CAPSA Working Paper No. 94

Status and Prospects of Feed Crops in Southeast Asia: An Integrated Report

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United Nations
ESCAP

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

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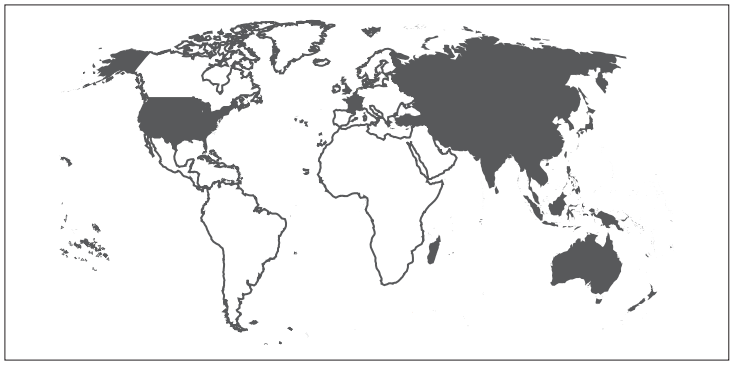

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The Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific (CAPSA) is a subsidiary body of UNESCAP. It was established as the Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) in 1981 and was renamed CAPSA in 2004.

Objectives

CAPSA promotes a more supportive policy environment in member countries to enhance the living conditions of rural poor populations in disadvantaged areas, particularly those who rely on secondary crop agriculture for their livelihood, and to promote research and development related to agriculture to alleviate poverty in the Asian and Pacific region.

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1. Introduction

1.1 Background and justification

Rising income and rapid urbanization in Southeast Asia have led to changes in the mix of cereal demand. As incomes rise further and lifestyles change with urbanization, there is a tendency to shift from rice to wheat. This observation can be generalized into the existence of three stylish archetype consumption bundles according to the level of income per capita. The first bundle occurs at lower per capita income levels where grains dominate. The second bundle occurs at mid-range per capita income levels where animal (livestock and fish) products dominate, followed by grains. The third bundle occurs at higher per capita income levels where animal products dominate followed by other food products, then horticulture and vegetable products, and finally, grains. In other words, demand for animal products increases while demand for grains as food decreases as per capita income grows.

The path of dietary change explains why demand for livestock and fish products in Asian developing countries has been accelerating rapidly in recent years. A combination of rising per capita income, population growth and urbanization in the Asia-Pacific region resulted in growth of demand for animal products reaching 66, 71, 140, 27 and 90 per cent for ruminant meat, pork, poultry meat, milk and eggs, respectively, over the 1985 to 1995 period. While per capita consumption of cereals increased by only 0.8 per cent per year, consumption per capita of milk, meat and fish increased by 2.4, 4.9 and 3.1 per cent per year respectively. In Southeast Asia, projected trends in meat and milk consumption show increases of 3.0 and 2.7 per cent respectively from 1993 to 2020. As a derived demand of animal husbandry, livestock and fish farming in particular, feed grain utilization per capita has also increased rapidly at 3.4 per cent annually. In Southeast Asia, cereal feed use is projected to rise by 2.7 per cent by 2020.

As the Asian population is still growing at around 1.5 per cent per year, demand for feed grains (indirect demand) is increasing by around 5 per cent per year, whereas total demand for direct consumption of cereals is increasing by around 2.3 per cent per year. Accordingly, total demand for such cereals, which are used both for human consumption and animal feed, especially maize, sorghum and millet, could increase by around 6 per cent per year. A large difference in the growth rate implies a rapid change in demand structure of such commodities towards more for feed and less for direct human consumption. In fact,

maize is primarily used for feed in many Asian countries. The increase in demand for feed in Southeast Asian countries will be much higher than of that in the South Asian region due to higher growth rates in almost all factors that determine total consumption. While the population growth rate is comparable, urban population and income per capita growth rates are much higher in Southeast Asia. The same is true for total meat consumption; 5.6 per cent compared to 4.2 per cent in South Asia.

In addition to demand induced factors, technological changes also contribute to the rapid expansion of demand for animal feed. Increasing land scarcity reduces pastureland availability and hence induces gradual changes in livestock farming systems from extensive cut-and-carry forage systems, to feeding manufactured feeds in commercial feedlots. The same also applies to fish farming. Intensive fish farming expands as a response to mounting scarcity of both natural fish stocks and ponds. Intensification of livestock and fish farming is a major source of higher demand for feeds in Southeast Asian countries.

Another technological factor that induces demand for manufactured feeds is the adoption of modern breeding lines in livestock and fish farming. The modern breeds perform better with manufactured feeds in an intensive barn or cage farming system. It should also be noted that intensive farming with manufactured feeds and modern breeding lines is extremely important to improve product quality. In other words, technological change is also a response to meet changes in demand patterns for livestock and fish products.

Coarse grains, pulses, roots and tubers or the products of these CGPRT crops dominate animal feeds. CGPRT products are generally either income inelastic or have negative income elasticity. This implies that direct demand for CGPRT products declines with increases in per capita income. This is considered a factor that causes CGPRT product prices and market opportunities, is general, to decline over time. Lower prices and falling demand are the two inherent causes of persistent stagnation and marginalization of most CGPRT farming. This is also the main reason why subsistence farmers in Southeast Asia generally dominate CGPRT farming. The rapidly emerging demand for feed crops shall, therefore, be able to reverse the marginalization of CGPRT farming. It creates a strong demand-pull for the rapid expansion of CGPRT production in many Southeast Asian countries.

Growing demand and rising prices of CGPRT products should enhance farm household welfare, inducing commercialization of CGPRT farming and also facilitating farm diversification, which has the potential to raise and stabilize farm income. Rapid expansion of CGPRT farming would create employment and contribute to the development of the rural

economy and alleviation of poverty. The rapidly growing livestock industry, supported by domestic feed crop farming and its processing industry, has long been considered the most appropriate path of agricultural diversification towards a balanced structural change of the economies of most Southeast Asian developing countries.

The ample opportunity to expand feed crop farming, however, may create a policy dilemma for some governments. With limited resources, land and water in particular, expanding CGPRT farming may result in a contraction of main staple food production. Some governments may consider this opportunity a threat to national food security. Furthermore, in some countries, the development of feed crop farming may be constrained by various policies, which were instituted to expand food crop farming. Supporting infrastructure may also be insufficient to fully tap the great opportunity for enhancing feed crop farming. In short, it is extremely important to elucidate the real opportunities, constraints and policy options to develop feed crop farming in Southeast Asian developing countries through comprehensive research.

Special considerations

With the exception of the period of financial and economic crisis that hit most countries in Southeast Asia, economic growth in the 1980s and early 1990s created rapidly increasing demand for livestock products and unprecedented successful development of the industry. Growth rates were expected to continue after the crisis. With the exorbitant growth in demand for animal products, traditional livestock production based on local feed resources has become industrialized. In addition, another adjustment on the production side is the trend towards monogastrics characterized by short-cycle species that offer better conversion of feed concentrate than ruminants. There is an obvious tendency to increase monogastric production, with robust expansion of poultry meat throughout Southeast Asia. In line with these changes, many countries in Southeast Asia will focus on the expansion of feed production, efficiency improvements of feed use and animal productivity. The productivity of the livestock sector in the region remains very low, which can be attributed to the poor-quality breeding base and the high cost of feeds and feed ingredients stemming from imports. The expansion of local feed sources would benefit CGPRT crop farmers as many CGPRT crops represent raw materials for animal feed.

1.2 Objectives

The general objectives of this research are to elucidate and analyse potentials, weaknesses, opportunities, constraints as well as policy options for the development of feed crop farming with emphasis placed on CGPRT crops in Southeast Asian developing countries in balance with the rapid development of the livestock and fish culture industry in Southeast Asia. More specifically, the objectives may be further broken down into:

(i) To analyse historical dynamics and future trends of demand and supply for feed crop products;

(ii) To evaluate potentials, weaknesses, opportunities and constraints for expanding feed crop farming with emphasis placed on CGPRT crops in the participating countries;

(iii) To propose possible co-operation schemes for the trade and development of feed crops/products among Southeast Asian countries; and

(iv) To formulate policy options to promote the sustainable development of feed crop farming in participating countries.

1.3 Analytical approach

1.3.1 Definition

Feed

Feed represents the range of food or feeding stuffs available to an animal. Feeding stuffs constitute one of the range of potential feeds available to farm livestock. This includes fresh forages, conserved forages (hay or silage), concentrates and succulent feeds.

Feed can also be classified as: conventional feedstuffs and non-conventional feedstuffs. Conventional feedstuffs are feedstuffs that have been traditionally used for decades or even centuries. They are normally abundant and are purposely cultivated to support animal production. Examples include maize, rice, sorghum, wheat, barley, cassava, fishmeal and copra meal. Non-conventional feedstuffs are defined as by-products derived from the industry due to the processing of the main product and those feeds which have not been traditionally used in animal feeding and/or not normally used in commercially produced rations for livestock.

Concentrates

Concentrates are animal feeding stuffs which have a high feed value relative to their volume. They are low-fiber, high-energy feeds that are concentrated by factory-blended sources of nutrients to raise the nutritional content of feed supplements.

Feed crops

Feed crops are the crops utilized fresh or processed to feed animals.

1.3.2 Analytical framework

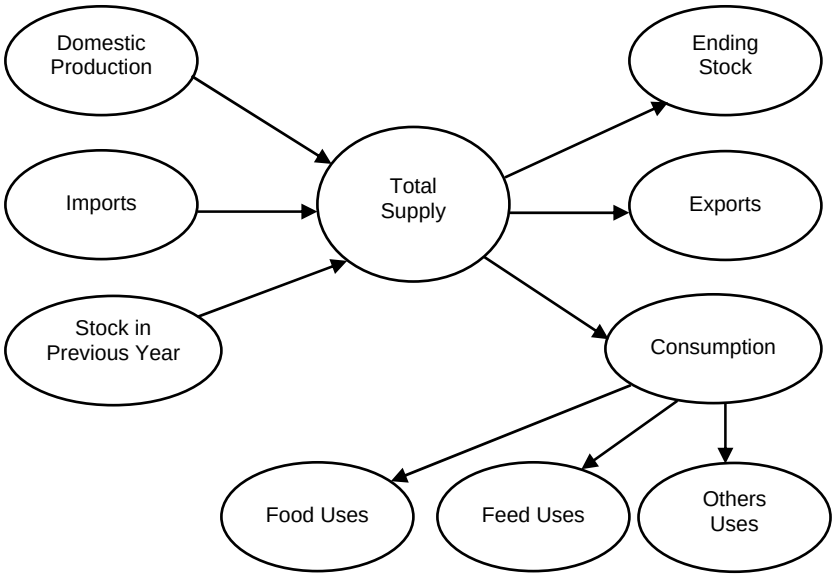
Since the study is interested in investigating the prospects of feed crop development it is important to establish empirically the impact of price mechanisms and other determinants such as technological factors, population and income in the production as well as consumption of feed crops. Furthermore, it is equally crucial to evaluate whether the effort is feasible from a managerial point of view, as commodity development programmes entail complicate decision making in production, marketing and processing. The study will be conducted by utilizing standard economic theory of supply and demand, complemented by the management planning tool known as SWOT analysis.

Supply and demand of feed crops

The total supply of a commodity is basically a summation of domestic production with some imports and its stock from the previous year as depicted in Figure 1.1.

Total supply is used for consumption, some exports and some to be stocked at the end of the year. Conversely, total consumption is comprised of food use by humans, feed to animals (livestock and fish), and other uses.

Figure 1.1 Supply of and demand for feed crops



The expansion of technology and its adoption as shown in area and production gains are not only determined by solely technical matters. Often they are also curtailed by management problems on the farms, at the market and in the processing industry, as well as with administration. Each decision maker at every level should have a common goal as to how the performance of the organization can be improved to guarantee the successful achievement of production quotas and the agro-industrial development of feed crops. The question faced is why the business is stagnant given the tendency of mounting competition? Whenever a number of alternatives are under consideration in the planning process, very careful analysis of the external and internal dimensions of influence is vital. Every important strategically decision should be subjected to an analysis whereby attention should be given to aspects such as:

- Whether the decision can be executed with the existing conditions?
- What opportunities are available now and in the foreseeable future?
- What are threats emanating from competitors, regulatory bodies, technological changes, or shifts in customer preferences?
- What are the unique strengths and internal abilities and how do they leverage the development of competitive advantage?
- What are the weaknesses and how can they be mitigated?

These were identified and analysed in the SWOT (strengths, weaknesses, opportunities and threats) analysis.

1.4 Implementation

The study was implemented in collaboration with partner institutes from selected countries in Southeast Asia, namely: Indonesia, Malaysia, the Philippines and Thailand, involving several researchers as national experts

Dr. Budiman Hutabarat, Senior Researcher, Indonesian Center for Agricultural Socio-Economic and Policy Studies (ICASEPS), Indonesia was appointed as the Regional Advisor and Dr. Erna M. Lokollo assigned as the Project Leader. Dr. Nobuyoshi Maeno, former Director, UNESCAP-CAPSA (formerly CGPRT Centre) was in charge of overall co-ordination and supervision.

The project officially started in July 2003 and the pre-consultative planning meeting was held in Bogor, Indonesia, in August 2003. The meeting was attended by the Regional Advisor, the Project Leader and the then Director of the Centre. The scope, concepts and method of the country study and workplan of the project, as described in the project document, were discussed and finalized. Subsequently, the project document was presented to the national experts at a planning meeting held in Bogor, Indonesia, in September 2003. The in-country studies began in October 2003 and country study reports were produced.

A regional workshop was organized in Bogor, Indonesia, in September 2004 attended by the national experts and commentators from participating countries, as well as several policymakers, researchers and reviewers. The aim was to discuss, review and improve the country studies. Country collaboration to bolster the development of feed crops in Southeast Asia was also discussed. The discussion also focused on "*the livestock revolution and its implications*".

1.5 Organization of the integrated report

The integrated report is presented in six chapters. Chapter 1 explains briefly the framework of the project and its implementation, followed by a review of the current situation with respect to feed crops, feeds and the animal production sector in the participating countries (Indonesia, Malaysia, the Philippines and Thailand) in Chapter 2. Chapter 3 explains the demand for feed and feed crops. Chapter 4 outlines the supply of feed and

feed crops. Chapter 5 explicates the trade and presents a SWOT analysis of feed crops. Chapter 6 highlights the conclusions and country specific recommendations suggested in the various individual country reports.

2. Review of Current Status

The Asian Economic Crisis began mid 1997 and hit most Southeast Asian countries, including Indonesia, Malaysia, Thailand and the Philippines. The livestock industries in these countries, especially the poultry industry, were significantly hampered due to soaring prices of raw feed materials, which were mostly imported. On the demand side, a decline in real per capita income reduced the consumption of livestock products. Consequently, the performance of feed and feed crop production also declined. The condition was exacerbated by bird flu (Avian Influenza), which spread throughout Southeast and East Asian countries. This chapter is an overview of the historical profile of livestock, feed and feed crops in the four participating Southeast Asian Countries.

2.1 Livestock population

The population of swine in Indonesia fluctuated over time. For the period of 1980-1998, the swine population grew positively by 5.16 per cent per year, namely from 3.16 million to 7.80 million heads. Since then, the population has shrunk from 7.80 million in 1998 to only 6.57 million heads in 2003 (-3.37 per cent per year). The continuous nature of the economic crisis hampered swine farms. Growth in the swine population was found in the Philippines. During the periods of 1980-1998 and 1998-2003, the number of heads grew steadily at rates of 1.41 and 3.90 per cent per year respectively.

Similar to Indonesia, swine numbers over the last five years in Thailand and Malaysia have also declined. During the period of 1980-1998, swine in Thailand significantly increased from 3.02 million heads to about 7.08 million (4.85 per cent per year). Meanwhile, the population slightly contracted to 7.06 million heads in 2003 (-0.07 per cent per annum).

A similar case was found in Malaysia, where positive growth of 2.64 per cent per annum was recorded from 1980-1998, while over the next five years the swine population declined by 6.90 per cent per year.

The aggregate swine population of the four participating countries rose from 15.95 million heads in 1980 to about 28.02 million heads in 1998, (3.18 per cent per annum). This significant growth was mostly attributed to high growth in Indonesia and Thailand. However, over the following five years the population stagnated at about 28.04 million heads in 2003

(0.01 per cent per year). During this period, significant positive growth only occurred in the Philippines, while the other three participating countries faced negative growth (Table 2.1).

Table 2.1 Livestock populations in the four participating countries, 1980-2003

(Thousands of heads)

Livestock	Year	Country				Total
		Indonesia	Philippines	Thailand	Malaysia	
Swine	1980	3 155	7 934	3 021	1 837	15 947
	1990	7 136	7 990	4 762	2 678	22 566
	1998	7 798	10 210	7 082	2 934	28 024
	2003	6 569	12 364	7 059	2 052	28 044
	Growth 1980-1998	5.16	1.41	4.85	2.64	3.18
	Growth 1998-2003	-3.37	3.90	-0.07	-6.90	0.01
Cattle	1980	6 440	1 883	3 938	550	12 811
	1990	10 410	1 629	5 669	668	18 376
	1998	11 939	2 395	5 159	714	20 207
	2003	10 878	2 557	5 048	723	19 206
	Growth 1980-1998	3.49	1.35	1.51	1.46	2.56
	Growth 1998-2003	-1.84	1.32	-0.43	0.25	-1.01
Goats	1980	7 691	2 960	56	342	11 049
	1990	11 298	4 790	121	331	16 540
	1998	13 560	6 000	131	236	19 927
	2003	12 722	6 300	178	227	19 427
	Growth 1980-1998	3.20	4.00	4.83	-2.04	3.33
	Growth 1998-2003	-1.27	0.98	6.32	-0.77	-0.51
Chicken	1980	149	53	56	51	309
	1990	571	82	108	57	818
	1998	646	138	205	120	1 109
	2003	1 204	128	177	165	1 674
	Growth 1980-1998	8.49	5.46	7.48	4.87	7.36
	Growth 1998-2003	13.26	-1.49	-2.89	6.58	8.58

Source: FAO, 2005, computed.

As shown in Table 2.1, the cattle population showed a similar growth pattern to that of swine. In Indonesia, significant positive growth of cattle occurred from 1880-1998 (3.49 per cent per annum), while during 1998-2003 it grew negatively at a rate of -1.84 per cent per annum. A similar case also transpired in Thailand, where during 1980-1998 the cattle population grew at a rate of 1.51 per cent per year, while during the next five years (1998-2003) growth became negative (-0.43 per cent per annum).

More conducive conditions were found in the Philippines and Malaysia. During 1980-1998, the cattle populations in these two countries grew at 1.35 and 1.46 per cent per annum respectively. Over the next five years (1998-2003), the cattle populations in these two countries maintained positive growth at 1.32 and 0.25 per cent per annum respectively. On aggregate, the growth in cattle populations in the four participating countries was similar

to that of Indonesia and Thailand, more specifically, positive growth during 1980-1998 and negative growth from 1998-2003.

The aggregate goat population of the four participating countries displayed a similar growth pattern to that of cattle. It grew by 3.33 per cent per annum during 1980-1998, and declined by 0.51 per cent per annum during 1998-2003. The growth patterns of goat populations in the participating countries primarily followed the pattern of Indonesia. Among the four countries Indonesia had the highest population of goats (about 65.5 per cent of the total population in the four countries).

The poultry population in Indonesia has grown extremely rapidly since 1980. The population expanded from 0.15 million in 1980 to 0.65 million birds in 1998 (a substantial increase of 8.49 per cent per annum). From 1998-2003, it grew even more dramatically to about 1.2 million in 2003, (13.26 per cent per annum).

Growth in the chicken population in Malaysia experienced a similar pattern to that of Indonesia. During 1980-1998, it grew by 4.87 per cent per year, while during 1998-2003 it grew more rapidly at 6.58 per cent per year.

In contrast, the Philippines and Thailand both recorded positive growth from 1980-1998, namely 5.46 per cent and 7.48 per cent per annum respectively. Subsequently, negative growth was reported of -1.49 per cent and -2.89 per cent per annum respectively, during the period of 1998-2003. Although the Philippines and Thailand experienced negative growth in chicken populations during 1998-2003, growth in chicken populations in the four participating countries as a whole displayed a similar pattern to that of Indonesia. This was due to the high share of the Indonesian chicken population, namely about 72 per cent of the total chicken population in the four countries. The growth rates of livestock populations during 1980-2003 in the four participating countries are presented in more detail in Table 2.1.

2.2 Production and consumption of livestock products

The livestock products discussed in this section include beef, pork, goat meat, chicken meat, eggs and milk. From 1980-1998, beef production in Indonesia increased from 220,800 tons to about 342,598 tons (2.47 per cent per annum). Over the following five years it still increased but at a lower rate reaching 369,710 tons in 2003 (1.53 per cent per annum).

Similar to Indonesia, the Philippines and Malaysia have shown positive growth in beef production for the last 23 years. During 1980-1998, beef production grew at 2.73 per

cent and 2.30 per cent per year respectively. For the next five years, beef production grew at 3.04 per cent and 2.03 per cent per annum respectively. In contrast, Thailand showed positive growth during 1980-1998 but negative over the subsequent five-year period, namely 2.21 per cent and -0.38 per cent per annum respectively. In general, for all participating countries, beef production growth followed a similar trend to that of Indonesia. Holistically, it grew by 2.45 per cent per annum from 1980-1998, and then by 1.41 per cent per year during 1998-2003, as presented in Table 2.2. Again, this was primarily attributable to the large share of Indonesian beef production; nearly 50 per cent of the total.

Pork production was dominated by the Philippines, namely almost 50 per cent of total pork production. In the Philippines, the share of pork production represented about 60 per cent of total national meat production (Cardenas *et al*., 2005). The next largest producer was Thailand, followed by Indonesia and Malaysia. This was as expected because most Indonesian people are Moslem, and therefore do not consume pork. Conversely, although pork is the most significant livestock product in Malaysia, however, its share within the four countries is relatively small, attributable to the small size of population that represents about 11 per cent of that of Indonesia.

The growth in pork production in the Philippines was 4.64 per cent per annum during 1980-1998, becoming more rapid (7.61 per cent) during 1998-2003. This increasing growth indicated good progress in the swine industry of this country. Similar to the Philippines, Thailand also made good progress in pork production. Growth increased from 3.18 per cent per annum during 1980-1998 to 6.49 per cent per annum during 1998-2003. In contrast, Indonesia and Malaysia both faced a sharp decline in pork production. In 1980-1998, the growth in pork production in these two countries were 7.26 per cent and 3.69 per cent per annum respectively, while in 1998-2003 growth plunged to -3.21 per cent and -5.30 per cent per annum respectively. On aggregate, pork production increased from 0.99 million tons in 1980 to about 2.28 million tons in 1998 (4.75 per cent per annum). Although in Indonesia and Malaysia pork production declined, during 1998-2003, aggregate pork production in the four countries grew positively at a rate of 3.52 per cent per year (Table 2.2).

Goat meat production in the four countries recorded buoyant growth; from 2.47 per cent per annum during 1980-1998 to 4.35 per cent per annum during 1998-2003. This robust growth was mainly attributed to the increasing growth of goat meat production in Indonesia, Thailand and Malaysia. Only the Philippines experienced negative growth. The largest producing country of goat meat among the four participating countries was Indonesia, followed by the Philippines, Malaysia and Thailand.

Dissimilar to other livestock products, chicken meat production experienced continuous positive growth in all participating countries. The highest growth was reported in Indonesia, namely 7.38 per cent per annum from 1980-1998 and 13.05 per cent during 1998-2003. The second highest growth was in Malaysia, followed by the Philippines and Thailand. In terms of production share, Thailand constituted the largest, followed by Indonesia, Malaysia and the Philippines. In the four participating countries, chicken meat production rose significantly from 0.79 million tons in 1980 to about 2.87 million tons in 1998 then to 3.74 million tons in 2003. In other words, it grew by 7.43 per cent per annum during 1980-1998, and by 5.48 per cent during 1998-2003. This high growth indicated that the poultry industries in the four participating countries are well developed.

Egg production in the four participating countries has continuously increased over the last 23 years, except in the Philippines. On the whole, egg production rose from 1.09 million tons in 1980 to 2.34 million tons in 1998 and about 2.81 million tons in 2003. In terms of growth, this represents 4.34 per cent per annum during 1989-1998 and 3.80 per cent in 1998-2003. The largest producer of eggs is Indonesia, followed by Thailand, the Philippines and Malaysia, as shown in Table 2.2.

Milk production was dominated by Thailand producing about 51 per cent of total milk production in the four participating countries. The second largest producer was Indonesia, followed by Malaysia and the Philippines. On aggregate, milk production increased from 0.15 million tons in 1980 to about 0.85 million tons in 1998 and 1.22 million tons in 2003. In other words, milk production in the four countries grew by 10.33 per cent per annum during 1980-1998 and about 7.40 per cent during 1998-2003.

In terms of consumption, per capita consumption of beef in Indonesia slowly rose from 1.74 kg/capita in 1980 to about 1.94 kg/capita in 1998 (0.62 per cent per annum). During the following 4-year period, consumption dipped to about 1.75 kg/capita in 2002 (-2.66 per cent per annum). As population growth reached 1.77 per cent and 1.32 per cent per annum respectively during 1980-1998 and 1998-2002, total consumption grew at 2.40 per cent and -1.05 per cent, respectively, over the same two periods. Per capita consumptions of pork, goat meat and poultry meat in Indonesia during 1980-1998 grew by -1.28, 0.57, and 5.31 per cent per annum respectively. Meanwhile, over the subsequent four years (1998-2002), per capita consumption of pork, goat meat and poultry meat were 46.68, 0.28 and 6.23 per cent per annum respectively.

Table 2.2 The production of livestock in the four participating countries, 1980-2003

(Metric tons)

Livestock product	Year	Country				Total
		Indonesia	Philippines	Thailand	Malaysia	
Beef	1980	220 800	96 000	123 780	11 794	452 374
	1990	259 200	82 000	180 129	11 113	532 442
	1998	342 598	155 800	183 480	17 770	699 648
	2003	369 710	180 967	180 000	19 651	750 328
	Growth 1980-1998	2.47	2.73	2.21	2.30	2.45
	Growth 1997-2003	1.53	3.04	-0.38	2.03	1.41
Pork	1980	176 000	412 000	267 000	135 575	990 575
	1990	544 500	684 000	337 500	226 599	1 792 599
	1998	621 500	932 810	468 950	260 172	2 283 432
	2003	528 000	1 345 759	642 200	198 128	2 714 087
	Growth 1980-1998	7.26	4.64	3.18	3.69	4.75
	Growth 1997-2003	-3.21	7.61	6.49	-5.30	3.52
Goat meat	1980	36 300	14 000	250	775	51 325
	1990	58 300	26 704	542	472	86 018
	1998	47 504	31 000	590	592	79 686
	2003	63 860	33 007	803	910	98 580
	Growth 1980-1998	1.51	4.52	4.89	-1.49	2.47
	Growth 1997-2003	6.10	1.26	6.36	8.98	4.35
Chicken meat	1980	167 800	220 244	287 000	114 500	789 544
	1990	498 200	229 277	575 000	348 500	1 650 977
	1998	604 707	491 230	1 097 000	675 000	2 867 937
	2003	1 116 700	635 131	1 227 000	765 035	3 743 866
	Growth 1980-1998	7.38	4.56	7.73	10.36	7.43
	Growth 1997-2003	13.05	5.27	2.27	2.54	5.48
Eggs	1980	259 400	263 548	425 500	138 700	1 087 148
	1990	484 000	372 500	725 100	301 200	1 882 800
	1998	529 569	594 000	815 563	396 900	2 336 032
	2003	973 590	575 000	834 000	432 050	2 814 640
	Growth 1980-1998	4.04	4.62	3.68	6.01	4.34
	Growth 1997-2003	12.95	-0.65	0.45	1.71	3.80
Milk	1980	78 400	13 000	30 000	24 000	145 400
	1990	345 600	15 000	130 278	29 200	520 078
	1998	375 382	9 240	437 116	31 970	853 708
	2003	553 400	11 250	620 000	35 523	1 220 173
	Growth 1980-1998	9.09	-1.88	16.05	1.61	10.33
	Growth 1997-2003	8.07	4.02	7.24	2.13	7.40

Source: FAO, 2005, computed.

Per capita consumption of eggs and milk during 1980-1998 grew by 2.00 per cent and 0.38 per cent per annum respectively. During 1998-2002, per capita consumption of eggs increased by 20.03 per cent per annum, while per capita consumption of milk only expanded by 0.11 per cent per year.

In the Philippines, per capita consumption of beef, pork, goat meat and poultry meat during of 1980-1998 grew by 1.84, 2.32, 2.15 and 2.31 per cent per annum respectively. From 1998-2002, per capita consumption grew more rapidly, except for goat meat, at the rates of 4.71, 7.07, -0.39 and 4.22 per cent per annum respectively. Per capita consumption

of eggs and milk from 1980-1998 grew by 2.25 per cent and 1.06 per cent per annum respectively, while during 1998-2002 per capita consumption dropped by 3.22 per cent and 12.40 per cent per annum respectively, as shown in Table 2.3.

Table 2.3 Per capita consumption of livestock products in the participating countries, 1980-2002 (Metric tons)

Product	Year	Indonesia	Malaysia	Philippines	Thailand	Total
Beef	1980	1.74	2.33	2.76	5.94	2.71
	1990	1.68	3.62	2.26	5.81	2.62
	1998	1.94	4.52	3.83	4.22	2.86
	2002	1.75	5.65	4.60	3.74	2.91
	Growth 1980-1998	0.62	3.75	1.84	-1.88	0.29
	Growth 1998-2002	-2.66	5.74	4.71	-2.98	0.41
Pork	1980	0.58	9.92	8.59	5.76	3.84
	1990	0.47	10.29	11.21	6.18	5.72
	1998	0.46	9.83	12.99	7.77	6.36
	2002	2.13	8.89	17.07	7.76	6.56
	Growth 1980-1998	-1.28	-0.05	2.32	1.68	2.84
	Growth 1998-2002	46.68	-2.49	7.07	-0.01	0.75
Mutton and goat meat	1980	0.36	0.49	0.30	0.01	0.29
	1990	0.50	0.50	0.44	0.02	0.40
	1998	0.40	0.71	0.43	0.02	0.35
	2002	0.40	0.79	0.43	0.02	0.36
	Growth 1980-1998	0.57	2.12	2.15	3.87	1.10
	Growth 1998-2002	0.28	2.71	-0.39	7.69	0.34
Poultry-Meat	1980	1.18	10.14	4.69	7.19	3.39
	1990	2.79	20.31	3.96	9.65	5.27
	1998	3.00	29.76	7.08	15.55	7.84
	2002	3.82	34.58	8.35	14.71	8.47
	Growth 1980-1998	5.31	6.16	2.31	4.38	4.77
	Growth 1998-2002	6.23	3.82	4.22	-1.38	1.94
Eggs	1980	1.40	10.20	5.48	9.17	4.21
	1990	2.10	15.57	6.10	13.13	5.86
	1998	2.00	16.81	8.18	13.54	6.39
	2002	4.15	13.51	7.17	12.70	6.75
	Growth 1980-1998	2.00	2.81	2.25	2.19	2.34
	Growth 1998-2002	20.03	-5.32	-3.22	-1.58	1.39
Milk	1980	4.20	34.82	3.93	1.91	4.28
	1990	4.41	38.47	7.06	4.40	5.04
	1998	4.50	35.22	4.76	12.35	5.74
	2002	4.52	55.29	2.80	5.83	5.17
	Growth 1980-1998	0.38	0.06	1.06	10.91	1.64
	Growth 1998-2002	0.11	11.93	-12.40	-17.12	-2.61

Source: FAO, 2004, computed.

In Thailand, per capita consumption of beef, pork and chicken meat experienced negative growth, especially during 1998-2002, with the exception of goat meat. During 1980-1998, per capita consumption of beef, pork, goat meat and chicken meat grew by

-1.88, 1.68, 3.87 and 4.38 per cent per annum respectively. Over the next four years (1998-2002), growth primarily became negative with growth rates of -2.98, -0.01, 7.69 and -1.38 per cent per annum respectively. Only goat meat showed continuous positive growth over the last 22 years. Furthermore, per capita consumption of eggs and milk grew by 2.19 per cent and 10.91 per cent per annum respectively, from 1980-1998. However, from 1998-2002, growth equalled -1.58 per cent and -17.12 per cent per annum respectively.

In Malaysia, per capita consumption of beef, pork, goat meat, poultry meat and chicken meat grew by 3.75, -0.05, 2.12 and 6.16 per cent per annum respectively from 1980-1998; and 5.74, -2.49, 2.71 and 3.82 per cent respectively, during 1998-2002. In Malaysia, only pork showed a continuous drop in per capita consumption for meat. For eggs and milk, per capita consumption grew at 2.81 per cent and 0.06 per cent per annum during 1980-1998, and -5.32 per cent and 11.93 per cent from 1998-2002.

Although some countries experienced negative growth, per capita consumption of meat and eggs in the four participating countries, as an aggregate, rose continuously but with decelerated growth. Only the per capita consumption of milk showed negative growth during the 1998-2002 period.

Among the four participating countries, Malaysia recorded the highest per capita consumption of beef, goat meat, poultry meat, as well as eggs and milk. Second came Thailand. Conversely, the Philippines recorded the highest per capita consumption of pork, which was consistent with the volume of pork produced being the highest among the four participating countries. Another reason is that most Filipinos are Non-Moslem.

The level of per capita consumption of livestock products reflects the level of per capita income, where Malaysia had the highest per capita income among the four countries, followed by Thailand, the Philippines and Indonesia. As shown in Table 2.4, per capita income in Malaysia exceeded US$ 3,500 per year, while Thailand, the Philippines and Indonesia reported around US$ 2,000; US$ 1,050 and US$ 700 per year respectively. A negative relationship exists between the size of the population and per capita income in a country, as shown in Table 2.4.

Table 2.4 Population and per capita income in the participating countries, 1999-2003

Item/Year	Indonesia	Malaysia	Philippines	Thailand
Population (million)				
1999	203.6	22.7	74.9	60.2
2002	211.8	24.3	79.9	61.6
2003	214.7	24.8	81.5	62.0
Income/capita (US$/yr)				
1999	590	3 370	1 040	2 000
2002	720	3 530	1 030	2 000
2003	810	3 880	1 080	2 190

Source: World Development Indicators Database, April 2005. World Bank.

2.3 Commodity balance sheets

In this section, the balance sheets of the main feed crops used as feed ingredients, namely maize and soybean meal, are discussed based on available data. Rice bran is another important component of feed ingredients, however, no data was available regarding national production and usage of this commodity. In the participating countries, maize represents the major component of feed ingredients, accounting for about 51 per cent in Indonesia, 30 per cent in the Philippines, 42-50 per cent in Malaysia, and about 50-55 per cent in Thailand (Swastika *et al*., 2005; Cardenas *et al*., 2005; Rojanasaroj *et al*., 2005; and Yahya and Sukir, 2005).

2.3.1 Maize

As a raw material of feed, maize has an advantage over other grains, especially for layer chickens, due to its xanthophylls content, which brightens the yolk. Feed ingredients for chickens, ducks and swine are dominated by maize. The other function of maize is as a source of energy for broilers. Substitutes of maize in feed rations are wheat, rye and oats. Such substitutes are usually employed in sub-tropical countries, such as Australia and Europe. Thus, the role of maize in tropical developing countries will remain important (Tangenjaya *et al.*, 2002).

The commodity-based balance sheet showed that during the last 22 years, Indonesia has predominantly shown a deficit in maize production, except in 1990. Swastika (2002) reported that before 1976, Indonesia was self-sufficient in maize and even had a production surplus, while since 1976 a deficit has persisted. In 2002, the deficit totalled 1.19 million tons or about 11 per cent of total domestic demand.

In Malaysia, the maize deficit is much greater, and continues to widen from about 0.68 million tons in 1980 to about 1.85 million tons in 1998 and 2.45 million tons in 2002. FAO data showed that in 2002 the maize deficit was about 97 per cent of total domestic

consumption. This indicates that Malaysia is highly dependent on imports to meet its domestic demand for maize.

The Philippines had a similar experience to Indonesia. A surplus occurred only in 1990. The maize deficit reached about 0.25 million tons, 1.54 million tons and 1.51 million tons respectively, in 1980, 1998 and 2002. In 2002, the deficit was about 26 per cent of total domestic demand.

In contrast with the three other participating countries, maize in Thailand was much more balanced. Over the last 22 years, Thailand only experienced a maize deficit in 1998 of about 0.10 million tons. Otherwise, a surplus of about 2.25 million tons, 1.23 million tons and 0.13 million tons, respectively, in 1980, 1990 and 2002 was recorded. This indicated that although a surplus existed, maize consumption in Thailand out grew production. Based on this phenomenon, it is projected that Thailand will face a maize deficit.

On aggregate, the participating countries will experience growing maize deficits. This implies that Southeast Asia will not be able to satisfy its growing demand for maize. In other words, the dependency of countries in the region on maize imports will increase. The maize balance sheets of the participating countries are presented in Table 2.5.

Table 2.5 The maize balance sheets of the participating countries, 1980-2002

(Thousands of tons)

Items	Year			
	1980	1990	1998	2002
Production				
Indonesia	3 525.6	6 734.0	10 169,5	9 527.1
Malaysia	8.0	35.0	50.0	70.0
Philippines	3 109.7	4 853.9	3 823.2	4 319.3
Thailand	2 997.9	3 722 266	4 617.5	4 210.8
Countries	10 106.5	15 345 185	18 660.1	18 127.1
Domestic demand				
Indonesia	3 544.5	6 596.9	10 483.0	10 712.4
Malaysia	684.1	1 535.7	1 903.1	2 521.4
Philippines	3 359.7	4 735.0	5 361.0	5 831.0
Thailand	743.4	2 489.6	4 720.1	4 078.7
Total	8 797.9	15 159.1	21 165.4	22 159.9
Surplus/deficit				
Indonesia	-18.9	137.1	-313.5	-1 185.3
Malaysia	-676.1	-1 500.7	-1 853.1	-2 451.4
Philippines	-250.0	118.9	-1 537.8	-1 511.7
Thailand	2 254.4	1 232.7	-102.6	132.0
Total	1 308.6	186.1	-2 505.3	-4 032.8

Sources: CAB of Indonesia, 1980-1991; BAS of the Philippines, 1990-2004; FAO, 2005.

2.3.2 Soybean meal

To meet the domestic demand for soybean meal as feed, Indonesia is fully dependent on imports, since there is no significant production of this commodity in the country. Soybean meal is primarily by-product of soybean oil production, which is not common in Indonesia.

Similar to Indonesia, domestic production of soybean meal in the Philippines averages about 8 per cent of total domestic demand. About 92 per cent of domestic consumption is imported from the global market. Imports increased from 0.23 million tons in 1980 to about 0.62 million tons in 1990 and then to 1.07 million tons in 1998 as well as 1.29 million tons in 2002. As the livestock industry in the Philippines is growing, demand for feed and, consequently, for feedstuffs will climb. Therefore, in the future, imports of soybean meal will increase as shown in Table 2.6.

Table 2.6 The balance sheet of soybean meal in the participating countries, 1980-2002
(Thousand of tons)

Item	Year			
	1980	1990	1998	2002
Production				
Indonesia	0.00	0.00	0.00	0.00
Malaysia	70.52	366.35	367.24	498.29
Philippines	14.83	20.38	107.16	187.04
Thailand	54.00	296.00	708.90	770.00
Total	139.35	922.73	1 183.30	1 455.33
Domestic demand				
Indonesia	26.64	243.25	667.87	1 350.12
Malaysia	198.42	500.03	818.50	961.48
Philippines	241.79	644.66	1 175.64	1 477.55
Thailand	208.68	636.03	1 666.39	2 525.55
Total	675.53	2 023.97	4 328.39	6 314.70
Surplus/deficit				
Indonesia	-27	-243	-668	-1 350
Malaysia	-128	-134	-451	-463
Philippines	-227	-624	-1 068	-1 291
Thailand	-155	-340	-957	-1 756
Total	-536	-1 101	-3 145	-4 859

Source: FAO, 2005.

Although Malaysia produced around 0.37 to 0.50 million tons of soybean meal, domestic demand for soybean meal, as an important feed ingredient, was double its production. Therefore, Malaysia still had to import nearly 50 per cent of total domestic demand.

Among the participating countries, Thailand produced the most soybean meal, recently about 0.77 million tons. However, domestic demand was more than double production. Therefore, an increasing deficit from about 0.15 million tons in 1980 to 0.34 million tons in 1990 was experienced, which then rapidly increased to about 0.96 million tons in 1998 and 1.76 million tons in 2002. In 2002, Thailand imported about 64 per cent of soybean meal to meet domestic demand. As such, none of the countries reported any surplus of soybean meal.

On aggregate, the participating countries showed a growing deficit for soybean meal from 0.54 million tons in 1980 and to about 1.10 million tons, 3.15 million tons and 4.86 million tons, respectively, in 1990, 1998 and 2002. In more detail, the balance sheet of soybean meal in the participating countries are presented in Table 2.6. In 2002, about 71 per cent of soybean consumption was imported from other regions; primarily China and USA.

2.4 Utilization of feed crops and feed ingredients

In terms of utilization, most maize in Indonesia is used for food. The Food Balance Sheet's data showed that in 2001, about 65 per cent of maize was used for food, consisting of direct food (7 per cent) and the food industry (58 per cent). Only about 24.5 per cent of maize was used by the feed industry. The remainder was for other uses, such as seeds and losses.

As the main feed component, especially for poultry and swine, the proportions of feed crops in feed ingredients were 51 per cent maize; 22 per cent rice bran; and about 17 per cent soybean meal. Fresh soybean and cassava were not used as feed ingredients.

In the Philippines, most maize, accounting for about 60-70 per cent, was used by the feed industry, while only about 15-25 per cent was consumed as direct food (especially white maize), and the rest was for the food industry. Recently, the use of maize for feed has tended to rise, while its usage as human food tended to drop.

In the feed ingredients, the dominant components have changed from 42 per cent copra meal and 24 per cent maize in 1988, to 30 per cent maize and 3 per cent copra meal in 2001 (Cardenas *et al*., 2005). This indicates the increasing importance and dominance of maize as a feed ingredient.

In Thailand, four crops are used as feed ingredients, namely maize, soybean meal, broken rice and cassava slices. Based on the total demand for feedstuffs in 1998-2002, maize consistently occupied the largest proportion, more specifically 48 per cent in 1998 to

about 52 per cent in 2002, of total feed crops in feed ingredients (computed from Rojanasaroj *et al*., 2005). The second and third most significant feed crops were soybean meal (26 per cent) and broken rice (23 per cent). The use of cassava slices represented less than 0.01 per cent of total feed crops.

Similar to other countries, maize in Malaysia was also the main feed ingredient. Maize occupied about 42-50 per cent of the feed ingredients for poultry, followed by soybean meal (25-32 per cent), rice bran (7-16 per cent) and fish meal (5 per cent). Maize was also the dominant component in swine feed because maize is relatively cheap, has good nutritional value in terms of high energy content and high starch digestibility; low fiber content (which is vital for poultry feed); rich in xanthophylls (for yellow colour of egg yolks); low variability in quality as well as being easy to handle and transport as a dry grain (Yahya and Sukir, 2005).

It would appear that maize is the dominant feed ingredient. Principally, all feed components have to contain the nutrients required by livestock. Nutrients crucial for livestock growth, health and reproduction are water, proteins, carbohydrates, fats, vitamins and minerals. The most common raw materials of feed (especially in Indonesia) are maize, soybean meal, corn gluten meal (CGM), rice bran, meat and bone meal (MBM), fish meal, wheat bran and coconut cake (Poultry Indonesia, 2003).

Maize is the feed component most frequently used in concentrated feed as a source of energy. The water content of maize must be lowered to below 16 per cent to avoid damage, loss of nutrients and fungal growth before it can be processed into feed. Yellow corn is preferred to white corn due to the higher content of vitamin A. Another advantage of yellow corn is its xanthophylls content, a colouring agent needed for yolk development. Soybean meal (SBM) is a by-product of soybean processed into oil. SBM retains protein, fat and crude fiber. Corn Gluten Meal (CGM) is a dried by-product of corn grain of which its starch, germ and outer membrane are extracted. During storage, the water content of CGM has to be maintained below 12 per cent. Rice bran is adequately available, especially during rice harvest seasons. Meat bone meal (MBM) has to contain at least 4.4 per cent of indigestible protein and not more than 11 per cent crude protein. Fish meal contains high crude protein (55-72 per cent). Sometimes it is substituted with MBM due to high prices. Wheat bran is frequently applied in feed rations due to its crude protein, crude fat and crude fiber content. Coconut cake also contains crude protein, crude fat and crude fiber.

2.5 Historical growth in production and consumption of feed crops

2.5.1 Maize

During the last 22 years, maize production in Indonesia has experienced a slower trend, with negative growth over the last four years. In 1980-1990, maize production increased from 3.53 million tons to about 6.73 million tons (6.69 per cent per annum). In the subsequent years (1990-1998), it increased to 10.17 million tons, (5.29 per cent per annum). During 1998-2002, maize production slid to about 9.53 million tons in 2002 (-1.62 per cent per annum).

In terms of consumption, growth was persistently positive, although at decelerated rates. The demand for maize was higher than production, except in 1990. Over the last 12 years (1990-2002) demand growth has been higher than production. It is projected that the deficit will steadily increase.

In Malaysia, maize production increased from 8,000 tons in 1980 to 35,000 tons, 50,000 tons and 70,000 tons in 1990, 1998 and 2002 respectively. During 1980-2002, growth reached 15.90, 4.56 and 8.78 per cent per annum, during 1980-1990, 1990-1998 and 1998-2002 respectively. However, the volume of production remained very small (about 3 per cent) compared to demand. On the other hand, the demand for maize in Malaysia rose from 0.68 million tons in 1980 to about 1.54 million tons, 1.90 million tons and 2.52 million tons in 1990, 1998 and 2002 respectively.

In the Philippines, maize production increased from 3.11 million tons in 1980 to about 4.85 million tons in 1990 (4.55 per cent per annum). Subsequently, it declined to 3.82 million tons in 1998 (-2.94 per cent per annum). In 2002, production increased to 4.32 million tons (3.10 per cent per annum). Maize consumption during the same period was higher than production. Demand for maize grew by 3.49, 1.56 and 2.12 per cent, during 1980-1990, 1990-1998 and 1998-2002 respectively. Similar to Indonesia, the Philippines faced a maize deficit during 1980-2002, with the exception of 1990.

In Thailand, maize production increased from 1980-1998 but then slowed during 1998-2002. Growth was 2.19, 2.73 and -2.28 per cent per annum, during 1980-1990, 1990-1998 and 1998-2002 respectively. On the consumption side, Thailand had a different experience from the other countries. Thailand only experienced a deficit in 1998, but rebounded. Demand grew by 12.85, 8.32 and -3.59 per cent per annum, during 1980-1990, 1990-1998 and 1998-2002 respectively. Based on the magnitudes of production and consumption growth, it is believed that Thailand will be able to maintain maize self-sufficiency.

As an aggregate of the participating countries, maize production slowed to 4.26, 2.47 and -0.72 per cent per annum, during 1980-1990, 1990-1998 and 1998-2002 respectively. On the other hand, demand grew by 5.59, 4.26 and 1.15 per cent per annum over the same periods. In terms of production and consumption, this region experienced a maize deficit during the 1990-1998 and 1998-2002 periods. Subsequently, the quantity and growth of maize demand has been much higher than production, such that future deficits will widen substantially. In more detail, the production of maize and respective growth are presented in Table 2.7, while demand is presented in Table 2.8.

Table 2.7 Maize production and growth in the participating countries, 1980-2002

(Thousands of tons)

Year	Indonesia	Malaysia	Philippines	Thailand	Total
1980	3 526	8	3 110	2 998	10 107
1990	6 734	35	4 854	3 722	15 345
1998	10 169	50	3 823	4 617	18 660
2002	9 527	70	4 319	4 211	18 127
Growth 1980-1990	6.69	15.90	4.55	2.19	4.26
Growth 1990-1998	5.29	4.56	-2.94	2.73	2.47
Growth 1998-2002	-1.62	8.78	3.10	-2.28	-0.72

Sources: Swastika *et al*., 2005; Cardenas *et al*., 2005; Rojanasaroj *et al*., 2005; Yahya and Sukir, 2005; FAO, 2005.

Table 2.8 Maize demand and growth in the participating countries, 1980-2002

(Thousands of tons)

Year	Indonesia	Malaysia	Philippines	Thailand	Total
1980	3 545	684	3 360	743	8 798
1990	6 611	1 536	4 523	2 490	15 159
1998	9 862	1 903	4 681	4 720	21 165
2002	10 712	2 521	4 847	4 079	22 160
Growth 1980-1990	6.41	8.42	3.49	12.85	5.59
Growth 1990-1998	5.96	2.72	1.56	8.32	4.28
Growth 1998-2002	0.54	7.29	2.12	-3.59	1.16

Sources: Swastika *et al*., 2005; Cardenas *et al*., 2005; Rojanasaroj *et al*., 2005; Yahya and Sukir, 2005; FAO, 2005.

2.5.2 Soybean meal

Indonesia did not produce soybean meal due to the absence of soybean oil factories in the country. Therefore, domestic demand for soybean meal was fully met through imports. Demand steadily increased by 24.75 per cent per annum during 1980-1990, by 13.46 per cent per annum during 1990-1998, and by 19.24 per cent per annum during 1998-2002.

In Malaysia, soybean meal production increased from 0.07 million tons in 1980 to about 0.37 million tons in 1990 and 1998, and 0.50 million tons in 2002. Growth was 17.91,

0.03 and 7.93 per cent per annum during 1980-1990, 1990-1998 and 1998-2002 respectively. On the demand side, the quantity was much larger and continuously increased from 0.20 million tons in 1980 to about 0.50 million tons, 0.82 million tons and 0.96 million tons, in 1990, 1998 and 2002 respectively. Demand grew by 9.68, 6.35 and 4.11 per cent per annum during 1980-1990, 1990-1998, and 1998-2002 respectively.

In the Philippines, soybean meal production grew by 3.23, 23.06 and 14.94 per cent per annum, during 1980-1990, 1990-1998 and 1998-2002 respectively. Although production grew rapidly, the share of domestic production in total domestic demand during 1980-2002 was less than 8 per cent on average. The demand for soybean meal steadily increased. By considering that 92 per cent (on average) of soybean meal was imported, it is projected that the Philippines will also depend greatly on global supply. The production of and the demand for soybean meal are presented in Table 2.9 and Table 2.10.

Table 2.9 Soybean meal production and growth in the participating countries, 1980-2002

(Thousands of tons)

Year	Indonesia	Malaysia	Philippines	Thailand	Total
1980	0.00	70.52	14.83	54.00	139.35
1990	0.00	366.35	20.38	296.00	922.73
1998	0.00	367.24	107.16	708.90	1183.30
2002	0.00	498.29	187.04	770.00	1455.33
Growth 1980-1990	0.00	17.91	3.23	18.55	20.81
Growth 1990-1998	0.00	0.03	23.06	11.54	3.16
Growth 1998-2002	0.00	7.93	14.94	2.09	5.31

Source: FAO, 2005.

Table 2.10 Demand for soybean meal and its growth in the participating countries, 1980-2002

(Thousands of tons)

Year	Indonesia	Malaysia	Philippines	Thailand	Total
1980	26.64	198.42	241.79	208.68	675.53
1990	243.25	500.03	644.66	636.03	2023.97
1998	667.87	818.50	1175.64	1666.39	4328.39
2002	1350.12	961.48	1477.55	2525.55	6314.70
Growth 1980-1990	24.75	9.68	10.30	11.79	11.60
Growth 1990-1998	13.46	6.35	7.80	12.79	9.97
Growth 1998-2002	19.24	4.11	5.88	10.95	9.90

Source: FAO, 2005.

Soybean meal production in Thailand grew at 18.55, 11.54 and 2.09 per cent per annum, from 1980-1990, 1990-1998 and 1998-2002 respectively. However, the growth of demand during 1990-1998 and 1998-2002 was more rapid, namely 12.79 per cent and 10.96 per cent per annum respectively. Thailand also imported about 36 per cent (on average) of soybean meal to meet domestic demand.

On aggregate, recent growth in demand has been much higher than production, namely 9.97 per cent and 9.90 per cent per annum respectively, during 1990-1998 and 1998-2002. On the production side, growth during the same periods only reached 3.16 per cent and 5.31 per cent per annum respectively. For the last 22 years (1980-2002), the production of soybean meal in this region has only been about 29 per cent, on average, of total demand.

2.6 Agro-industrial and feedstuff processing industries

Agro-industrial development has become increasingly important to the economies of most developing countries. Such development will generate value added for agricultural products, which will, in turn benefit the farmers. Feed mills are one among many other agro-industries that utilize feed crops as raw materials.

In Indonesia, there are five feed mills at the national level classified as large producers, namely Charoen Pokphand, Japfa Comfeed, Sierad Produce, Cheil Jedang and Wonokoyo. The main five accounted for more than 65 per cent of national production. Overall domestic feed production in 2003 was 6.86 million metric tons, which was still below production capacity of 11 million metric tons.

The feed mills are found in several provinces, namely North Sumatra with production of 0.62 million metric tons, Lampung (0.36 million metric tons), Banten (2.09 million metric tons), Jakarta (0.56 million metric tons), West Java (0.76 million metric tons), Central Java (0.45 million metric tons), East Java (2.00 million metric tons), and South Sulawesi (0.02 million metric tons).

In Malaysia, commercial feed millers began operations more than 40 years ago, and currently there are 47 feed mills operating with 38 located in Peninsular Malaysia, and 9 located in Sabah and Sarawak. There are also home mixers producing about 0.28 million metric tons of feed annually (Raghavan, 2000 *In* Yahya and Sukir, 2005).

With the development of science in animal nutrition, the formulation of feeds has developed to a high level of specificity for various types of animal and for various growth stages. The feed enhances the growth of broilers and layers, reduces their marketing days and brings more economic returns to the farmers.

In the Philippines, there were 425 registered feed mills in 2002, 300 of which were classified as commercial mills, while the rest consisted of non-commercial manufacturers (home and integrators). In terms of the number of commercial feed mills by scale, the majority (48 per cent) belonged to the group with a production capacity of less than 20

metric tons per 8-hour shift. This was followed by large commercial feed mills (28 per cent), and medium-scale feed mills (20-50 mt capacity/8-hour shift) accounting for 24 per cent. Although large-scale commercial feed mills constitute only 28 per cent of the total, they contributed about 82 per cent of the total registered capacity of 20,363 mt per 8-hour shift in 2002.

In terms of location, the majority (66 per cent) of commercial feed mills are located on the large island of Luzon, particularly in Central Luzon (30 per cent), Southern Tagalog (22 per cent), and the National Capital Region (14 per cent). The feed mills in this region shared 73 per cent of total feed mill capacity in the Philippines. Ironically, the major maize producer (Mindanao) only accounted for 6 per cent of total feed production in the country, although it produced about 60 per cent of total maize in 2002. Feed millers opted to locate their plants in Luzon since most commercial livestock raisers are in this area. They therefore, incur higher costs for the transportation of inputs but are able to save on distribution costs. Another reason is the peace and order situation in Mindanao, which is not favourable for investors to operate.

In Thailand, more than 1,000 mills producing compound feed were registered with the Ministry of Industries in 2002. Besides, there have been both small-scale and large-scale operators producing feed for private use. Only those that intend to sell require a marketing license for livestock feed from the Department of Livestock Development. Those who wish to sell feed for aquatic animals have to obtain a sales permit from the Department of Fisheries on an annual basis.

In 2002, a total of 170 feed manufacturing plants registered to sell compound feed. These plants are scattered around the country, but mostly (70.59 per cent) are concentrated in the central region. In contrast to the Philippines, the Central Plains is both the major producing area for feed crops as well as the concentration of livestock production and aquaculture. Therefore, the agribusiness for the livestock and feed industries in the country were more efficient compared to Indonesia and the Philippines.

3. Demand for Feed and Feed Crops

Increasing livestock populations, especially poultry and swine, in Southeast Asia have triggered mounting demand for feed and, consequently, feed crops in the region. The most popular feed crops used for poultry and swine feed are maize, soybean (soybean meal) and rice bran. This chapter sets out a discussion on maize and soybean meal as well as the feed itself. The structure and characteristics of demand for feed crops and feed are elaborated using the coefficients from econometric models.

3.1 Consumption structure and characteristics

3.1.1 Maize

In Indonesia, maize consumption can be grouped into four categories, namely, direct human consumption, raw materials for the feed industry, raw materials for the food industry, and other uses (seed, loss, etc.). The structure and characteristics of each category, based on econometric models, are as follows:

The behaviour of maize demand for direct food is explicated using the domestic prices of maize and milled rice, as well as per capita income with an F-statistic of 0.0001 and R^2 = 0.90. The short-run elasticities were -0.07, 0.09 and -1.05 for the prices of maize and milled rice as well as per capita income respectively. The long-run elasticities of demand with respect to the same variables were -0.20, 0.28 and -3.21. The positive elasticity of maize demand with respect to the price of milled rice indicates the substitution relationship between maize and rice. On the other hand, the negative elasticity of maize demand with respect to per capita income indicates the inferior characteristic of maize as a direct food.

Maize demand from the feed industry is determined by the prices of maize, feed and soybean (representative of soybean meal price), with an F-statistic of 0.0001 and adjusted R^2 = 0.8208. The short-run elasticity of maize demand with respect to its own price, feed price and soybean price were -0.2157, 0.0003 and -0.2395 respectively. While in the long run, the elasticities of maize demand with respect to the same explanatory variables were -1.4764, 0.0017 and -1.6389 respectively, as presented in Table 3.1.

Table 3.1 Maize demand in Indonesia

Maize demand/ Explanatory variable	Elasticity of maize demand		Prob (F-stat)	D-Watson	R^2
	Short run	Long run			
Direct food:					
Own domestic price	-0.0665	-0.2041			
Per capita income	-1.0473	-3.2141			
Milled rice price	0.0903	0.2772	0.0001	1.073	0.9002
Feed industry:					
Own domestic price	-0.2157	-1.4764			
Price of feed	0.0003	0.0017			
Price of soybean	-0.2395	-1.6389	0.0001	1.778	0.8208
Food industry:					
Price of manufacture food	0.5772	2.1166			
Own dom. price	-0.6573	-2.4103			
Per capita income	1.5634	5.7329	0.0001	1.716	0.9764

Source: Swastika *et al*., 2005.

Notwithstanding, the short-run elasticities of maize demand from the food industry, with respect to the prices of manufactured food, the price of maize and per capita income were 0.5772, -0.6573 and 1.5634 respectively. Conversely, the long-run elasticities of maize demand from the food industry, with respect to the same variables were 2.1166, -2.4103 and 5.7329 respectively. It is noteworthy that maize is no longer considered as an inferior food, subsequent to processing into manufactured food. This is indicated by the positive elasticity of maize demand from the food industry with respect to per capita income.

In Malaysia, maize is mainly used for two purposes: food and feed. Maize demand for feed raw materials is influenced by the domestic price of maize, the price of maize flakes and per capita income with $R^2 = 0.6751$. Using the Cobb-Douglas model, the elasticity of maize demand for food with respect to the prices of maize and maize flakes, as well as per capita income were -0.5723, -0.7083 and 1.5026 respectively. The positive result with respect to per capita income indicated that maize is not considered an inferior food, since maize in Malaysia is primarily consumed as a processed food, instead of a staple food.

Maize demand from the feed industry is determined by the prices of imported maize grain and prepared feeds, with $R^2 = 0.7906$. The elasticities of maize demand for feed, with respect to the prices of imported maize and prepared feeds were -0.1972 and -0.1381 respectively. In more detail, maize demand in Malaysia is presented in Table 3.2.

Table 3.2 Maize demand in Malaysia

Maize demand/ Explanatory variable	Elasticity of maize demand	t-stat	D-Watson	R^2
Food				
Own domestic price	-0.5723	-1.0853		
Price of maize flakes	-0.7083	-2.2827		
Per capita income	1.5026	0.7125	1.9595	0.6751
Feed Industry				
Imported maize price	-0.1972	-0.478		
Price of prepared feed	-0.1381	-0.2819	2.2607	0.7906

Source: Yahya and Sukir, 2005.

Similar to Malaysia, in the Philippines the two categories of maize consumption are food and feed. Maize demand for food is influenced by the prices of maize and rice, as well as per capita income. The elasticities of maize demand with respect to the prices of maize and rice, as well as per capita income were -0.31, -0.81 and -0.47 respectively. As a food, maize is considered inferior, implied by the negative elasticity of maize demand with respect to per capita income. In other words, as per capita income rises, people in the Philippines purchase less maize and buy other sources of carbohydrates, such as rice.

Maize demand as feed in the Philippines is influenced by the wholesale price of maize, poultry production and pork production. The elasticities of maize demand as feed with respect to the wholesale price of maize, poultry and pork production are -0.08, 0.22 and 0.47 respectively. A 1 per cent increase in poultry production *ceteris paribus*, raises maize demand as feed by 0.22 per cent. The details of maize demand in the Philippines are presented in Table 3.3.

Table 3.3 Maize demand in the Philippines

Maize demand/ Explanatory variable	Elasticity of maize demand	t-stat	D-Watson	R^2
Food		-		
Own domestic price	-0.31	-		
Price of rice	-0.81	-		
Per capita income	-0.47	-	-	0.65
Feed Industry				
Wholesale price of maize	-0.08	-		
Poultry production	0.22	-		
Pork production	0.47	-	-	0.96

Source: Cardenas *et al*., 2005.

All maize in Thailand is used for the feed industry. Maize demand as feed is determined by the price of maize, the prices of broilers and eggs as well as the poultry and swine populations, with R^2 of 0.91 and Durbin-Watson of 2.11. The elasticities of maize

demand with respect to such variables are presented in Table 3.4. The explanatory variable that has greatest influence on maize demand is swine population, followed by the price of maize. As swine population grows by 1 per cent, demand for maize will increase by 1.09 per cent. This indicates that most feed using maize as a raw material is used for raising swine.

Table 3.4 Maize demand for feed in Thailand

Explanatory variable	Elasticity of maize demand	t-stat	D-Watson	R^2
Domestic price	-0.42	-2.52		
Price of broilers	0.19	2.01		
Price of eggs	0.21	1.49		
Number of broilers	0.31	1.92		
Number of swine	1.09	4.58	2.11	0.91

Source: Rojanasaroj, 2005.

3.1.2 Soybean meal

In Indonesia, all soybean meal used in the feed industry is imported; no domestic production of this commodity exists. Using econometric models, soybean meal imports are determined by the prices of feed, the price of soybean, the exchange rate and the volume of domestic feed production. The F-statistic was 0.0834, D-Watson = 2.28 and adjusted R^2 = 0.76. The short-run elasticities of soybean meal imports with respect to such variables are presented in Table 3.5.

Table 3.5 Soybean meal imports in Indonesia

Explanatory variable	Elasticity of soybean meal imports		t-stat	D-Watson	R^2
	Short run	Long run			
Price of feed	0.0017	0.0031			
Price of soybean	0.0007	0.0012			
Exchange rate	-0.0294	-0.0536			
Domestic feed production	0.0126	0.0230	0.0834	2.28	0.7602

Source: Swastika *et al*., 2005.

In Malaysia, demand for soybean meal (for feed) is influenced by the prices of imported soybean meal, imported maize, poultry production and the price of imported fish meal. The elasticities of soybean meal demand with respect to the four explanatory variables mentioned were -0.1499, 1.5209, 2.6261 and -0.0042 respectively. As indicated in Table 3.6, the most sensitive variable to demand for soybean meal is poultry production, since most feed production is used for poultry.

Table 3.6 Soybean meal demand in Malaysia

Explanatory variable	Elasticity of soy meal demand	t-stat	D-Watson	R^2
Price of imported SBM	-0.1499	-1.2847		
Price of imported maize	1.5209	8.8768		
Poultry production	2.6526	33.5016		
Price of imported fish meal	-0.0042	-0.0441	2.6291	0.9876

Source: Yahya and Sukir, 2005.

In the Philippines, soybean demand as feed is influenced by the wholesale price of soybean and poultry production. The elasticities of soybean demand as feed with respect to the wholesale price of soybean and poultry production are 0.12 and 2.78 respectively, as presented in Table 3.7. This implies that poultry production is the most responsive variable to determine soybean demand as feed. The wholesale price of soybean has a positive elasticity, which violates the theory, but is not significant.

Table 3.7 The behaviour of soybean demand for feed in the Philippines

Explanatory variable	Elasticity of soybean demand	t-stat	D-Watson	R^2
Wholesale price of soybean	0.12	0.28		
Poultry production	2.78	9.41	-	0.89

Source: Cardenas *et al*., 2005.

In Thailand, demand for soybean meal as a raw material of feed is determined by the price of imported soybean meal and the broiler population. The elasticities of soybean demand for feed with respect to its imported price and poultry population were -0.08 and 2.27 respectively, as shown in Table 3.8. The most causal factor determining soybean meal demand for feed is poultry production, represented by its population.

Table 3.8 Soybean meal demand for feed in Thailand

Explanatory variable	Elasticity of soy meal demand	t-stat	D-Watson	R^2
Import price of soybean	-0.08	-5.78		
Poultry population	2.27	18.88	1.65	0.96

Source: Rojanasaroj *et al*., 2005.

3.1.3 Feed

The demand for feed in Indonesia is determined by the price of feed, the price of chicken meat and the chicken population. The effects of all explanatory variables were significant as exhibited by the F-statistic, which was 0.0001. The coefficient of determination is 0.97, meaning that about 97 per cent of the feed demand can be explained by the

variation of variables included in the model. The short-run elasticities of feed demand with respect to the price of feed, price of chicken meat and chicken population are -0.04, 4.32 and 0.93 respectively. Furthermore, the long-run elasticities of feed demand with respect to the said variables are -0.05, 4.87 and 0.94 respectively. The demand for feed is highly responsive to the price of chicken meat, shown by the high elasticity. As the price of chicken meat rises by 1 per cent, the demand for feed jumps by 4.32 per cent in the short run and 4.87 per cent in the long run. In more detail, the elasticities of feed demand with respect to the explanatory variables are presented in Table 3.9.

Table 3.9 Feed demand in Indonesia

Explanatory variable	Elasticity of feed demand		F-stat	D-Watson	R^2
	Short run	Long run			
Price of feed	-0.0405	-0.0456			
Price of chicken meat	4.3200	4.8654			
Chicken population	0.9311	0.9360	0.0001	2.2420	0.9750

Source: Swastika *et al*., 2005.

3.2 Consumer price behaviour

Consumer price behaviour in Indonesia was estimated in relation to the demand for maize and the demand for feed. The domestic price of maize is significantly influenced by domestic demand for maize. Even though the import price of maize did not significantly affect the behaviour of domestic maize prices, however, it is responsive over the long run with an elasticity of 1.34. The short-run as well as long-run elasticities of domestic maize prices with respect to its explanatory variables are presented in Table 3.10.

Table 3.10 Domestic prices of maize in Indonesia

Explanatory variable	Elasticity		Prob(F-stat)	D-Watson	R^2
	Short run	Long run			
Domestic supply of maize	-0.4045	-0.5732			
Domestic demand for maize	0.3567	0.3579			
Imported price of maize	0.9439	1.3377	0.4470	2.0390	0.3327

Source: Swastika *et al*., 2005.

In Malaysia, consumers of feedstuffs comprise largely of feed millers and, to a small extent, home mixers. Since most feedstuffs are imported, their prices are determined by supply and demand in the global market. Large feed millers have the financial strength to undertake contract buying of feedstuffs to avoid price volatility. At the same time, in the formulation of feeds, the use of sophisticated software to program the least-cost

combination of feed without compromising the nutritional quality adds advantage in terms of price and production efficiency.

Consumers of poultry products are protected by a ceiling price imposed by the Government of Malaysia. The retail price of poultry products fluctuates mildly below the ceiling price. The enforcement officers of the Ministry of Domestic Trade and Consumer Affairs strictly monitor the price of food items and retailers are required to display the prices and use double-faced weighing machines (Yahya and Sukir, 2005). Therefore, consumer prices of food items are predominantly under control.

In the Philippines, the wholesale price of maize rose by 10 per cent per annum from 1982 to 2002. In contrast, the global price of yellow maize quoted at USA (f.o.b) Gulf port, declined by 20 per cent per annum during the same period. There was significant maize price protection, indicated by the wholesale domestic price of maize, which was double that of the export parity price (Gonzales, 2000 in Cardenas *et al*., 2005). Conversely, estimated import parity prices of yellow maize indicated that, in order to be competitive locally, the Philippines must impose at least a 36 per cent import tariff. The study revealed that with a 36 per cent import tariff, maize production in the Philippines would be competitive in the domestic market. However, given its high cost of production and high prices compared to major maize-producing countries, Philippine maize is highly uncompetitive in the global market.

The domestic retail price of maize exhibited a similar trend to the wholesale price, rising by 10 per cent per annum. Compared with the retail price of white maize, the retail price of yellow maize has been 5 per cent higher, on average, for the last two decades.

In Thailand, consumer prices fluctuated largely depending upon farm prices, while farm prices depended upon the international world market, especially broken rice and cassava slices. Maize is monopolistically bought by a small number of feed millers who fix their buying prices that are transmitted to local markets and the farm prices. In a year when maize is in short supply and prices of broken rice are high, imports are cheaper than local prices.

4. Supply of Feed and Feed Crops

4.1 Production structure and characteristics

4.1.1 Maize

In Indonesia, domestic maize production contributes about 90 per cent to total maize supply, and the other 10 per cent stems from imports. This means that Indonesia is highly dependent upon domestic maize production. On the contrary, domestic production tended to decline, indicated by negative production growth from 1998-2002, primarily due to a reduction in planted area.

The area planted with maize in Indonesia is significantly determined by its own price the previous year (t-1), the soybean price and the peanut price with an F-statistic = 0.0175, coefficient of determination = 0.51 and Durbin-Watson = 2.5427. The elasticities of area with respect to said three variables were 0.74, 0.66 and -0.61 respectively, as presented in Table 4.1. The positive cross-price elasticity of maize area with respect to the price of soybean indicated that soybean is not a competitor crop to maize due to differing planting seasons. Conversely, peanut is a competitor crop to maize, indicated by its negative cross-price elasticity.

Table 4.1 The analysis of maize area response in Indonesia and the Philippines

Explanatory variable	Elasticity	Prob(F-stat/ t-stat	D-Watson	R^2
Indonesia:				
Lagged maize price (Rp/kg)	0.74			
Soybean price (Rp/kg)	0.66			
Peanut price (Rp/kg)	-0.61	F= 0.0175	2.5427	0.5076
Philippines:				
Lagged farm gate maize price (P/kg)	0.81	t = 2.80		
Lagged farm gate paddy price (P/kg)	-0.45	t = -1.06		
Lagged farm gate soybean price (P/kg)	0.23	t = 1.37	-	0.6430

Sources: Swastika *et al*., 2005; Cardenas *et al*., 2005.

In the Philippines, the area planted with maize is positively affected by the lagged farm gate price of maize and lagged farm gate price of soybean. Oppositely, the farm gate price of paddy has a negative effect on the planted area of maize (Table 4.1). The coefficient of determination was 0.64, meaning that about 64 per cent of the variation in area planted with maize can be explained by the explanatory variables included in the model. Similarly to Indonesia, in the Philippines soybean is also not a competitor crop to

maize, because they are usually planted in different seasons. On the other hand, rice is presumably a competitor crop for maize in terms of land use in the Philippines, particularly during the dry season.

Apart from area, another component of maize production for domestic supply is yield. In Indonesia maize yield is influenced by the lagged price of maize, lagged price of fertilizer and wage rates. All signs were consistent with expectations. However, the responsiveness of yield with respect to the explanatory variables was quite low; indicated by its short-run and long-run elasticities (Table 4.2).

Table 4.2 The analysis of maize yield in Indonesia and the Philippines

Explanatory variable	Elasticity		Prob(F-stat)/ t-stat	D-Watson	R^2
	Short run	Long run			
Indonesia:					
Lagged maize price (Rp/kg)	0.14	0.19			
Lagged fertilizer price (Rp/kg)	-0.06	-0.08			
Wage rate (Rp/man day)	-0.04	-0.06	F = 0.0001	1.7993	0.99
Philippines:					
Lagged maize farm gate price (P/kg)	-0.25	-	t = -2.09		
Fertilizer price (P/kg)	-0.18	-	t = -2.34		
Lagged wage rate (P/man day)	0.69	-	t = 3.83	-	0.91

Sources: Swastika *et al*., 2005; Cardenas *et al*., 2005.

Similar explanatory variables were used in the yield response model for Indonesia and the Philippines. The difference is only in terms of lagged fertilizer price and wage rates. Meanwhile, the signs of two parameters (maize price and wage rates) in the Philippines estimation were not as expected, although the variables taken holistically explained approximately 91 per cent of the variation in maize yield. The details of maize yield responses in two participating countries are presented in Table 4.2.

Dissimilar to Indonesia and the Philippines, the supply model estimations in Malaysia and Thailand used a direct approach. By using an autoregressive model, domestic maize production in Malaysia was determined by maize acreage, producer price of maize and lagged 1 to 3 autoregressive variables. It revealed that 90 per cent of maize production variation can be explained by the explanatory variables used in the model. Among the explanatory variables, maize acreage in year **t** is responsive, as indicated by its elasticity (Table 4.3). An increase in maize acreage by 1 per cent would expand maize production by 1.08 per cent. This effect is highly significant.

Table 4.3 The analysis of maize production in Malaysia and Thailand

Explanatory variable	Elasticity	Prob(F-stat)/ t-stat	D-Watson	R^2
Malaysia:				
Maize acreage (MA t)	1.08	t = 9.07 **		
Lagged maize acreage (MA t-1)	0.24	t = 1.98		
Producer price of maize (PPM t)	0.33	t = 3.19 *		
Auto regressive lagged 1 year (AR 1)	-0.49	t = -0.82		
Auto regressive lagged 1 year (AR 2)	0.22	t = 0.62		
Auto regressive lagged 1 year (AR 3)	0.31	t = 0.92	2.28	0.90
Thailand:				
Maize wholesale price in year t-1	0.55	t = 6.98		
Price of sugarcane in year t-3	-0.42	t =- 5.16		
Price of cassava in year t	0.08	t = -1.81		
Price of fertilizer in year t	0.35	t = 3.03	1.98	0.87

Sources: Swastika *et al*., 2005; Cardenas *et al*., 2005.

In Thailand, maize production in year t is significantly determined by the wholesale price of maize in year t-1, sugarcane price in year t-3, the price of cassava in year t and the price of fertilizer in year t. The explanatory variables explained about 87 per cent of the variation in maize production (Table 4.3). Among the four explanatory variables, the signs of elasticity for maize production with respect to the prices of cassava and fertilizers are not as expected. Based on the results, cassava is not considered a competitor crop to maize, while sugarcane is.

4.1.2 Feed

All manufactured feed in Indonesia is produced domestically. The poultry industry boom in the mid 1980s was followed by rapid growth in the feed industry. Before the economic crisis, the feed market was almost balanced. However, since 1997 (during and after the crisis), the demand for feed has declined in concordance with the contraction of the poultry industry. As such, the feed market was over supplied, despite operating under capacity. For example, in 2001 feed production in Indonesia totalled 4.5 million tons, while demand was only about 2.5 million tons.

Feed production in Indonesia is determined by the prices of feed, the local price of maize, maize demand for feed, the domestic price of imported feed ingredients and the interest rate, with an F-statistic of 0.0001. About 95 per cent of the variation in feed production was explained by the explanatory variables used in the model. All signs of parameter estimates were in line with economic theory. Among the five explanatory variables, the domestic price of maize is the most likely to trigger a response. It was exhibited by the short-run and long-run elasticities of feed production with respect to the

domestic price of maize. The second and third most responsive variables were maize demand for feed and the domestic prices of imported feed ingredients. In more detail, the behaviour of feed production in Indonesia is presented in Table 4.4.

Table 4.4 Feed production in Indonesia

Explanatory variable	Elasticity		Prob (F-stat)	D-Watson	R^2
	Short run	Long run			
Price of feed	0.21	0.25			
Domestic price of maize	-1.81	-2.20			
Maize demand for feed	1.25	1.52			
Domestic price of imported feed ingredient	-1.10	-1.34			
Interest rate	-0.24	-0.29	0.0001	2.2140	0.95

Source: Swastika *et al*., 2005.

4.2 Producer price behaviour

4.2.1 Prices of feed crops

The behaviour of feed crop prices in Indonesia, in terms of their response to determining variables, has been discussed previously. The domestic price of maize is determined by the domestic supply and the demand for maize, as well as by the import price of maize.

In Malaysia, there are no producer prices established for feed crops, since there are very limited feed crops grown, most are imported. As feed costs constitute about 75 per cent of total livestock production, livestock producers always try to minimize feed costs. Consequently, domestic feed crop producers continue to face restricted growth in their output attributable to the rising costs of feed crop production. Therefore, profit from feed crops is very thin and not attractive. Farmers are better off producing food crops where there is a ready market, higher output prices and better profits are generated.

In the Philippines, the nominal farm gate price of maize has been rising by 10 per cent per year over the last 20 years. Similarly, the nominal price of rice and soybean have also risen; by 11 per cent and 8 per cent per annum respectively.

In Thailand, the oligopolistic maize buyers (feed millers) set their buying price and transmit it through regional traders to the farmers. Farmers have very little or no negotiating power. In this regards, in a year of abundant maize supply and lower global price, the National Food Policy Committee, as representative of the Ministry of Agriculture and Co-operatives, the Ministry of Commerce, and private concerns intervene with a maize mortgage programme.

4.2.2 Product prices

Compound or manufactured feed (called feed) in Indonesia is a product of feed crops. The price of feed is determined by its market forces, namely the supply of and the demand for feed. Consistent with economic theory, as the supply of feed grows, its price will decline. Inversely, a rise in demand for feed triggers a hike in its price. The magnitudes of the effects of feed supply and demand on the changes in price of feed are reflected by their respective elasticities (Table 4.5).

Table 4.5 Feed price trends in Indonesia (Thousands of tons)

Explanatory variable	Elasticity		F-stat	D-Watson	R^2
	Short run	Long run			
Demand for feed	0.73	0.99			
Supply of feed	-1.46	-1.77	0.0001	2.3330	0.86

Source: Swastika *et al*., 2005.

In Malaysia, no product prices for feed crops are posted. In the past, cassava was processed into starch. Fortunately, there was waste produced from the process and the cassava waste was used for swine feed. The price of cassava waste was not as competitive as imported cassava.

In the Philippines, yellow maize and soybean meal are considered as feed crop products. In general, the prices of yellow maize and soybean meal increased by 2 per cent and 3 per cent per year, respectively, from 1996-2002. The decline in the price of yellow maize in 1999 can be attributed to the growth in production brought about by area expansion for yellow maize and a sudden plunge in world prices. On the other hand, the decline in soybean meal price that same year may be attributed to peso appreciation.

In Thailand, locally produced soybean meal was protected by a minimum price. Soybean meal importers are required to purchase a set amount from local producers to maintain local prices. In this regard, a crushing mill can sell soybean meal at a price higher than the imported product because it is fresh, non-GMO soybean meal. The wholesale price of compound feed is regulated by the Ministry of Commerce (MOC) and the selling price cannot exceed the maximum price set. However, feed millers may be permitted to adjust their feed prices upwards if it can be justified and the MOC rules in favour of the request. After a MOC notification, a new price can be administered.

4.3 Production and demand projections to 2015

The parameters used in the econometric models on supply and demand for feed crops as well as feed in four participating countries, were used to forecast future supply and demand for feed crops and manufactured feed. The results are presented in Table 4.6. Among the participating countries, Indonesia and Thailand projected feed and feed crop supply and demand, while Malaysia and the Philippines projected only feed crop supply and demand.

As presented in Table 4.6, maize production in Indonesia is projected to be 9.74 million tons in 2003, rising to about 10.18 million tons in 2005, 11.50 million tons in 2010 and 12.92 million tons in 2015. The projected growth in maize production is 2.38 per cent per annum over the 2003-2015 period. Conversely, the demand for maize is projected to be 10.01 million tons in 2003, rising to 10.76 million tons, 14.82 million tons and 19.27 million tons, respectively, in 2005, 2010 and 2015. The projected demand for maize always exceeds its projected production. Therefore, Indonesia is projected to perpetuate its maize deficit. In addition, the projected growth of demand for maize is high at 5.61 per cent per annum during the period of 2003-2015. Since growth in demand is much higher than growth in production, the future maize deficit is projected to steadily widen; from 0.27 million tons in 2003 to about 6.35 million tons in 2015.

In terms of feed, production is projected to rise from 4.61 million tons in 2003, rising to 4.72 million tons, 5.02 million tons and 5.35 million tons, respectively, in 2005, 2010 and 2015, with growth of 1.25 per cent per year during 2003-2015. Demand for feed is also projected to increase; from 3.70 million tons in 2003 to 4.09 million tons, 5.37 million tons and 6.98 million tons in 2005, 2010 and 2015 respectively. The growth in demand for feed is projected at a rate of 5.44 per cent per year during 2003-2015. It is forecast that before 2010, Indonesia will produce a feed surplus. Since growth in demand is expected to be higher than that of production, a deficit will occur as of 2010. The details of projected supply and demand for feed in Indonesia and other participating countries are presented in Table 4.6.

Table 4.6 Projected production, demand and balance of feed and feed crops in the participating countries, 2003-2015 (thousands of tons)

Description	Country	Commodity	2003	2005	2010	2015
Production	Indonesia	Maize	9 744	10 184	11 500	12 923
		Feed	4 606	4 722	5 024	5 346
	Malaysia	Maize	-	13	15	18
		Soybean meal	-	n.a.	n.a.	n.a.
	Philippines	Maize	4 315	4 307	4 286	4 266
		Soybean meal	n.a.	n.a.	n.a.	n.a.
	Thailand	Maize	4 736	4 827	5 121	5 493
		Soybean meal	n.a.	n.a.	n.a.	n.a.
		Feed	n.a.	n.a.	n.a.	n.a.
Demand	Indonesia	Maize	10 011	10 765	14 821	19 270
		Feed	3 700	4 091	5 369	6 985
	Malaysia	Maize	-	2 618	2 710	2 807
		Soybean meal	-	603	803	1 068
	Philippines	Maize	5 946	6 226	7 037	8 029
		Soy-meal	1 524	1 679	2 142	2 733
	Thailand	Maize	4 373	4 587	5 060	5 419
		Soybean meal	3 433	3 849	5 000	6 306
		Feed	7 890	8 361	9 607	11 302
Balance	Indonesia	Maize	-267	-581	-3 321	-6 347
		Feed	906	631	-345	-1 639
	Malaysia	Maize	-	-2 605	-2 695	-2 789
		Soybean meal	-	-603	-803	-1 068
	Philippines	Maize	-1 631	-1 919	-2 751	-3 763
		Soy-meal	-1 524	-1 679	-2 142	-2 733
	Thailand	Maize	363	240	61	74
		Soybean meal	-3 433	-3 849	-5 000	-6 306
		Feed	nda	n.a.	n.a.	n.a.

Sources: Swastika *et al*., 2005; Yahya and Sukir, 2005; Cardenas *et al*., 2005; Rojanasaroj *et al*., 2005.
n.a. = no data available due to no projections conducted.

In Malaysia it is projected that maize production, although relatively small, will increase from 13 thousand tons in 2005 to about 15 million tons in 2010 and 18 million tons in 2015; growing at a rate of 3.03 per cent per annum during 2005-2015. On the other hand, demand for maize will remain much higher and steadily grow from 2.62 million tons in 2005 to 2.71 million tons and 2.81 million tons in 2010 and 2015 respectively. The projected growth is about 0.70 per cent per annum during 2005-2015. Since the share of domestic production is insignificant, the deficit will widen from 2.60 million tons in 2005 to about 2.79 million tons in 2015.

In addition, the demand for soybean meal in Malaysia is also projected to increase; from 0.60 million tons in 2005 to about 1.07 million tons in 2015, or growing at a rate of 5.88 per cent per annum. No domestic production of soybean meal is expected in Malaysia.

Dissimilar to the other countries, maize production in the Philippines is projected to decrease from 4.31 million tons in 2003 to about 4.27 million tons in 2015; a dip of -0.10 per cent per annum from 2003-2015. Inversely, demand for maize over the same period is forecast to rise from 5.95 million tons in 2003 to 8.03 million tons in 2015 (2.53 per cent per annum). Therefore, the Philippines will face a burgeoning maize deficit from 1.63 million tons in 2003 to about 3.76 million tons in 2015.

Regarding soybean meal, no production is projected. In contrast, the demand for soybean meal is expected to rise from 1.52 million tons in 2003 to about 2.73 million tons in 2015. In other words, the demand for soybean meal is projected to grow at a rate of 4.99 per cent per annum during 2003-2015. This implies that the Philippines will be more dependent upon imports of soybean meal. This is the case for most Southeast Asian Countries.

Maize production in Thailand is projected to rise from 4.74 million tons in 2003 to about 5.49 million tons in 2015 (1.24 per cent per annum). However, the demand for maize is also anticipated to surge from 4.37 million tons in 2003 to about 5.42 million tons in 2015 (1.80 per cent per annum). Thailand is the only country among the participating countries that is expected to experience a maize surplus until 2015, although the surplus is projected to narrow.

In terms of soybean meal, no projections were conducted for production. Meanwhile, demand for soybean meal is thought to rapidly increase from 3.43 million tons in 2003 to about 6.31 million tons in 2015 (95.20 per cent per year from 2003-2015). Similarly, the other participating countries as well as Thailand are dependent on imports of soybean meal.

The demand for feed is also estimated to jump from 7.89 million tons in 2003 to 11.30 million tons in 2015 (3.04 per cent per annum from 2003-2015), as shown in Table 4.6. No feed production is projected, thus it is impossible to estimate the feed balance, whether it be surplus or deficit.

These projections show that, except for Thailand, the participating countries in the future will face maize deficits, at least until 2015. Without any breakthroughs, the dependence of these countries on maize imports will increase in line with the rapid growth of the poultry industry. Conversely, maize trade in the global market is considered to be in decline, despite production increases. This means that in future, maize will not be easily obtained in the international market. Currently, USA is the biggest maize exporter and the superpower in determining the price of this commodity in the global market. It is not a

conducive situation for the livestock industry in developing countries, including the participating countries.

Almost 100 per cent of soybean meal is imported, especially from countries where a soybean-oil industry is present. The deficit of this commodity in the future is projected to widen sharply, while the volume of soybean meal trade in the global market might be sparse. Substitutes are necessary to replace a part of the soybean meal as a source of protein and crude fiber for feed ingredients, otherwise, the feed industry and the poultry industry will slip into decline.

5. Trade and SWOT Analysis of Feed Crops

5.1 Trade of feed crops

Reflected by higher per capita income and diverse food consumption of wheat, beef, dairy products, temperate vegetables and fruit, for which Southeast Asia is either a non-traditional or minor producer, Southeast Asia has emerged as a significant importer of a wide range of food and agricultural products in the world. For some traditional products, such as pulses and seafood, domestic production has failed to keep pace with demand, likewise resulting in more imports.

Over the past decade, most Southeast Asian countries studied (Indonesia, Malaysia, and the Philippines) have been net importers of major feed crops like corn/maize as well as soybean and its derivatives, with Thailand as the exception. In Thailand, maize and soybean are completely utilized domestically. Only rice and cassava in Thailand have an exportable surplus supply. Malaysia depends solely on imported maize, soybean and soybean meal for its livestock industry. Meanwhile, Indonesia imports maize to meet the requirement for raw materials from the feed industry. Over the last three decades, the share of imported maize in Indonesia has increased by 11.81 per cent per year. In the Philippines, the most commonly imported feeding stuff was soybean oil cake/meal. Its share in 2002 was 61 per cent of total imports of feed crops and feed stuffs.

The global maize trade is dominated by the USA, Latin America (Brazil, Mexico and Argentina) and China. It is estimated that by 2020 their shares will respectively be 45, 15 and 23 per cent (Kasryno, 2002). Despite the aggregated share of maize production from developing countries projected to rise from 45 to 52 per cent by 2020, consumption will expand further from 49 to 60 per cent. This is driven by dramatic growth in maize consumption from the feed industry.

Indonesia will continue as a net importer of maize, which is indicated by the widening maize deficit. Projected domestic demand for maize as food as well as feed will grow more than double its projected production (5.39 per cent compared to 2.36 per cent growth for maize as food and 5.40 per cent compared to 1.25 per cent growth for maize as feed). Maize import behaviour to Indonesia is influenced by: (i) import price; (ii) domestic price; (iii) exchange rate of rupiah to US dollar; (iv) Indonesian GDP; and (v) lagged volume of maize

imports (Swastika *et al*., 2005). The feed market in Indonesia tends towards an oligopolistic structure dominated by a few large feed factories. They market animal feed to small-scale livestock raisers, particularly poultry breeders.

The feed industry in Indonesia is heavily reliant on imported feed ingredients, such as soybean meal and maize. Therefore, any trade policies imposed by exporting countries affect the domestic feed market. This illustrates the close links between the domestic and international markets.

In Thailand, trading of feed crops and feedstuffs is operated liberally in the local scheme. The buyers are the producers of feed both for sale and direct feeding in the company's livestock programmes. There are also farmers who buy the feedstuffs for self-mixing. Meanwhile, in terms of international trading, Thailand is bound by WTO commitments on the list of 23 Thai farm commodities tied to the tariff system. For soybean, the government permits liberal imports and exports at zero tariff; whereas for soybean meal an export permit must be sought from the National Food Policy Committee, while imports can be made freely at a 5 per cent tariff. For maize, exports are liberal but imports are on a tariff quota basis.

The Government of Thailand has implemented policy to solve a number of feedstuff shortage issues with Cambodia, Myanmar and Lao Peoples' Democratic Republic. This one-way free trade includes soybean, maize and rice. Through such agreements, tariffs have been reduced to zero. Consequently, the three neighbouring countries have become a part of the resources for feed crop supply to Thailand in times of internal shortages. In addition, Thailand grants technical assistance for feed crop production to its neighbour countries.

Malaysian Government policy continues to depend on imported maize, soybean and soybean meal for the livestock industry. China is their largest supplier of maize, followed by the USA and Argentina. There are other smaller maize suppliers such as Thailand, Myanmar, France, Indonesia, United Arab Emirates, the Netherlands, Belgium, Korea and India. In terms of soybean, Argentina remains the top supplier to Malaysia with 44 per cent market share followed by the USA with 34 per cent. Other suppliers include China, Canada, Brazil and India. Competitively priced soybean and soybean meal from Argentina continue to be its strength compared to the USA.

The Philippines is a net importer of maize and soybean as well as other feedstuffs for animals. Imported feeding stuffs for animals include soybean oil cake/meal, cereal bran, fodder roots, flour, feed additives and solid food residues, among others. The few feedstuff

exports from the Philippines include sugarcane tops, corn cobs/stalks/leaves, fruit waste (peels), wheat bran and other residues, as well as copra oil cake and solid residues.

Prior to the GATT-WTO agreement, corn imports to the Philippines were low due to import restrictions imposed by the government. Imports then skyrocketed in 1995 when the Philippines began to liberalize the maize sector by removing quantitative restrictions, as required by the WTO agreement. Soybean imports also accelerated but at a slower rate. These phenomena can be explained by the trends in world prices of maize and soybean. After GATT-WTO implementation in 1995, the international price of yellow maize dropped. This, coupled with the removal of quantitative restrictions, affected the increasing trend of maize imports. On the other hand, soybean prices rose after 1995, forcing a decline in soybean imports.

The descriptions above illustrate the complexity of the challenges many countries in Southeast Asia face, which spiral into an increasing reliance on imports. The existence of livestock industries and their supporting components in the region have exposed the region to an influx of both input materials and livestock end products. Many analysts argue that this phenomenon is a simple matter of trade issues under comparative advantage. However, we argue that the pseudo-comparative advantage in grains and livestock product exports from exporting countries abounds because these countries provide a substantial amount of support to their own grain and livestock farmers in various forms classified by the WTO as domestic support, export competition or subsidies and high tariffs.

Market-driven developments have been accompanied by government-directed regional initiatives. In January 1992, ASEAN leaders agreed to create an ASEAN Free Trade Area (AFTA) over 15 years. In its current form, AFTA applies only to the trade of manufactured products. However, with the emergence of a Southeast Asian pattern of food and agricultural trade and investment, the potential advantage of widening AFTA to include unprocessed goods and raw materials, and eventually extending AFTA membership to the Indo-China economies and Myanmar, are being noted by some.

Sub-regional growth zones -better known as growth triangles- are likely to play an increasingly important role in the development of the region's food and agricultural production. These initiatives remove political and other impediments to the joint commercial development of neighbouring -and economically complementary- countries. For example, the Singapore-Johor-Riau (SIJORI) growth triangle, which combines Singaporean capital with land, labour and natural resources available in Malaysia and Indonesia, has already spawned a number of agro-processing ventures. Encouraged by the success of SIJORI,

Southeast Asian governments are supporting a number of other growth zone proposals. A prerequisite for the undertakings is that a central government should delegate the local government to assume some responsibility in making strategic decisions regarding its vision on how to pursue agricultural development.

Co-operation among members of the ASEAN/AFTA could be strengthened to develop a regional livestock industry to protect the industry from increasing competition from external markets. The enhancement of indigenous feed resources, through promotion and expansion, is undoubtedly an important way of helping livestock producers reduce their costs. Some government initiatives and more importantly those of the private sector are required to stimulate the livestock stakeholders' interest for feed and feed ingredient alternatives. In Malaysia, the exploration of abundant agro-industrial waste and new sources of forage such as chopped oil palm fronds are in progress. The potential of oil industry by-products, such as oil palm frond (OPF), palm kernel cake (PKC), palm oil mill effluent (POME), palm press fiber (PPF), empty fruit bunches (EFB) and oil palm trunk (OPT) is high and their use should be aggressively promoted for acceptance as ruminant feeds. Thailand had a long history of conducting research on cassava (*manihot esculenta*) utilization but then the EU cut its cassava pellet imports. In the Philippines the use of cassava and ipil-ipil leaf (*leucaena leucocephala*) meal for animal feeds has gained popularity in recent years because of their abundance due to various government programmes. Other materials that can substitute energy from grains are cassava and sweet potato. Roots, tubers and fruit plants can also be served as potential substitutes for cereals to provide nutrients. For protein substitutes, Southeast Asian countries can rely on their own fishery resources. For fat substitutes, Indonesian and Malaysian palm oil and also Philippine coconut oil are available. Through appropriate processing methods and complex testing, these substitute products may substantially reduce dependence upon fish meal and other imported protein-rich feedstuffs.

5.2 SWOT analysis

The strengths, weaknesses, opportunities and threats of feed crops and feed development in each participating country were identified by the researchers. Some of the common characteristics are listed in Table 5.1. Common characteristics, in term of strengths include: availability; climate suitability; high domestic direct and derived demand as well as consumption; new improved and hybrid seeds, especially maize due to its higher quality as animal nutrients than imported maize; abundant indigenous feed resources from plants that

can be exploited and promoted as feed as substitutes for imported feed; and the existence of national programmes (in the Philippines, Indonesia and Thailand for rice, maize, soybean, cassava and other secondary crops as well as for oil palm in Malaysia).

Inappropriate post-harvest handling; seasonal price fluctuations; product price cutting; fragmented landholdings; lack of input unavailability (including water in the northern region of Thailand, and credit accessibility in Indonesia); low feed crop production and competitiveness compared to other crops; unorganized marketing systems; a lack of farm investment, research; as well as weak extension and farmer linkages, are mentioned as the primary weaknesses. The opportunities of the Southeast Asian region are categorized as strong and steady increasing demand for feed crops and feed stuffs; the presence of HYV and improved varieties of the feed crops; the presence of contract farming schemes and partnerships between feed producers and farmers; more markets are accessible through Free Trade Agreement (FTA's), Bilateral and Multilateral Regional Trade; the establishment of the huge "halal" food market in the world; the presence and establishment of "organic" and/or non-GMO markets; increasing demand for PKC (Palm Kernel Cake) from Europe and Japan as ruminant feed; and the existence of government policies, such as the Grains Highway Programme (in the Philippines), Gemapalagung programme (in Indonesia) as well as the one-way free trade policies of Thailand to neighbouring countries.

The threats commonly faced by Southeast Asian countries include the rising trend of imports (maize, soybean, soybean meal and rice, among others); supply shortages in the global market; the spread of Avian flu and other diseases that can cripple the livestock industry and subsequently the animal feed industry; inconsistency in the tariff schemes, which negatively affects local farmers; government instability, including changes in the legal framework and constitutional matters; peace and order in "hot-spot' areas affect investment; climate change (floods, La Nina, El Niño); lack of private sector involvement; strong competition from other crops in utilizing the land, especially in rainfed areas; stiff competition among the many processors of prepared feeds in the global market; and a lack of farmer knowledge regarding acceptable post-harvest management.

Table 5.1 SWOT analysis for feed and feed crop development in Southeast Asia

STRENGTHS	➢ Area availability and climate suitability ➢ High domestic direct and derived demand, as well as consumption ➢ New improved and hybrid seeds, especially maize that is of better quality in terms of animal nutrients than the imported product ➢ Abundant indigenous feed resources from plants that can be exploited and promoted as feed as substitutes for imported feed ➢ The existence of national programmes (in the Philippines, Indonesia and Thailand for rice, maize, soybean, cassava and other secondary crops and in Malaysia for oil palm)
WEAKNESSES	➢ Inappropriate post-harvest handling ➢ Seasonal price fluctuations and product price cutting ➢ Landholdings are fragmented and there is a lack of input availability (including water in the northern region of Thailand, credit accessibility in Indonesia) ➢ Productivity of feed crops is low ➢ Less competitive compared to other crops ➢ Unorganized marketing system ➢ Lack of farm investment ➢ Research, extension and farmer linkages are weak
OPPORTUNITIES	➢ Strong and steadily rising demand ➢ The presence of HYV and improved varieties of feed crops ➢ The presence of contract farming schemes and partnerships between feed producers and farmers ➢ More markets are accessible through Free Trade Agreement (FTA), Bilateral and Multilateral Regional Trade ➢ Establishment of the huge “halal” food market in the world ➢ The presence and establishment of “organic” and/or non-GMO markets ➢ The increasing demand for PKC (Palm Kernel Cake) from Europe and Japan as ruminant feed ➢ The existence of government policies, such as the Grains Highway Programme (in the Philippines), the Gemapalagung programme (in Indonesia), and one-way, free trade policies to neighbouring countries (in Thailand)

Continued …

Table 5.1 SWOT analysis for feed and feed crop development in Southeast Asia
(continued)

THREATS	➢ Increasing trend of imports (maize, soybean, soybean meal, rice) and a shortage in global supply ➢ The spread of Avian flu and other animal diseases can cripple the livestock industry and subsequently the animal feed industry ➢ Inconsistency in the tariff schemes negatively affects local farmers ➢ Government instability, including changes in the legal framework and constitutional matters; peace and order in "hot-spot' areas, affect investment ➢ Climate changes (floods, La Nina, El Niño) ➢ Lack of private sector involvement ➢ Strong competition from other crops in utilizing the land, especially in rainfed areas ➢ Stiff competition among the many processors of prepared feeds in the global market ➢ Farmers lack knowledge regarding post-harvest management

6. Conclusions and Recommendations

6.1 Conclusions

A period of strong economic growth in most Southeast Asian countries, rapid structural change, increasing affluence and a projected population of over 615 million by 2010, represent contributing factors triggering higher demand for food and agricultural products. The primary concern relating to feed and feed crops in the Southeast Asian region is that domestic production remains unable to meet the increasing demand.

For the last five years, the major producer of chicken meat and milk among the four participating countries in this study has been Thailand, while the Philippines has been the major producer of pork, and Indonesia the major producer of beef and goat meat. In terms of per capita consumption, the highest per capita consumption of livestock products has been Malaysia, presumably driven by the highest per capita income among the four countries. Rapid growth in the poultry and swine industries have triggered an increase in the demand for feed and subsequently feed crops.

Maize is the most popular ingredient of manufactured feed in the participating countries. In second and third place are soybean meal and rice bran. The previous chapters showed that almost all participating countries have maize deficits, except Thailand. In 2002, the maize deficit of the region was about 4.03 million tons; nearly 20 per cent of the total imported from other regions, primarily from the USA. A wider deficit exists for soybean meal, with about 4.86 million tons or about 77 per cent of total demand imported from other regions. Since demand growth for maize and soybean meal has been much higher than that of domestic supply, the deficits of maize and soybean meal are expanding.

As a direct food, maize in Indonesia and the Philippines is considered inferior; shown by its negative elasticity with respect to per capita income. Meanwhile, in Malaysia and Thailand, maize is consumed as processed food, instead of a staple or direct food. Thus, maize is no longer treated as an inferior food because it is processed into manufactured food.

In the supply model, Indonesia and the Philippines focused on a similar approach, namely an indirect approach. With this approach, domestic maize production, as the main source of domestic supply, is split into area and yield responses. In contrast, Malaysia and Thailand use a direct approach, namely supply response. Elasticities obtained from each

model were used to project supply and demand for feed and feed crops. Based on the results of the projections, all participating countries, except Thailand, are projected to experience burgeoning deficits for maize, soybean meal as well as compound feed. Breakthroughs are necessary to overcome these deficits in the region because in future, the global maize market will be unable to absorb the demand from developing countries. On the other hand, international trade in soybean meal will rise to slightly over 40 metric tons in years to come. Two factors that encourage this trend are: (i) low prices; and (ii) the use of soybean meal as the main source of protein in animal feed.

Of the four participating countries studied, Malaysia confirmed that per capita consumption of poultry, eggs and swine has reached a plateau implying that Malaysia must seek new markets posthaste. Malaysia also confirmed its endeavors to tap the huge "halal" food market as well as poultry meat and eggs. Various measures have already been taken to promote Malaysia as a regional "halal" food hub.

It is very clear that co-operation among members of the ASEAN-AFTA should be strengthened to develop and protect the regional livestock industry from increasing competition from external markets. Bilateral arrangements or trilateral arrangements could also be pursued to mutually benefit the countries involved. Thailand has already adopted free trade arrangements with its neighbouring countries (Cambodia, Myanmar and Lao Peoples' Democratic Republic) to stabilize its domestic market of feedstuffs while at the same time assisting the neighbouring countries. Meanwhile, Thailand has also acknowledged China as a potential market for rice and cassava. Bilateral trade agreements encompass the formation of a free trade area through the reduction of tariffs and other trade barriers imposed at the "border". They go beyond border measures, extending into large areas of domestic policy-making. One salient option of the participating countries is to collectively establish themselves through ASEAN, as the alternative hub.

This study also identified indigenous feed resources that may be used as substitutes for feed ingredients. This effort should be seen as one of many alternatives to alleviate poverty in the region through the utilization of secondary crops. In Malaysia, for example, experiments on oil palm frond (OPF)-based feed have shown that it is superior in nutritive value when compared to conventional feeds based on native grasses. There is potential for OPF-based feed if it can be produced competitively against the other substitutes. There are about 3.8 million hectares of oil palm in the country and a good supply of OPF is not an issue, although the cost of collection is. The potential for other oil industry by-products such as palm press fiber (PPF), empty fruit bunches (EFB) and oil palm trunk (OPT) is good and

their use should be aggressively promoted for acceptance as ruminant feeds. Thailand's effort in utilizing cassava as animal feed serves as another example. The Philippine experience of using cassava and ipil-ipil leaf (*leucaena leucocephala*) meal for animal feeds has gained popularity in recent years and is yet another example of promoting indigenous resources as substitutes for feed ingredients. Indonesia, Malaysia and the Philippines can utilize and expand the use of coconut oil as a fat substitute, also using fish and fish products as protein substitutes.

6.2 Recommendations

The general recommendations emerging from the studies in the participating countries are: (i) governments need to implement programmes aimed at helping the development of feed crops. The Philippines could enhance its National Programme for Corn and Rice or the Grains Highway Programme; Indonesia could relax its protective policies on rice and sugarcane (which are in tight competition with maize and soybean for the same land); Thailand could promote relay planting in the uplands and promote competitive crop cultivation in parts of maize producing areas to trigger a reduction effect, and concomitantly, promote maize planting in paddy fields to ensure year-round distribution; Malaysia could promote food crops that have dual uses, namely food and feed (for example, promote sweetcorn that has the opportunity as a food crop while the stalks and leaves post harvest can be processed into silage for animal feed); (ii) both the public and private sectors should co-operate to increase investment in the research and development of feed crops, in particular the development of high-yielding and improved varieties and their application in the fields; research and development is also required concerning post-harvest handling and processing with the participation of the private sector, including grading and standardization; and (iii) given the new world trade order, trade negotiations and co-operation at the regional level or between countries (bilaterally) are needed to ensure that a complementary arrangement is arrived at and simultaneously implementing the promised safety net measures in order to deal with competition from other countries.

Specific recommendations emerged from each participating country studied as follows: For Indonesia, to achieve efficient maize production, the action programmes necessary comprise of eight prioritized programmes: (1) maize intensification; (2) soft credit for maize production (subsidized interest rate); (3) farmer training on post-harvest handling and processing; (4) provision of post-harvest machinery through farm credit; (5) maize intensification and extensification using areas between estate crop plantations; (6)

consolidation of farmers' groups, especially on-farm management and marketing; (7) post-harvest handling field schools; and (8) promotion of grain quality management. Other feed crops such as soybean and tuber crops should be comprehensively studied. Newly released maize varieties, so called "Quality Protein Maize" (QPM), must be closely evaluated as a demand driven commodity in order to create demand. QPM has the potential to reduce the use of soybean meal as the protein contained in this type maize is higher, especially lysine, compared to other maize varieties including hybrid maize.

For Malaysia, implementation issues or problems arising from tapping the huge "halal" food market and poultry meat and eggs need to be resolved as quickly as possible. The possibility of substituting expensive feed ingredients with by-products from the oil palm industry should be aggressively promoted for acceptance as ruminant feeds.

For the Philippines, a solution to the peace and order problem in Mindanao (major maize production area) must be sought by the government. This will not only benefit the feed crop sector but also the country as a whole. On the issue of credit and access to capital, production arrangements, like the collaborative project for a soybean plantation in Surigaro del Sur, are models to observe. If this is successful, similar arrangements can be made, consolidating farmers' land into one large plantation (400 or more hectares) and providing them with farming support. The advantage of the model is that farmers can access quality seeds, new farming technologies, as well as a sure market. For maize, possible partners include the livestock and poultry industries. Market tie-ups could be pursued and the livestock and poultry producers could provide credit and quality seeds. This would also help ensure that quality feed crops are received.

For Thailand, a comprehensive extension programme (including training) is suggested for farmers, covering maize quality improvements, improved high-yield varieties for rice, appropriate post-harvest practices for cassava to obtain a higher starch content, as well as grading and standardization of soybean in terms of moisture. Another advantage, if Thailand develops these food and feed crops, is that their varieties are well known and promoted as being non-GMO farm products (non Genetically Modified Organism) for human food and feed. With promotion, this can be translated into price mechanisms that could benefit farmers and industries alike in Thailand.

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Foreword

The research project “Prospects of Feed Crops in Southeast Asia” began in July 2003 and was officially completed in December 2005. This project represents a continuation of an earlier and similar project conducted in four South Asian countries namely, India, Nepal, Pakistan and Sri Lanka.

The idea to formulate the project was initiated by Dr. Haruo Inagaki, Dr. Pantjar Simatupang and Dr. Muhammad Chowdhury during their tenure at UNESCAP-CAPSA (formerly CGPRT Centre) respectively as the Director, the Programme Leader of Research and Development, and a member of the professional staff, based on their discussions with numerous people from different sectors and countries in South Asia. From all discussions it was clear that secondary crops have an important contribution to play not only in traditional human consumption but also industrial raw materials and feed to support the livestock sector. From these value-added products, it is expected that the farmers’ income could be raised if proper government policies are implemented and private sector involvement is sought (FEED Project). The continuation of this project was then conducted in Southeast Asia (FEED-SEA Project). This is the main thrust for undertaking both FEED and FEED SEA projects.

Four countries in the Southeast Asia namely, Indonesia, Thailand, the Philippines and Malaysia were involved in the project. The four countries were chosen to represent the region in terms of economic and agroclimatological diversity. The main activity included in the project was the undertaking of a country study by the national researchers. The reports of the country studies were published separately for individual countries in the Centre’s working paper series.

This integrated report aims firstly, to compile the country reports of the four participating countries, and secondly, provide consolidated discussions on strategies and policies to develop feed crops in the region. I sincerely hope that this integrated report, together with the country reports, will contribute to the further improvement of feed and feed crop development in the participating countries as well as in those countries that have similar conditions.

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Taco Bottema
Director
UNESCAP-CAPSA

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Erna M. Lokollo, Programme Leader
Budiman Hutabarat, Regional Advisor
Dewa K.S. Swastika, Indonesian National Expert

Executive Summary

Demand for feed in Southeast Asia changes as income, population and other socio-economic characteristics of society change. The rapid urbanization of developing Southeast Asia and associated changes in lifestyles will have profound effects on food preferences and hence, on demand. Therefore, the challenges faced by Southeast Asian countries include how to satisfy the increasing demand and qualitative changes in demand through the development of prospective feed crops and livestock industries.

The general objective of this project is to elucidate and analyse the current status of feed crop farming with special emphasis placed on secondary crops in Southeast Asian developing countries. The study is a continuation of a similar study conducted in South Asian countries in 2002-2003. More specifically, the objectives are as follows:

(i) To analyse historical dynamics and future trends of demand and supply for feed crop products;

(ii) To evaluate potentials, weaknesses, opportunities and constraints for expanding feed crop farming with emphasis placed on secondary crops in participating countries;

(iii) To propose possible co-operation schemes for the trade and development of feed crops/products among Southeast Asian countries; and

(iv) To formulate policy options to promote the sustainable development of feed crop farming in participating countries.

SWOT analysis was also performed to provide a more comprehensive view of whether the effort was feasible from a managerial point of view.

The project was undertaken from July 2003 to December 2004 through a collaborative study with partner institutes in Indonesia, Malaysia, the Philippines and Thailand. One team from each participating country lead by a national researcher/expert undertook the tasks of their study in their respective country and prepared country reports. The teams are:

- Dr. Dewa K.S. Swastika, Senior Researcher, Indonesian Center for Agricultural Socio-Economic and Policy Studies (ICASEPS), Bogor, Indonesia.

- Tunku Mahmud bin Tunku Yahya, Senior Research Officer, Economic and Technology Management Centre, Malaysian Agricultural Research and Development Institute (MARDI), Serdang, Selangor, Malaysia.
- Dr. Danilo C. Cardenas, Chief, Science Research Specialist, Philippines Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines.
- Ms. Chamras Rojanasaroj, Senior Economist, Office of Agricultural Economics (OAE), Ministry of Agriculture and Cooperatives, Bangkok, Thailand.

This Working Paper has been compiled using information generated by individual country studies complemented with other relevant information to provide a regional perspective on current issues and prospects.

Agro-industrial development is becoming increasingly important to economies in most Southeast Asian countries. This development has the potential to generate value-added for agricultural products, and part of the value-added process can benefit farmers.

Maize is the most popular ingredient of manufactured feed in the participating countries; second and third are soybean meal and rice bran respectively. The study finds that except for Thailand, all participating countries experience a deficit for maize; and the region experiences an even higher deficit for soybean meal. Regional supplies of both maize and soybean meal are expected to fall short of demand in the years to come.

In the supply model, Indonesia and the Philippines applied similar indirect approaches, in which domestic maize production was disaggregated into area and yield. The Malaysia and Thailand studies apply direct approaches. Elasticities estimated in each model were used to make projections of supply and demand for feed and feed crops. Based on the results of the projections (2010, 2015) all participating countries, except Thailand, are projected to register increasing deficits for maize, soybean meal as well as compound feed.

The study also identifies indigenous feed resources which can be used as substitutes for feed ingredients. In Malaysia, experiments on oil palm frond (OPF)-based feed have shown that it is superior in nutritive value compared to conventional feeds based on native grasses. Thailand has long experience in using cassava as animal feed; the Philippines is experienced in using cassava and ipil-ipil leaf *(leucaena leucocephala)* as meal for animal feed. All participating countries have abundant and reportedly, under-utilized sources of fish and fish products along their coastlines to be used as protein substitutes for animal feed in the region.

The studies also highlight the potential of co-operation in trade among members of ASEAN/AFTA through bilateral agreements. The Thailand experience in adopting free trade arrangements with neighbouring countries (Cambodia, Myanmar and Lao People's Democratic Republic) serve as an example of how Thailand stabilized and secured its domestic market for feed stuffs. An issue of importance is to what extent one may sustain rural income increases in such countries.

The most serious concerns relating to feed crops in the Southeast Asian region are: (i) the demand for maize and soybean meal as feed ingredients in each participating country will out pace domestic supply, except for maize in Thailand. The gap between demand and supply will become more pronounced in coming years, especially in Indonesia, Malaysia and the Philippines; and (ii) the development of these crops is constrained by factors such as a lack of competitiveness compared to other crops, stagnating local market integration, as well as a lack of input availability and support policies for farmers.

Some of the measures that policymakers in participating countries can pursue immediately are: (i) to strengthen trade co-operation among ASEAN/AFTA countries, (ii) to facilitate the development of contract procurement between farmers and feed producers ensuring an available market and fair prices, (iii) to maintain national programmes for maize, soybean, cassava and other crops to protect and assist domestic farmers.

Some common strengths, weaknesses, opportunities and threats related to the development of feed crops have been identified in this study. However, each country has its own uniqueness in pursuing efforts to capitalize on the challenges faced in the development of feed crops.