Forage data from both Guanacaste (Murillo Bravo, 1977) and Cartago (Palmer 1977), Costa Rica revealed low forage Zn concentrations. Lang et al. (1975) reported approximately 24 percent of cattle livers from Guana–caste, Costa Rica to be low in Zn concentration. Sixty percent of 90 forages from Guanacaste contained less than 20 ppm Zn. From San Marcos and Huehuetenango, Guatemala, forage Zn concentrations were extremely low, ranging between 5 and 25 ppm (Flores, J. A., M. T. Cabezas, B. Murillo and R. Bressani 1978, unpublished data). In a study of six ranches in northern Mato Grosso, Brazil, Sousa et al. (1978) reported Zn defic–iency on the basis of low concentrations of this element in soils, forages and livers. Forage analyses from the state of Goias, Brazil indicated that about 50 percent of the forage samples had less than 20 ppm Zn (Lopes, E. 1978, unpublished data). Of 100 forage samples analysed in the eastern llanos of Venezuela, one–third contained less than 40 ppm Zn.

Iron deficiency is of practical concern for grazing cattle in circumstances involving blood loss or parasitic infestation. Livestock suffering from a K deficiency have been reported in Haiti, with Brazil, Panama and Venezuela reporting low forage concentrations of this mineral (Table 2). Sulfur may be lacking for livestock in Ecuador, as has been indicated by improve–ment observed following its administration in sulfurized salt blocks (Phillips 1956).

Detection of Mineral Deficiencies or Toxicities

Clinical signs of mineral deficiencies, along with soil, water, plant, and animal tissue analyses, have all been used with varying degrees of success in establishing mineral deficiencies and toxicities. The most reliable method for confirming mineral deficiencies is the response derived from specific mineral supplementation. However, supplementation studies are costly in time and resources if conducted with adequate control and assessment.

Severe deficiencies of I, Mg and Cu, and toxicities of Se and F are often characterized by specific clinical signs. However, the majority of mineral deficiencies or toxicities, particularly borderline deficiencies, do not result in clinical signs specific only to a given mineral. Therefore, it often becomes necessary to resort to chemical analyses in order to adequately determine mineral insufficiencies.

Specific soil mineral analyses can sometimes provide clues to livestock mineral deficiencies while other soil elements seem unrelated to the animal's status. In studies of cattle ranches in Mato Grosso, Brazil, soil concentrations of Ca, Co, P and K were positively related to levels of these minerals in forages (Sousa 1978; Conrad et al. 1978). However, data from this experiment indicate that positive correlations among soil and forages for Mg, Cu, Fe, Mn, Na, Mo and Zn were low or nonexistent.

Disadvantages of relaying on forage element analyses to asses mineral adequacy for ruminants include: 1) un–certainty of collecting samples comparable to what ruminants consume, 2) difficulty of estimating forage intake, and 3) possibility of forage samples containing soil contamination. Without question, forage analysis is a much better indicator of mineral availability than is soil analyses. Likewise, animal tissue mineral concen–trations are better indicators of the availability of minerals than are forage analyses, and more accurately portray the contribution of the total environment in meeting the mineral requirements of grazing animals.

Liver concentrations of trace minerals are useful in evaluating the mineral status of cattle. Recently, Mendes (1978), on the basis of research in northern Mato Grosso, Brazil, concluded that the status of specific minerals in cattle can be determined satisfactorily in liver samples obtained either by biopsy or at slaughter. It was likewise found that liver samples should be obtained from growing animals and/or lactating cows in the rainy season, since production rates are higher and consequently mineral requirements are higher during this time. Since mineral analyses are complicated and expensive, it is important to select and analyze the minimum number of plant and animal tissues which are most indicative of the mineral status of livestock. Table 3 illustrates analyses of considerable value in assessing specific mineral deficiencies and toxicities in cattle.

AGENCY FOR INTERNATIONAL DEVELOPMENT UNIVERSITY OF FLORIDA MINERAL RESEARCH

Since late 1974, the Department of Animal Science at the University of Florida has been engaged in a contract with the Agency for International Development entitled "Determination of Mineral Deficiencies and Toxicities for Ruminants in Tropical Countries." Principal objectives of this research include: 1) determining the locations of mineral deficiencies, adequacies and toxicities in selected areas of Latin America where grazing livestock predominate, 2) establishing, by experimentation, the biological response and economic benefit of mineral supplementation to grazing animals, and 3) distributing research information in order to stimulate the widespread use of mineral supplements.

At the present time, cooperative research is underway with institutions in 11 Latin American, 4 Asian and 2 African countries. Mineral research programs have only more recently been initiated in Southeast Asia. Institutions in each of these countries are presently locating mineral deficiencies and toxicities for ruminants by use of a systematic mapping technique which analyzes plant and animal tissues. Forage and animal tissue samples are taken at least two times per year (i.e., end of both the wet and dry seasons) from two or more different classes of animals. From this information, it is possible to determine which minerals may be deficient, what time(s) of the year supplementation is required, and which class of animal is more likely affected. In Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Indonesia, Malaysia, Peru and Venezuela, supplementation studies are presently underway to establish the biological response to mineral supplements and the economic benefits of providing minerals.

Specific mineral research results from four Southeast Asian countries are as follows:

Philippines– Forage values from the Philippines have noted low concentrations of Na, P, Zn and Co. From 56 forage samples representing 25 species, 52, 38, 63 and 48 percent of the samples were deficient in Na, P, Zn, and Co, respectively (Lopez, P. 1980), unpublished data). Iodine deficiency, as evidenced by goiter, has been observed in the Mindanao region of the Philippines. In two areas of the Philippines, mineral supplementation has increased calving percentage above that of control animals, from 57 to 79 percent (Calub and Amril 1979) and from 76 to 80–84 percent (Nocom, A. 1980, personal communication).

Malaysia– Apparent cobalt deficiencies have been reported from two areas in Malaysia, with animals responding to vitamin B_{12} injections (Mannetje et al. 1976) or cobalt pellets (Braithwaite, B. 1980, personal communication). Forage analyses from Malaysia indicated low forage concentrations of P (0.05%) and Cu (3.5 ppm) (Hutagalung, R. and Hew Peng Yew 1980, unpublished data). Hill et al. (1962) reported the extent of Cu inadequacy in Malaysia, by noting that 80 percent of the surveyed cattle and buffalo were Cu deficient.

Indonesia– Low forage phosphorus levels have been reported in Indonesia (Cook, L. J. 1979, unpublished data). Iodine deficiency has been noted on the basis of goitrous animals (Toha and S. Lebdosoekojo, S., and A. Tillman 1978, unpublished data). Forages low in Zn and P, and corn low in Se have been reported (Edwardly, J. 1980, unpublished data).

Thailand– Tumwasorn et al. (1980) reported that nonsupplemented cattle gained 176 gm per head daily during an 180–day study, compared to 230 gm for those receiving mineral supplements during the wet season. In the same study, cows receiving mineral supplements had an increased conception rate of 21 percent averaging 64 percent versus 43 percent for controls.

Falvey (1980) reported Na deficiencies in cattle from the Thai highlands (Chiang Mai). Low forage Na (0.01%) concentrations, along with low Na levels in saliva, rumen fluid and feces, were noted. Overall production increased by 20 percent when supplementary Na was provided.

TABLE 3 Detection of Specific Mineral Deficiencies or Toxicities in Cattle[a]

Element	Dietary level	Tissue	Critical level indicating deficiency
Calcium	0.18–0.60%	Plasma	8 mg/100 ml
Magnesium		Serum	1–2 mg/100 ml
		Urine	2–10 mg/100 ml
Phosphorus	0.18–0.43%	Plasma	4.5 mg/100 ml
Potassium	0.60–0.80%		
Sodium	0.10%	Saliva	100–200 mg/100 ml
Sulfur	0.10%		
Cobalt	0.05–0.1 mg/kg	Liver	0.05 mg/kg
Copper		Liver	25 mg/kg
Iodine		Milk	300 μg/day
Iron		Hemoglobin	10 g/100 ml
		Transferrin	13–15% saturation
Manganese	20–40 mg/kg	Liver	6–10 mg/kg
Selenium	0.05–0.10 mg/kg	Liver	0.25–0.5 mg/kg
Zinc	10–50 mg/kg	Plasma	0.04 mg/100 ml
			Critical level indicating toxicity
Copper		Liver	700 mg/kg
Fluorine		Bone	4500–5500 mg/kg
Manganese	1000–2000 mg/kg	Hair	70 mg/kg
Molybdenum	6–20 mg/kg		
Selenium	5 mg/kg	Liver	5–15 mg/kg

[a]References for critical levels: McDowell (1976).

MINERAL SUPPLEMENTATION FOR GRAZING CATTLE

Recent results from cattle mineral supplementation trials in Bolivia, Brazil, and Peru illustrate growth benefits from minerals. For the year end results from the Beni of Bolivia (Bauer, B. 1978, unpublished data), bonemeal supplemented, weaned animals gained 97 kg versus 77 kg for controls. From Peru, cattle grazing native pasture and supplemented with P had daily gains of 0.59 kg versus 0.27 kg for the controls (Echevarria et al. 1977). From the state of Goias, Brazil, cattle receiving common salt gained only 53 gm/day versus 90, 137 and 112 gm/day for animals receiving P, P + Co + Cu + I, and P + Co + Cu + I + Zn + Fe + Mn, respectively (Lopes 1978, unpublished data).

Although growth responses from mineral supplementation are important, the most devastating economic result of mineral deficiencies is reproductive failure, with mineral supplementation dramatically increasing fertility levels in grazing cattle from many parts of the world. Table 4 illustrates reports from tropical countries where calving percentage was increased by mineral supplementation. The specific mineral or minerals responsible for increasing reproductive performance in the given experiments is unclear. Phosphorus most likely contributed the greatest to this improvement.

Problems concerned with mineral supplementation programs in tropical countries include: 1) insufficient chemical analyses and biological data to determine which minerals are required and in what quantities; 2) lack of mineral consumption data needed for formulating supplements; 3) inaccurate and/or unreliable information on mineral ingredient labels; 4) supplements that contain inadequate amounts or imbalances; 5) standardized mineral mixtures that are inflexible for diverse ecological regions (i.e., supplements containing Se distributed in a Se toxic region); 6) farmers not supplying mixtures as recommended by the manufacturer (i.e., mineral mixtures diluted 10:1 to 100:1 with additional salt); and 7) difficulties involved with transportation, storage and cost of mineral supplements.

Even though P supplements are administed to some cattle in the tropics, frequently the quantities are insufficient, the incorrect class of animal is emphasized (animals growing or in maintenance versus breeding females) or minerals are supplied at the wrong time of the year (dry season versus the wet).

TABLE 4 Latin American Studies on Effects of Mineral Supplementation on Increased Calving Percentages[a]

Country	Control[b]	Control + mineral supplement	Reference
Bolivia	67.5	80.8[c]	Bauer (1976, unpublished data)
Brazil	55.0	77.0[c]	Conrad and Mendes (1965)
Brazil	49.0	72.0[c]	Guimaraes and Nascimento (1971)
Brazil	25.6	47.3[c]	Grunert and Santiago (1969)
Colombia	50.0	84.0[d]	Stonaker (1975)
Panama	62.2	68.8[e]	Rios Arauz (1972)
Panama	42.0	80.0[c]	Poultney (1972, personal communication)
Peru	25.0	75.0[f]	Echevarria et al. (1974)
Philippines	57.0	79.0[d]	Calub and Amril (1979)
Thailand	43.0	64.0[c]	Tumwasorn et al. (1980)
Uruguay	48.0	64.0[c]	de Leon Lora (1963)
Uruguay	86.9	96.4[c]	Schiersmann (1965)

[a]McDowell and Conrad, 1977.
[b]Control animals received only common salt (NaCl).
[c]Bonemeal.
[d]Complete mineral mixture.
[e]Dicalcium phosphate + triple superphosphate.
[f]Dicalcium phosphate + copper sulfate.

As a low cost insurance to provide adequate mineral nutrition, "complete" mineral supplements should be available "free choice" to cattle (Cunha et al. 1964). A "complete" mineral mixture usually includes salt, a low fluoride P source, Ca, Co, Cu, I, Mn and Zn. Selenium, Mg, K, S, Fe or additional elements can be incorporated into a mineral supplement as new information suggests the need. In the case of Mg, an oral supplement would only be of value during the seasonal occurrences of grass tetany (Allcroft 1961). Copper, Se and Ca, when in excess, can be more detrimental to ruminant production than any benefit derived by providing a mineral supplement. In regions where high forage Mo predominates, 3–5 times the Cu content in mineral mixtures is needed to counteract Mo toxicity (Cunha et al. 1964). Data from Florida (Becker et al. 1965) and Montilonia, Colombia (Gil, A. 1975, personal communication) note that the salt content of water supplies is important in formulating mineral supplements.

Table 5 lists the characteristics of a "good" mineral supplement. In order to evaluate a mineral supplement for ruminants, it is necessary to have an approximation of 1) requirement for each element; 2) biological availability of the element in the compounds supplied; 3) daily intake per head per day of both mineral mixture and total dry matter; and 4) concentration of elements in the mineral mixture (Houser et al. 1978)

TABLE 5 Characteristics of a "Good" Cattle Mineral Supplement

An acceptable cattle mineral supplement should be as follows:

1. Final mixture containing a minimum of 6–8 percent total P. In areas where forages are consistently lower than .20 percent, mineral supplements in the 8–10 percent P range are preferred.
2. Calcium–phosphorus ratio, not substantially over 2:1.
3. Provide a significant proportion (i.e., 50 percent) of the trace mineral requirements of Co, Cu, I, Mn and Zn. In known trace mineral deficient regions, 100 percent of specific trace minerals should be provided.
4. Composed of high quality mineral salts that provide the biologically available forms of each mineral element. Avoidance of and/or minimal inclusion of mineral salts containing toxic elements (i.e., phosphates containing high F concentrations).
5. Formulated to be sufficiently palatable to allow adequate consumption in relation to requirements.
6. Backed by a reputable manufacturer with quality control quarantees in relation to requirements.
7. An acceptable particle size which will allow adequate mixing without smaller size particles settling out.

Table 6 provides an example of an inferior mineral mixture available in Latin America. This particular mineral supplement is recommended for cattle, sheep, pigs and chickens. It is impossible to meet requirements of both ruminants and monogastric animals with the same mixture. This imbalanced mineral mixture, which is extremely high in Ca (29.4%) and low in P (1.8%), would likely be more detrimental to grazing cattle than would a complete lack of access to any supplemental minerals at all.

For grazing beef cattle, provision of free choice minerals is recommended since concentrates are not generally provided. However, with dairy cattle, minerals can be provided either free choice or in concentrate mixtures or liquid protein supplements (i.e., molasses, urea and minerals). When minerals are added to a concentrate mixture, this helps to assure that each animal will be provided with minerals. One limitation of free choice mineral supplementation is that, individually, cattle may tend to over – or under consume the mixture. Under consumption can substantially be avoided by providing supplements that are sufficiently palatable.

Mineral toxicities are more difficult to control than deficiencies, especially under grazing conditions.

Molybdenosis is controlled by additional doses of Cu, fluorosis by periodic removal of cattle from fluoridated feed or water, and selenosis by rotational grazing to avoid continuous access to high Se forages or by diluting the ration with low Se feeds.

No single factor has as much potential to increase live–stock production in tropical countries at a low cost input as does adequate mineral nutrition. Economical return on mineral investment has been at least two to one in some studies (Conrad 1976).

TABLE 6 An Example of an Inferior Mineral Mixture Available in Latin America[a,b,c]

Element	Dietary allowance	Percentage in mineral mixture	Amount from mineral mix	Percentage allowance for mineral mixture
Sodium Chloride	0.50%	20.00	0.10%	20.0
Calcium	0.30%	29.44	0.147%	49.1
Phosphorus	0.25%	1.80	0.009%	3.6
Magnesium	2000. ppm	3.20	0.016%	8.0
Iron	100. ppm	0.88	44. ppm	44.0
Zinc	50. ppm	0.02	1. ppm	2.0
Cobalt	0.1 ppm	0.002	0.1 ppm	100.
Iodine	0.80 ppm	0.001	0.05 ppm	6.25
Copper	10. ppm	0.015	0.75 ppm	7.5
Manganese	25. ppm	0.075	3.75 ppm	15.0
Selenium	0.1 ppm	0.0005	0.025 ppm	25.0

[a]Mineral mixture is recommended for cattle, sheep, pigs, and chickens.

[b]It is assumed that mineral consumption will average approximately 0.5 percent of the total dietary intake. This is based on an estimated intake of 50 g of mineral mixture for cattle and 10 kg of total dry feed per head per day. The calculation is made as follows:

$$\frac{\text{\% element in mineral mix} \times \text{daily intake of mineral mix (g)}}{\text{total daily dry matter intake (g)}} = \text{element in total diet.}$$

If, for example: Copper in mineral mixture (%) = 0.015
Daily intake of mineral mixture (g) = 50
Total daily intake of dry matter (g) = 10,000

Then,

$$\frac{0.015 \times 50}{10{,}000} = 0.000075\% \text{ or } 0.75 \text{ ppm}$$

[c]Criticisms of mineral mixture are as follows: 1) Mixture extremely low in P and exceptionally high in Ca. The Ca:P ration is 16.4:1. 2) The supplement does not provide a significant proportion (i.e., 50%) of the trace mineral requirements of Cu, I, Mn, and Zn. 3) The majority of the Fe is from ferric oxide, an unavailable form of this element. 4) Since this diet contains 29.4% Ca and only 20% salt (NaCl), it is likely to be of low palatability. 5) Impossible for one mixture to be recommended for cattle, sheep, pigs and chickens.

REFERENCES CITED

Agricultural Research Council. 1965. The Nutrient Requirements of Farm Livestock, No. 2. Ruminants. A.R.C., London, England.

Allcroft, R. 1961. The use and misuse of mineral supplements. Vet. Rec. 73:1255.

Allman, R.T. and T. S. Hamilton. 1949. Nutritional deficiencies in livestock. FAO Agricultural Studies, No. 5 Washington, D. C.

Alvarado, J., S. Gonzalez, G. Meini and N. Clavo. 1970. Deficiencia de magnesio en bovinos en la selva. Cuarto Boletín Extraordinario, IVITA. p. 215. Universidad Nacional Mayor de San Marcos, Lima, Perú.

Ammerman, C. B. and J. M. Miller. 1972. Biological availability of minor mineral ions: A review. J. Anim. Sci. 35:681.

Ancasi, H. R , R. V. Talavera and T. S. Aguilar F. 1973. Contenido de elementos minerales en el suelo de vacunos en proceso de engorde. 3a Reunión de Especialistas e Investigadores Forrajeros del Perú. Pucallpa, Perú. p. 77.

Arroyo-Aguilú, J. A. and J. Coward-Lord. 1974. Mineral composition of 10 tropical forage grasses in Puerto Rico. J. Agr. Univ. Puerto Rico 58:436.

Becker, R. B., J. R. Henderson and R. B. Leighty. 1965. Mineral malnutrition in cattle. Florida Agr. Exp. Sta. Bull. 699.

Butterworth, M. H. 1967. The digestibility of tropical grasses. Nutr. Abstr. Rev. 37:349.

Calub, Arsenio and Aripin Amril. 1979. How to raise rate of pregnancy. Philippine Farmers J. (Dec.) 50.

CIAT. 1973. Centro Internacional de Agricultura Tropical Annual Rep. CIAT, Cali, Colombia.

Cohen, R. D. H. 1975. Phosphorus and the grazing ruminant. World Rev. Anim. Prod. 11(2):27.

Conrad, J. H. 1976. Phosphorus supplementation for increasing reproduction in cattle. Ruminant Livestock Production System. Georgetown, Guyana.

Conrad, J. H. and M. O. Mendes. 1965. Estudo comparativo do uso de suplementos minerais e fonte de proteína sobre a percentagem de nacimento de bezerros. Rep. Escritório Técnico de Agr., Revista Dos Criodores, Brazil.

Conrad, J, H., J. C. Sousa, M. O. Mendes and L. R. McDowell 1978. Trace element interrelationships among soils, plants and ruminants. p. 33. World Congress on Animal Feeding Madrid, Spain.

Corrêa, R. 1957. Deficiency of Co in cattle. I. Clinic study and experimental demonstration of the disease in Brazil. Arquivos do Instituto Biologicos 24(15):199.

Cunha, T. J. 1973. Recent developments in mineral nutrition A look at the highlights of research involving the mineral requirements for swine, beef cattle and horses. Feedstuffs 45(20):27.

Cunha, T. J., R. L. Shirley, H. L. Chapman, Jr., C. B. Ammerman, G. K. Davis, W. G. Kirk and J. F. Hentges. 1964. Minerals for beef cattle in Florida. Florida Agr. Exp. Sta. Bull. 683.

de León Lora, L. A. 1963. Efectos de suplementación de fósforo sobre la eficiencia reproductiva de Herefords en praderas naturales del Uruguay. Instituto Interamericano de Ciencias Agricolas, Turrialba, Costa Rica (Thesis).

Echevarría, Mariano, A. Riesco, V. Morales, O. del Valle and M. García. 1977. p. R-53. ALPA Proc., Havana, Cuba.

Echevarría, M., R. Valdivia, J. Barua, K. Santhirasegaram and L. Campos. 1974. Suplementación fosforada a vaquillas nellore. p. 9, ALPA Memoria.

Falvey, Lindsay. 1980. Sodium and phosphorus supplementation studies in the Thai Highlands. First Seminar on Mineral Nutrition in Thailand, Kasetsart University, Bangkok (in press).

Fick, K. R., L. R. McDowell and R. H. Houser. 1978. Current status of mineral research in Latin America. Proc. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. p. 149. Gainesville.

Fleming, G. A. 1973. Mineral Composition of Herbage. Chemistry and Biochemistry, Vol. 1, p. 259. Academic Press, New York.

Fonseca, H. A. and G. K. Davis. 1968. Manganese content of some forage crops in Costa Rica and its relation to cattle infertility. Proc. 2nd World Conference on Anim. Prod. Bruce Publishing Co., St. Paul, Minn. p 371 (Abstr.).

Gavillón, O and A. T. Quadros. 1970. O cálcio e o fósforo em pastagens nativas do Rio Grando do Sul: Constatacão de deficiências na primavera e no verão. Dept. da Prod. Anim., Porto Alegre. Boletin Técnico No. 17.

Gil, A., L. McDowell and J. Gritschler. 1977. Minerales para bovinos en Colombia. p. R-74. ALPA Proc., Havana, Cuba.

Gomide, J. A., C. H. Noller, G. O. Mott, J. H. Conrad and D. L. Hill. 1969. Mineral composition of six tropical grasses as influenced by plant age and nitrogen fertilization. Agron. J. 61:120.

Grunert, E. and C. Santiago. 1969. Uber den Einfluss von Knochenfutermehl auf die Fruchtbarkeit von Fleischrindern in Rio Grande do Sul. Brasilien Zuchthyg. 4:65;

Guimarães, J. M. A. and C. N. B. do Nascimento. 1971. Effect of mineral supplement on calving percentage in beef cattle herds on the island of Marajó. Instituto de Pesquisas e Experimentacão Agropecuarias do Norte. Estudio sobre Bovinos (1(2):37.

Hall, G. A. 1977. Phosphorus and trace mineral nutrition of grazing livestock in southern Brazil. Symposium on Feed Composition, Animal Nutrient Requirements, and Computerization of Diets. p. 369. Utah State Univ., Logan, Utah

Healy, W. B. 1974. Ingested soil as a source of elements to grazing animals. Trace Element Metabolism in Animals – 2. University Park Press, Baltimore, Md.

Hill, R., R. Thanbyah, S. P. Wan and C. S. Shanta. 1962. The copper status of cattle and buffalo in Malaysia. J. Agr. Sci. 59:409.

Houser, R. H., L. R. McDowell and K. R. Fick. 1978. Evaluation of mineral supplements for ruminants. Proc. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. p. 173. Gainesville, Fla.

Hudson, J. R. 1944. Notes on animal disease. XXHI. Deficiency diseases E. African Agr. J. 10:51.

Kemp, A., W. B. Dejis, O. J. Hemkes and A. J. H. Van Es. 1961. Hypomagnesia in milking cows: intake and utilization of magnesium from herbage by lactation. Netherlands J. Agr. Sci. 9:134.

Kiatoko, M., L. R. McDowell, K. R. Fick, H. Fonseca, J. Camacho, J. K. Loosli and J. H. Conrad. 1978. Mineral status of cattle in the San Carlos region of Costa Rica. J. Dairy Sci. 61:324.

Lang, C. E. 1971. Contenido de manganeso en los forrajes del valle de Orosi y su efecto sobre la concentración en el pelo y la reproducción en vacas lecheras. Univ. Costa Rica, San José (Thesis)

Lang, C. E., L. R. McDowell, J. H. Conrad and H. Fonseca. 1975. Estado mineral del ganado en Guanacaste, Costa Rica. 5a Reunión ALPA. p. R-2.

Legg, S. P. and L. Sears. 1960. Zinc sulfate treatment of parakeratosis in cattle. Nature 186:1061.

Loosli, J. K. 1978a. Mineral problems as related to tropical diseases. Proc. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. p. 1. Univ. of Fla. Gainesville, Fla.

Loosli, J. K 1978b. Sodium and chlorine in ruminant nutrition. Proc. Latin American Symposium on Mineral Nutrition Research with Grasing Ruminants. P. 54. Univ. of Fla., Gainesville, Fla.

Long, M. I. E., W. K. Ndyanabo, B. Marshall and D. D. Thornton. 1969. Nutritive value of grasses in Ankole and the Queen

Elizabeth National Park, Uganda. IV. Mineral content. Trinidad Trop. Agr. 46(3):201
Mannetje, L. T., Ajit Singh Sidhu and M. Murugaiah. 1976. Cobalt deficiency in cattle in Johore. Liveweight changes and response to treatments. MARDI Res. Bull. 4(1):90.
McDowell, L. R. 1976. Mineral deficiencies and toxicities and their effect on beef production in developing countries. p. 216. Beef Cattle Production in Developing Countries. Edited by A. J. Smith, Edinburgh, Scotland.
McDowell, L. R. and J. H. Conrad. 1977. Trace mineral nutrition in Latin America. World Anim. Rev. No. 24:24.
McDowell, L. R., J. H. Conrad, J. E. Thomas and L. E. Harris. 1974. Latin American Tables of Feed Composition. Univ. of Fla., Gainesville, Fla.
McDowell, L. R., J. H. Conrad, J. E. Thomas, L. E. Harris and K. R. Fick. 1978. Nutritional composition of Latin American forages. Trop. Anim. Prod. 2:273.
McDowell, L. R., K. R. Fick, C. B. Ammerman, S. M. Miller and R. H. Houser. 1978. Newer essential elements and toxic elements in mineral nutrition. Proc. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. p. 117. Gainesville, Fla.
Mendes, M. O. 1978. Mineral status of beef cattle in northern part of Mato Grosso, Brazil, as indicated by age, season and sampling technique. Univ. of Fla., Gainesville Fla. (PhD Thesis).
Milford, R. and K. P. H. Haydock. 1965. The nutritive value of protein in subtropical pasture species grown in southeast Queensland. Aust. J. Exp. Agr. Anim. Husb. 5:13.
Miller, W. J., J. W. Lassiter and J. B. Jones. 1972. Problems in the use of mineral values for feed formulation. Proc. Ga. Nutrition Conference for Feed Industry. p. 94.
Moore, J. E. and G. O. Mott. 1973. Structural inhibitors of quality in tropical grasses. In: Anti–quality components of forages. Crop Sci. Sco. America. Madison, Wis. Special Publication No. 4:53.
Murillo Bravo, O. 1977. Evaluación del estado de nutrición mineral del ganado bovion en pastoreo en el canton de Canas, Guanacaste. Facultad de Agronomía Univ. de Costa Rica. San José. (Thesis).
National Research Council. 1976. Nutrient Requirements of Domestic Animals. No. 4, Nutrients Requirements of Beef Cattle. N.R.C., Washington, D.C.
National Research Council. 1978. Nutrient Requirements of Domestic Animals. No. 3, Nutrient Requirements of Dairy Cattle. N.R.C., Washington, D.C.
Palmer Francis, Luís Fdo. 1977. Evaluación del estado de nutrición mineral del ganado bovino de la provincia de Cartago. Facultad de Agronomía, Univ. de Costa Rico, San José. (Thesis).
Payne, W. J. A. 1976. Nutrition of ruminants in the tropics. Nutrition Abstr. and Rev. 36 (3):653.
Pate, F. M. and J. R. Crockett. 1977. Honduras Beef Cattle Project Nutritional Evaluation Studies Rep., Belle Glade, Fla.
Perla, F., L. A. Silva, G. Acosta M., F. de Moreno, L. R. McDowell, J. K. Loosli and J. H. Conrad. 1978. Mineral status of cattle in El Salvador. Abstr. 1978 American Soc. or Anim. Sci. meetings. p. 433.
Phillips R. W. (ed.). 1956. Recent developments affecting livestock production in the Americas. FAO Agr. Development Paper 55:83.
Ray, S. M. 1963. Discussant's paper to topic 2 (India). Proc. of the 1st World Conference on Anim. Prod. European Assn. of Anim. Prod., Rome. 2:109.
Reuter, D. J. 1975. The recognition and correction of trace element deficiencies. Trace Elements in Soil–Plant– Animal Systems. p. 291. Academic Press, New York, N.Y.
Ríos Araúz, S. 1972. Efecto de la suplementación de fósforo en la reproducción y crecimiento del ganado Braham en Panama. Instituto Interamericano de Ciencias Agrícolas, Turrialba, Costa Rica. (Thesis).
Schiersmann, G. C. S. 1965. Efecto de la suplementación con fósforo sobre la eficiencia reproductiva y crecimiento de un hato de ganado Hereford en praderas naturales del Uruguay. Instituto Interamericano de Ciencias Agrícolas, La Estanzuela, Colonia, Uruguay. (Thesis).
Schutte, K. H. 1964. Biology of the Trace Elements. Their Role in Nutrition. J. P. Lippincott, Philadelphia, Pa.
Smith, C. A. 1962. The utilization of Hyparrhenia veld for the nutrition of cattle in the dry season. J. of Agr. Sci. 58:173.
Sousa, J. C. 1978. Interrelationships among mineral levels in soil, forage and animal tissues on ranches in northern Mato Grosso, Brazil. Univ. of Fla., Gainesville, Fla. (Thesis)
Stonaker, H. H., J. J. Salazar, D. H. Bushman, J. Villar, J. Gomez Gomez and G. Osorio. 1974. Influencia de las prácticas de manejo en la productividad. Potencial para incrementar la producción de carne en América Tropical. Seminario CIAT, Calo, Colombia.
Stonaker, H. H. 1975. Beef production systems in the tropics. I. Extensive production systems on infertile soils. J. Anim. Sci. 41:1218.
Tartour, G. 1975. Copper status in livestock, pasture and woil in western Sudan. Trop. Anim. Health Prod. 7:87.
Tergas, L. E. and W. G. Blue. 1971. Nitrogen and phosphorus in Jaraguagrass (Hyparrhenia rufa (nees) Stapf) during the dry season in a tropical savanna as affected by nitrogen fertilization. Agron. J. 63:6.
Thornton, D. D., M. I. E. Long and B. Marshall. 1969. The mineral status of dairy farms in the parts of Buganda and Busoga bordering Lake Victoria, Uganda. I. General ecology and soils. Trinidad Trop. Agr. 46 (4):269.
Tumwasorn, Sornthep, Chinatat Najasingha, Chairverk Kaeowphrommarn and Arwoot Wanitchart. 1980. Mineral supplementation for one–fourth American Braham crossbred calves in the village. First Seminar on Mineral Nutrition in Thailand, Kasetsart Univ., Bangkok (In Press).
Underwood, E. J. 1966. The Mineral Nutrition of Livestock. The Central Press, Aberdeen, Scotland.
Van Niekerk, B. D. H. 1975. Supplementation of grazing cattle. Potential to increase beef production. Proc. Ciat, Cali, Colombia. p. 83.
Van Niekerk, B. D. H. 1977. Limiting nutrients: Their identification and supplementation in grazing ruminants. Proc. Latin American Symposium on Mineral Nutrition Research with Grazing Ruminants. Gainesville, Fla.
Ward, H. K. 1968. Supplementation of beef cows grazing on veld. Rhod. J. Agr. Res. 6:93.
Weiner, G. and A. C. Field. 1969. Copper concentrations in the liver and blood of sheep of different breeds in relation to swayback history. J. of Comp. Path. 79:7.
Williams, R. D. 1963. Minor Elements and Their Effects on the Growth and Chemical Composition of Herbage Plants. Mimeographed Publication No. 1/1959. Commonwealth Agr. Bureaux, Bucks, England.
Young, J. S. 1968. Breeding patterns in commercial beef herds. I. Herd performance in New South Wales. Aust. Vet. J. 44:350.

AN OVERVIEW OF THE MAJOR CONSTRAINTS AND SOME SOLUTIONS IN LIVESTOCK DEVELOPMENT IN SOUTHEAST ASIA

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SUMMARY

General characteristics of livestock production in Southeast Asian countries are briefly described with emphasis on special features of animal production on small, subsistence farms. Some major problems that limit possible livestock development are classified into three catagories, 1) constraints related to production factors, 2) limitations concerning research and extension systems, and 3) problems related to additional supporting services. Possible solutions to certain problems are recommended. A major conclusion is that, in order to improve animal production, thereby helping to uplift the farmers' standard of living, background information on the existing animal production systems must be well understood.

OVERVIEW OF LIVESTOCK PRODUCTION IN SOUTHEAST ASIA

Most of the human population (60–80 percent) in Southeast Asia, except in Singapore, is engaged in agriculture. Livestock, including poultry, is a major component of that agriculture, and may provide 20–30 percent of the total farm income as in Thailand. Livestock production in Southeast Asian countries could be generally classified as backyard or traditional production as for cattle, buffalo, sheep, goats, and to a certain degree swine, dairy, and poultry. Semi–commercial or commercial production involves large–scale chicken layers and broilers, ducks, swine, and dairy animals. In general, integrated farming of crops and livestock is a familiar scene in this region (Anonymous 1976a). Production of crops such as paddy rice, maize, cassava, beans, etc., generates tremendous amounts of waste and non–marketable by–products that are suitable for livestock feeding. Rice straw, maize cobs and stalks, etc., are good roughages for ruminants. Most farmers raise a few cattle and/or buffalo primarily to be used for draft purposes during cropping season. Meat and/or milk from these animals are considered as by–products.

Cattle and buffalo are traditionally considered to be a long term asset by farmers in Southeast Asia. Goats and sheep are also raised in small numbers by the farmers for meat and milk. In general, one to three sows may be raised for additional income through the sale of weaning pigs. Backyard swine feeding is primarily based on crop by– products like rice bran and/or plant wastes such as banana stems, as well as weeds such as water hyacinth and morning glory that are available locally at no cost. Swine can be sold for cash every six months. Therefore, farmers consider them the semi– annual cash savings. Backyard chicken raising is common to almost all Southeast Asian farmers. It provides income when quick cash is needed, and the birds are a source of protein as meat and, to a lesser extent, eggs. Duck raising in paddy fields close to canals or water ways is common and is becoming more popular throughout the region and especially in Thailand and Indonesia.

However, specialized commercial production of poultry, swine and, to a lesser extent, dairy animals, is expanding to meet increasing demand for meat, eggs and milk. This is generally due to the expanding human population, especially the urban population, and to the rise in their level of education and standard of living.

Ruminant Production

Cattle and Buffalo. The general characteristics of cattle and buffalo raising, except dairy production, in Southeast Asia can be briefly described as follows (Chantalakhana 1979a):

As a complement to crop production. Cattle and buffalo are raised primarily to provide farm draft power for crop production; hence, the number of animals on each farm is generally small (usually 3–6 head). When an animal becomes too old for work (between 12–20 years of age), it will be sold as a meat animal. The cash return from the sale of cattle and buffalo is considered as a long–

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time family saving, a by–product. Manure from cattle and buffalo is applied to the land and is very useful in maintaining soil fertility.

Cattle and buffalo production in Southeast Asia is in the hands of small farmers whose income and livelihood come mainly from crop production, therefore, breeding, feeding, and management of cattle and buffalo are influenced by cropping seasons and cultivation practices.

Utilization of non–marketable farm products and marginal land. The main feedstuffs for cattle and buffalo are rice straw, crop residues, and supplementary cut–and–carry green grass and weeds gleened from roadways, ditches, etc. during the cultivating season. Some of them may be tethered or let loose on available marginal land which is, for some reason, not under crop production. After crop harvest, cattle and buffalo will graze in fields where plenty of green weeds, rice or crop straw and stubble are available. In Southeast Asia where rain–fed agriculture is predominant, at least 6–7 months out of a year crop fields will lay barren. These areas are useful for grazing ruminants. Animal feed supplies are plentiful soon after crop harvest, but generally decline gradually as the dry season approaches. During this period, animals gain weight. During the dry season of 3–4 months when sources of roughage in the field are scarce animals slowly lose body weight.

Utilization of surplus family labor. The individuals who look after animals are generally children, elderly people, or women. These people are usually not busy with any regular farm duty. In performing this service, they become useful and productive. In economic terms, there is no cost involved in having the children and elderly tending the animals.

Required minimal cash inputs and simple and traditional technologies. The only amount of cash needed for the raising of an animal is that needed to purchase it. Other input such as feed, drugs, or housing are generally derived from local resources. Most technologies employed by farmers in cattle and buffalo production in Southeast Asia rely upon many traditional drugs and health treatments, as well as village–raised feed supplements. Vaccination against some serious diseases and artificial insemination using superior germ plasm are given free of charge as a government service, but on a limited scale.

Non market–oriented production. As mentioned earlier, cattle and buffalo are raised primarily in Southeast Asia for farm draft power and not for meat or milk production. The rates of buying and selling cattle and buffalo are generally very low. Cattle and buffalo are considered by most farmers as a long–term investment or a source of fixed property. Usually only very old animals are sold for slaughter.

Very low degree of risk. There is relatively little risk of losing cattle and buffalo due to disease or mismanagement, or feed shortage. The profit of keeping a definite number of cattle and buffalo on a crop farm is fully realized by most farmers. However, in some locations within some countries, cattle and buffalo stealing may be a problem. In such cases, many farmers give up keeping these animals.

As for dairy production in Southeast Asia, the number of milk animals per holding has generally been small. These animals are mostly crossbred cattle with a few dairy buffalo present. Since they are raised to produce milk, a better standard of feeding and management is generally provided. The animals are generally fed green grass plus some supplemental feeds. Health care, housing, etc. is also provided.

Sheep and Goat. In Southeast Asia, there are large numbers of sheep and goats only in Indonesia and the Philippines. There is, however, a keen interest in the potential for raising sheep and goat production systems in other countries, such as Malaysia and Thailand.

As described by the UNDP/FAO Regional Livestock Development Survey (Anonymous 1976b): "In general, sheep and goat raising is still mostly in the hands of nomads. The majority of persons engaged in this enterprise either do not possess any land or the land holding with them is so small that it cannot provide them with year–round employment. There are some stationery flocks, no doubt, and in such cases, the size of flocks is smaller than the migratory flocks. Sheep farmers usually graze their animals in localized areas, in harvested fields, or in the forest areas and hill–slopes. In some countries, flocks are confined in enclosures near the house or in open fields either for collecting manure or for direct fertilization of the fields. Sheep and goat manure constitutes an important source of income, in some cases almost equal to that from the sale of wool from sheep. Goats are generally maintained as leaders by sheep stockmen, and are maintained on browsing and natural grazing, seldom being given any supplementary feed. Goats are more popular than sheep in villages because of their better reproduction rate and relatively lesser requirement of management skills."

According to Devendra (1974), more goats than sheep live in Southeast Asia, with the ratio being about 1:8. Indonesia and the Philippines, together have more than 82 percent of all goats in Southeast Asia. The majority of goats in these countries are kept by small farmers on their household property; approximately 80 percent of the total goat population in the Philippines is kept in small numbers by the small farmers. Only small numbers of goats are found in Thailand, Laos, Vietnam and Burma.

Non–Ruminant Production

Swine. Most pigs that go to the slaughterhouse are derived directly or indirectly from backyeard or traditional swine production methods. In Thailand, more than 90 percent of the pigs slaughtered come from production at the small farmer level (Chantalakhana 1977). The traditional production method features the integration of crop and animal production. However, swine production is primarily market–oriented. They are raised and sold either at weaning (8 weeks of age at approximately 12 to 15 kg) or at a market weight of 100 to 150 kg. The swine raised on small farms are generally fed with rice bran and broken rice, as well as banana stems and different kinds of weeds and plant wastes.

In some countries (e.g., Thailand and Malaysia) in this region, however, swine production under semi–commercial and commercial systems is steadily developing. Commercial swine production usually occurs in peri–urban areas for ease in marketing. Swine production is also related to some degree to a proximity of rice mills, flour mills, feed mills, or feed distributors. Semi–commercial and commercial swine production operations are based on nutritionally well–balanced rations with well–developed management practices.

Poultry. In Southeast Asia, chicken and duck raising are common practices among the rural populations. These backyard chickens and ducks are very efficient scavengers. Almost every rural household raises some chickens for meat and eggs. Traditionally, backyard poultry provided a significant though often unnoticed portion of a country's total production.

Semi–commercial egg production began to appear in Southeast Asian countries such as Thailand after World War II (Chantalakhana 1979b). Improved breeds and hybrid chicks are raised under commercial production. Advanced technology in feeding and management is employed. Today, in most countries, egg and broiler production for urban markets is fully commercialized.

For duck egg production, the level of feeding and management has been more or less traditional. Recently, ducks have been more commonly produced for meat in large flocks on rice fields after harvest such as in Thailand or Indonesia. In Thailand, ducklings and supplies of starter feed for the first month are being provided to rice farm operators by the commercial city producers. After one month of age, the ducks will live by scavenging around rice fields and nearby canals until they are ready for market (Chantalakhana 1977).

MAJOR CONSTRAINTS AND SOME SOLUTIONS TO LIVESTOCK DEVELOPMENT

Livestock production in all Southeast Asian countries needs to be improved or new systems developed in order to keep pace with the increasing demand for animal products resulting both from fast population growth as well as from the better education and improved standard of living of the urban population. Furthermore, it is evident that the energy crisis will become more and more serious; therefore, the demands for animal power in crop cultivation will certainly increase. Cattle and buffalo used for farm work not only saves money and keeps farmers busy, but also consumes non–marketable farm wastes and by–products. Also, considering the availability of certain areas of land, the distribution of labor, and the various suitable climates, as well as some socio–politico–economic factors, livestock production should receive high priority in agricultural development in Southeast Asia. Many serious constraints or problems, however, hinder the progress of livestock production in various Southeast Asian countries. For simplicity, these constraints can be classified as related to:

- Problems directly related to animal production factors,
- Problems related to research and extension systems, and
- Problems related to supporting services.

Animal Production Factors

Breeds and breeding, feeds and feeding, management, and health care are animal production factors that require immediate attention. Specific levels of every production factor must be provided simultaneously in order to obtain optimum production from the animals. These problems have been discussed in length by Soekanto (1980) and will be omitted here.

Livestock Research and Extension Systems

Livestock Research. In various Southeast Asian countries, livestock research is being carried out by many independent organizations and institutions; lack of coordination among them has been quite a serious problem. Many attempts have been made by different countries to overcome this problem, e.g., MARDI (Malaysian Agricultural Research and Development Institute) and PCARR (Philippines Council for Agricultural Research and Resources). The success of these organizations is yet to be evaluated.

Another serious pitfall is the lack of linkage between research and extension systems. As a consequence, livestock researchers are generally ignorant of the real needs and problems facing farmers. Very often, the researchers are accused of being isolated in "the ivory tower." And, as a result, most information obtained from research projects are not applicable to real farm, especially small farm, conditions. It is recommended that the training of research personnel should be geared to existing problems and conditions of the developing countries in this region. Also, it is highly recommended that all research programs or projects designed to include inter–agency and inter–disciplinary approaches, and that extension personnel and selected farmers participate fully in all research planning.

A common constraint in livestock research is a lack of well qualified personnel and suitable research facilities. Many research personnel in these countries are uninformed about current progress in their own field. Another very important and serious problem in research is a lack of efficient research management.

Livestock Extension. It has been generally recognized that one important constraint to the expansion of livestock production in Southeast Asian countries is a lack of effective extension services. Government livestock promotion and extension services are usually organized in a very bureaucratic fashion and do not serve the farm community. Many government extension officers in some countries are not well qualified technically nor socially. The majority do not observe or understand the prevailing livestock production in their own country, but gear their efforts towards commercial livestock production while neglecting small farmers. In addition, in most countries, small budgets and a lack of trained personnel are common.

It is strongly recommended that effective extension organizations be developed to promote livestock production. It is also very important that careful planning and maximum attention be given to the training of each staff member. A common opinion has been that improvement in livestock production can be obtained simply through effective transfer of already– known technology to the farmers.

Other Supporting Services

Farmers in Southeast Asia are generally poor and their farm production is generally at subsistence level. The scattered nature of small farms, both in terms of production and location, makes agricultural development more difficult. It has been agreed that in order to promote animal production in Southeast Asia, much infrastructure for supporting services needs to be either improved or developed. Major problems concerning supporting services will be discussed here, with specific reference to the author's experience in Thailand.

Farmers' organization. To facilitate the delivery of public services to needy farmers at a grassroots level, certain organizations of farmer groups have to be developed. Farmers' associations, farmers' groups, and agricultural cooperatives are some examples of farmer organizations, none of which would be best for every country. In fact, none seem to work well in all cases in any country in Southeast Asia at the present time. In Thailand, many farmer cooperatives and groups have been formed during the last 70 years and yet, today a very few of them have proven to be effective. Numerous reports of failures and a few successes, can be discussed.

The government should put strong emphasis on the formulation of a unified and effective system of farmers' organizations. It is strongly urged that a farmers' organization must begin at the grassroots level, each and every individual farmer must be educated and trained to clearly realize his duty and obligation. Each farmer must be prepared so that when he decides to become a member of the organization it is to help himself, instead of the usual primary purpose of obtaining loans or credits.

Agricultural credits. It is evident that most farmers are financially limited in agricultural productivity. It is common knowledge that farmers receive loans, both in terms of cash and supplies, at very high interest rates from local money lenders. The supply of production credit is, therefore, a very important prerequisite, and it is recommended that more institutional credit facilities be expanded and improved to aid small farmers. A certain portion of commercial bank credit should be allocated for agricultural loans at low interest rates.

Marketing. In most Southeast Asian countries, livestock marketing is inefficient and operates on a small scale and irregular basis. The "middleman" acts as a link between the individual farmer and local buyers, while local and central assembly livestock markets as well as slaughterhouses form intermediate chains to retailers and consumers. Livestock marketing in Thailand, for example, is a very complicated and unorganized process. As a result, the farm prices for swine, broilers, or eggs is generally subject to extreme fluctuation; and a fair share of return to the farmer is lost to market operators.

Although no effective solution has been found, it is very important that the livestock marketing system be improved, and to effect improvement, one must begin at the roots of each country's problems.

It is evident that price incentives alone can have a significant impact on the expansion of animal production. Certain measures of price guarantee could be implemented by the government to accelerate selected livestock production, especially at early stages of development.

Processing plants for livestock products should be established to stabilize the market demands and supplies. Export markets for livestock and livestock products should also be sought to provide a market for surplus quantities of high-quality animal products.

Law enforcement and farmer security. Laws and regulations concerning livestock directly influence expansion of animal production. In each country, laws and regulations have been formulated in relation to feeds, sanitation, disease control, transportation, animal slaughter, and exports. Some of these laws and regulations may be out of date and not conducive to current livestock development; it is strongly recommended that such laws or regulations be reviewed and amended.

In addition, certain regulations such as those affecting livestock exports, should not only be aimed at controlling export quotas, earning foreign exchange, and protecting export markets, but should work to stimulate animal production at grassroots level.

Effective law enforcement has been quite a problem in some countries. Frequently, a slaughter ban is violated and illegal slaughtering takes place; also, law officers pocket illegal fines from livestock transport, and so on. These are chronic problems, and only an improved system of justice can rid the people of them. Cattle and buffalo rustling also prevents farmers from increasing the size of their herds.

Other government support. One of the most effective primary inputs from any government is a sincere interest in promoting livestock development. This is important because livestock development requires a relatively long period of time, when, compared to crop production, before any significant improvement can be realized by the public. Since politicians usually don't like to wait, support for livestock development is usually low on their lists of priorities.

Certain land policies do have impact on livestock production. In most countries, the area of farm land per farm family has been getting smaller. Also, the percentage of land owned by farmers has been gradually decreasing. In Central Thailand, only about 50 percent of the farmers have title to their farm land. Land reform, if effective, would indirectly have certain favorable effects on animal production.

To create a long-term commitment to promoting livestock production, it is recommended that some kind of Livestock Development Authority be established to coordinate all efforts, both government and private, to encourage promising developments as well as to implement measures leading to the expansion of livestock production in the nation.

CONCLUSION

To develop livestock production in Southeast Asian countries, it is imperative that all personnel (government, researchers, extension, etc.) must first learn to understand and appreciate the socio-economic aspects of the small farmer, as well as commercial operators and the existing systems of animal production in their own countries. Those who have been educated and trained in the Western countries, where geographic and socio-economic conditions are completely different, must always be alert and prepared to learn from farmers under subsistence situations.

It is natural that general government policies be directed first to help the majority of the farmers, but it has been evident that in many agricultural development cases through poor program design and implementation, the smaller farmers have not received proper assistance. Hence, in the past the majority of farmers (large and especially small) in most countries of this region have not received their fair share of the national resources for the enhancement of their income or an improvement in their standard of living.

REFERENCES CITED

Anomymous 1976a. Integration of Livestock with crop production at small farm level. Vol. 1. FAO, Bangkok, Thailand.

Anomymous 1976b. Regional livestock development survey. Technical Report. FAO Rome, Italy.

Chantalakhana, Charan. 1977. Swine production in Thailand and some major constraints. Paper presented at the FFTC/ASPAC Seminar on Swine Production on Small Farm (26 April – May 4th, 1977). Taiwan, ROC.

Chantalakhana, Charan. 1979a. Breeding improvement of swamp buffalo for small farms in Southeast Asia. Paper presented at the FFTC/ASPAC Seminar on Increasing Buffalo Production on Small Farm (29–31 March 1979). Kasetsart University, Bangkok, Thailand.

Chantalakhana, Charan. 1979b. Potential and limitations of livestock production in Thailand. Paper presented at the ADAB Seminar on Animal Health and Nutrition in the Tropics (18–23 February 1979). James Cook University of North Queensland, Australia.

Devendra, C. 1974. A case study: goat production on small farms in Southeast Asia. In the Report of the Expert Group on Livestock Programs for Small Farmers and Agricultural Laborers in Asia and Far East. Vol II. FAO, Bangkok, Thailand.

Soekanto, L. 1980. Production problems facing the smallholder in Southeast Asia. The IFI Workshop on Feed Composition, Data Documentation, and Feeding Systems in Southeast Asia (22–24 January 1980). Manila, Philippines.

Workshop Group Discussions and Recommendations

Three groups were selected to review the current situation concerning overall animal production efficiency and suggest recommendations for improvement. Topics for discussion were:

1) Feed Industry (feed producers)
2) Livestock Industry (feed end–users)
3) Government Regulations and Assistance

FEED INDUSTRY (FEED PRODUCERS)

Chairperson: Mr. Jose Limjap (PAFMI)

SUMMARY

Common Problems Among Southeast Asia Countries

National shortage of feed both in terms of availability of feed ingredients and varieties of feedstuffs.

Regional shortage of feed supplies, specifically the protein and energy sources.

Limited feed mill industry technology. The feed industry is generally dependent on cereal and oil by-products. Knowledge of non-conventional feedstuff is very limited.

Price and market instability and other constraints both in local and international markets.

Feed quality constraints. There seems to be rampant adulteration of most if not all of the feedstuffs available in the market.

RECOMMENDATIONS

Generate more information on the nutrient values of feeds, especially non-conventional feeds and increases in the kinds of feedstuffs available.

Develop appropriate pricing policies for feedstuffs and meal products.

Develop the feed industry to the point where it uses more of the non-conventional feedstuffs.

Study the possibilities for a more vigorous intra-regional trade (SEA).

Implement more stringent government rules and regulations for quality control.

Develop a comprehensive program for Regional cooperation in production, utilization (consumption), and trade of feedstuffs; to follow-up and complement this first BAI/APHCA/IFI Technical Workshop, a consultation should be organized to facilitate development of a program for regional cooperation in production, use, and trade of feedstuffs. Such a consultation may help identify in a comprehensive manner technical, economic, and trade elements for cooperation; and set the direction and define the mechanics of implementation.

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

LIVESTOCK INDUSTRY (FEED END–USERS)

Chairperson: Dr. S. Jalaluddin

SUMMARY

The problems of the feed industry were identified as follows:

- Supply
- Price structure
- Quality
- Maximum utilization of available feed ingredients or raw materials

The major feed materials available in the region were categorized into conventional and non–conventional types. Conventional types are those which are commonly used and presently included in feed mixing/million operations. Non–conventional raw materials are those which are not being fully utilized or commonly used for feeding livestock and poultry but which are produced or available in volume that would warrant economic utilization.

Classification of non–conventional feed materials were identified as:

Roughage group
- field crops
- tree crops

These are materials derived from whole or parts of plants with high crude fiber content.

Concentrate group
- protein sources
- energy sources
- plant protein sources
- animal protein sources

To avoid confusion, groupings and nomenclature of feed ingredients or materials shall be patterned after the International Feed Vocabulary as described by the International Network of Feed Information Centers.

Identification of non–conventional feed materials by country are:

Indonesia

Roughage
- rice straw/hulls
- sugarcane tops
- water hyacinth
- banana stems
- tree leaves ("Waru", jackfruit, visum)
- cassava leaves
- shrub leaves (Sesbania, Glyricidia)
- Imperata cylindrica (L) Beauv ("Alang–alang"– common name)

For more details, please refer to the paper of Dr. Nitis on "Beef Cattle and Water Buffalo Production in South–east Asia", page 100.

Energy sources
- sago
- taru root

Protein sources
- rubber seed meal
- kapok seed meal
- snail meal

Philippines

Roughages
- rice straw/hulls
- sugarcane tops/ bagasse
- fiber processing wastes (ramie/abaca)
- sawdust as litter of poultry
- tree leaves (tamarind, acacia, *Glyricidia* sp., *Pithecolobrium* sp., etc.)
- pineapple waste
- banana stems
- water hyacinth

Energy source
- root crops (camote/cassava)
- banana rejects
- *Amorphophallus campanulatus* "Pongapong" or elephant yam
- recycling of animal manure

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

Protein source

mulberry leaves
earthworm
single–cell protein (chlorella/algae)
winged bean

Thailand

Roughage

rice straw/hulls
maize cob/stover
bean straw
peanut straw/hulls or shells
kenaf
sorghum hay/stover or stalks

Malaysia

Roughage

sugarcane bagasse
rice hulls/straw
sweet potato/cassava leaves
palm pressed fiber
bamboo leaves
tree leaves
crop residue (for cattle/goats)

For details, refer to Dr. C. Devendra's paper on "Sheep and Goat Production in Southeast Asia", page 100.

Energy sources

sago
palm oil sludge

Protein sources

green legumes/cover crop
rubber seed meal
palm kernel cake
single cell protein

Sri Lanka

Roughage

tea waste

Energy sources

jackfruit
taru (gabi)
cashew apple
cacao pods
sugarcane scum
coconut flower sap residue ("tuba")
NPN (urea)

Protein sources

tamarind seeds
velvet beans

Protein sources (continued)

Glyricidia Sp.
silkworm pupa
snail meal

Discussions were held on various agronomic practices of plants identified above. This is important in relating the effective utilization of these feed materials with the other traditionally produced feedstuffs. These agronomic practices may include the following:

- How and where these crops are planted?
- What distribution channels are used?
- How are the plants harvested?
- Other relevant information.

Evaluation of field trials which shall be conducted to determine the economic and technical feasibility of using these non–conventional feed materials for animal production was discussed by the group. The result of these evaluations shall be properly documented and made available to APHCA member countries.

The need for a coordinated, collaborative research activity in the region was discussed at length. Many interesting studies on conventional and non–conventional feed materials are being done, but most of this information is sometimes printed in languages not understood by researchers/end–users in these countries. The group also discussed the possibility of establishing a databank on matured research results from all member countries with APHCA Secretariat at Bangkok, Thailand as the repository for retrieval or circulation purposes. The responsibility of coordinating and collating all research results of each member country shall be handled by:

Name	Country
Dr. A. N. Eusebio	Philippines
Dr. A. S. B. Rajaguru	Sri Lanka
Dr. Soekanto L.	Indonesia
Dr. Sarote Khajarern	Thailand
Dr. S. Jalaluddin	Malaysia

Titles and highlights of all research undertaken shall be regularly submitted to APHCA which shall be responsible for printing the same in Asian Livestock for the information and reference of interested persons, agencies, and institutions of the member countries of the Commission.

The feed materials identified above shall be segregated according to the following:

- Supply or volume available

- Significant contribution to:

  Waste utilization
  Pollution control
  Others

- Potential value in terms of cost savings.

Extensiveness of research and development activities shall be based on the foregoing considerations. As mentioned earlier, a collaborative and properly coordinated research program is very important in order that duplication and waste of resources are avoided.

It was agreed that if sufficient ingredients of good quality are sufficiently available, the problem of the end–users, insofar as feed is concerned, can be overcome.

GOVERNMENTAL REGULATION AND ASSISTANCE

Chairperson: Ms. Emily Leong

DELIBERATIONS AND RECOMMENDATIONS FOR ADOPTION

Deliberations

A quick assessment of current governmental controls and regulations on feed quality, and the forms of assistance existing in various countries was made through a recapitulation by members of the group, and it was found that the degree of regulation exercised varied considerably between countries in the region; in some cases there are definite statutory regulations and in others little or no control is imposed.

Much deliberation and discussion were centered around quality control of feed materials and mixed feeds, and the need to exert greater control and regulation over the minimum standard of feed requirements for mixed feeds, in the interest of the consumers, i.e., farmers, and to benefit the society as a whole.

It was the opinion of the group members that the practice of labeling of feedstuffs is not as crucial as the compliance of the contents of the bagged feeds with the stipulations stated on the labels, based on the minimum standard requirements of nutrients. There was further discussion generated on the extent of imposition of analysis beyond crude protein, to incorporate amino–acids, and the determination of metabolizable energy. However, for the purpose of this workshop and in consonance with the level of technological development of feed production among member countries, it was decided, for the moment, to consider only the extent of analysis, for protein level, up to the crude protein level.

There was general agreement among members on the need for greater collaboration and the diffusion and effusion of ideas and programs on several aspects covering nutrient requirements, feeding systems, feed formulation, and composition, pertaining to particular species of livestock. The need to further examine methods of feed evaluation, terminology, and the standardization of analytical procedures for quality control is fully recognized.

For the promotion of effective trade on feed commodities to facilitate the expanding demands of feeds for livestock, there is a need to synchronize programs in agricultural crop production among member countries to meet the needs of the livestock sector. In this respect, the provision for regional market intelligence, which includes forecasts on feed crop production and import requirements of countries, will prove to be invaluable.

Members of the workshop group agreed that analytical services on special aspects of nutrient composition and feed evaluation should be rendered through the coordination services of APHCA to member countries which are lacking in such services.

Members of the workshop group also reconfirmed that in the formulation of controls or regulations over feed quality, there should be coordination with the various agencies or bodies both at the national and international levels, dealing with the control of food or drugs in so far as feed additives, antioxidants, drugs, hormones, and antibiotics are concerned.

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

Recommendations for Adoption

In summation, the workshop group proposes the following recommendations for adoption:

- That a main committee and sub–committees be formed by APHCA on feeding systems. APHCA could appoint the main committee. The main committee would appoint subcommittees for each species of animal (beef cattle, dairy cattle, buffalo, swine, sheep, goats, and poultry). These subcommittees would prepare feeding systems for each species of animal. The reports would essentially consist of three parts: nutrient requirements (input/output), feed composition (about 100 to 200 important feeds for the species of animal), and feeding systems for different physiological functions within climatic zones. The reports should be revised every three to five years.

- That for the strengthening of collaboration among member countries for the effective exchange of information on technical aspects and the promotion of effective trade by the provision of market intelligence, the establishment of feed information centers among member countries and regional coordinated feed information centers is endorsed.

- That the rendition of analytical services on special aspects of nutrient composition and feed evaluation should be available, through the coordination services of APHCA, to member countries who are lacking in such services.

WORKSHOP COMMITTEE: DISCUSSIONS AND RECOMMENDATIONS

The International Workshop on Studies on Feeds and Feeding of Livestock and Poultry, Feed Composition, Data Documentation and Feeding Systems in the APHCA Region, after

noting the current status of member countries concerning animal feed supplies, both conventional and non–conventional; operations of the feed milling industry; patterns of utilization in production systems specific to ruminants (buffalo, cattle, goats, and sheep) and non–ruminants (pigs, poultry, and ducks); dependence on cereals and oil–meal by–products,

discussing the common problems concerning shortages of total feed supplies both in the medium and long term; problems of feed quality; limited knowledge especially on non–conventional feeds; fluctuations of prices and market instability; various constraints for efficient animal production; the need for appropriate standards, and

realizing the need for reducing the dependence on cereals and oil meal by–products that are in competition with human needs; documentation of information about feeds; intensifying research on various feeds and feeding systems; and interaction among animal scientists, agronomists, economists, and feed millers; developing appropriate policies for the sustained production and utilization of feed resources; and promoting more vigorous intra–regional trade within the region, recommends the following:

- Complete an inventory within each country of all available feeds in terms of type, quantity available, characteristics and nutritive values,
- that individual developing countries realize that animal production systems should be organized for optimum production on the basis of available feed resources,
- special emphasis be given to the documentation of information on non–conventional feed resources,
- that the INFIC system concerning feed nomenclature and standardization of procedures pertaining to the assessment of feeds be adopted,
- an increase in the effort going into research on feeds and feeding systems and nutrient requirements appropriate to individual species,
- that collaboration and communication both nationally and regionally among institutions and persons working on research, chemical analyses and/or documentation concerning feeds and feeding systems be strengthened,
- that standard methods for feed analyses be adopted so that data collected from various countries can be compared.
- promote the implementation of effective measures of quality control and appropriate policies for the production and utilization of feed resources,
- organize a system for training individuals in the proper procedures used in feed analyses, and an understanding of the regulations governing feed quality control and standardization,
- that as a follow up to the Workshop, a Consultation be organized to promote regional cooperation in the production, utilization and trade of all categories of feedstuffs, and to identify problems and establish appropriate integrated action–oriented programs to overcome the difficulties and improve the efficiency of the feed and livestock industries of member countries in the region.

Presented at the APHCA – IFI Workshop, Manila, Philippines, January 22–24, 1980.

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