Economic and Social Commission for Asia and the Pacific

CAPSA Monograph No. 47

Prospects of Feed Crops in Southeast Asia: Alternatives to Alleviate Poverty Through Secondary Crops' Development

Proceedings of the Regional Workshop Held in Bogor, Indonesia September 14-15, 2004

United Nations
ESCAP

UNESCAP-CAPSA

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.

Functions

1. Coordination of socio-economic and policy research on secondary crops.
2. Networking and partnership with other international organizations and key stakeholders.
3. Research and analysis of trends and opportunities with regard to improving the economic status of rural populations.
4. Production, packaging and dissemination of information and successful practices on poverty reduction.
5. Dissemination of information and good practices on poverty reduction measures.
6. Training of national personnel, particularly national scientists and policy analysts.
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"UNESCAP-CAPSA: Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific"

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Erna M. Lokollo
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UNESCAP-CAPSA
Centre for Alleviation of Poverty
through Secondary Crops' Development
in Asia and the Pacific

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Foreword

A regional workshop on "Prospects of Feed Crops in Southeast Asia: Alternatives to Alleviate Poverty through Secondary Crops' Development" was held on 14-15 September 2004 in Bogor, Indonesia, to discuss the findings and policy options of an eighteen-month research project "Prospects of Feed Crops in Southeast Asia (FEED-SEA). The project is a continuation of a similar project in South Asia (FEED) conducted by the Centre one year previously.

The National experts of participating countries, Indonesia, Malaysia, the Philippines and Thailand presented the reports of country studies and the commentators from each country provided additional information and comments. A resource person, Prof. S.S.E. Ranawana, Gonawila University, Sri Lanka, presented the paper the "Feed Crops in South Asian Countries: Problems and Prospects". The workshop had a question-answer session and open discussions provoked by a consolidated discussion by Dr. Budiman Hutabarat who served as regional advisor.

I thank those speakers who participated in the workshop and provided drafts for discussion. I also thank Dr. Erna Maria Lokollo, Dr. Budiman Hutabarat and Mr. Matthew L. Burrows for their effort in compiling and editing this volume. Finally, I express my sincere appreciation to the Government of Japan for funding the project and supporting the workshop.

I do hope these proceedings will provide useful information to the readers and to the countries involved in the study.

August 2005

Yap Kioe Sheng
Officer-in-charge of CAPSA

Acknowledgements

This project and the regional workshop were made possible through the involvement and contribution of many individuals and institutions. Our deepest appreciation and gratitude goes first to Dr. Nobuyoshi Maeno, the former director of UNESCAP-CAPSA, for giving us the opportunity and chance to proceed with the study. He gave continuous motivation and support.

I acknowledge and am indebted to Dr. Budiman Hutabarat, my predecessor and the "architect" of the FEED project in the project formulation and initiation. As regional advisor Dr. Hutabarat was also involved actively in the project.

I wish to thank the national experts of the project: Dr. Dewa K.S. Swastika from Indonesia, Mr. Tunku Mahmud bin Tunku Yahya from Malaysia, Dr. Danilo C. Cardenas from the Philippines, and Ms. Chamras Rojanasaroj from Thailand, for their valuable contribution.

Thank you to all outstanding commentators of the respective country reports: Dr. Kusumo Diwyanto of Indonesia; Dr. Ibrahim Che' Embong of Malaysia; Dr. Danilo Baldos from The Philippines; and Mr. Chan Chiumkanokchai from Thailand.

I also appreciate the involvement and participation of Mr. Yap Kioe Sheng, Chief, Poverty Reduction Section, Poverty and Development Division, UNESCAP.

I acknowledge the participation of Prof. S.S.E. Ranawana from Wayamba University, Sri Lanka; Mr. Kasmin Nadeak from Directorate General of Food Crops Production Development; Ms. Sudariyah from the Directorate General of Livestock Service; Dr. Raffi Paramawati from the Indonesian Center for Agricultural Engineering Research and Development; Dr. Yusdar Hilman and Dr. Alex Sudaryono from the Indonesian Legume and Tuber Crops Research Institute; Dr. Pius P. Ketaren from the Indonesian Research Institute for Animal Production; Mr. Bambang Sayaka and Mr. I Ketut Kariyasa from the Indonesian Center for Agricultural Socio Economic Research and Development; and Mr. Tadahiro Suzuki, Post Graduate Student, University of Tokyo. I also would like to thank the participation of the UNESCAP-CAPSA staff: Dr. Robin Bourgeois, Mr. Tomohide Sugino, Dr. Parulian Hutagaol, Dr. Wayan Reda Susila, Ms. Fetty Prihastini, Mr. M.L. Burrows, Mr. H. Zulfikar, Mr. Muhamad Arif, Ms. Fransisca Wijaya and Ms. Agustina Mardyanti. I am grateful for the continuous assistance of Mr. Burrows in editing the material of these proceedings. Finally, I am grateful to Ms. Babay P. Putra for her job in compiling and adjusting the manuscript of the project.

Erna M. Lokollo
Programme Leader
Research and Development
UNESCAP-CAPSA

Opening Session

Opening Address

Yap Kioe Sheng[*]

Distinguished National Experts, Participants,
Ladies and Gentlemen,

It is my pleasure to welcome you all to UNESCAP-CAPSA and I thank you for joining us this morning at the Regional Workshop of "Prospect of Feed Crops in Southeast Asia". I would like to take this opportunity to thank the UNESCAP-CAPSA staff, who have worked hard with ESCAP Secretariat in Bangkok and all the national experts of the participating countries for the past years on this programme, especially during my period as officer in-charge based in Bangkok in addition to my duties as Chief of Poverty Reduction Section, Poverty and Development Division.

This workshop aims to discuss, review and improve the reports of the country studies of the research project "Prospects of Feed Crops in Southeast Asian Countries".

First, allow me to briefly explain the changes currently underway within UNESCAP and therefore within the UNESCAP-CAPSA and the reason why. In the year 2000, the Executive Secretary initiated a review of the UNESCAP. In May 2002, the Commission adopted resolution for the UNESCAP to refocus its work on ***three*** thematic priorities, namely ***poverty reduction, managing globalization and addressing emerging social issues.*** Poverty alleviation is one of the UN's objectives as has already been outlined as the first goal in the "Millennium Development Goals" (MDG). Poverty is not a country issue; it is a global and region issue. Poverty is now recognized as a multi faced complex phenomenon affected by a variety of factors.

UNESCAP-CAPSA as one of the regional institutions of the UNESCAP has also undergone changes, align with the new priorities of the UNESCAP and focus to the Poverty and Development Issues. In October 2003, on it's extraordinary Governing Board meeting in Bangkok, member countries agreed to change the name of the Centre from CGPRT Centre to CAPSA (Centre for Alleviation of Poverty through Secondary Crops Development in Asia and the Pacific) and change the focus of the Centre to work from the development of production, utilization and trade of CGPRT crops to the reduction of poverty among population groups dealing with the crops. In short, the Centre will focus more on people rather than crops. On the 60th session of the Commission, Shanghai, China, 2004, the resolution of the UNESCAP-CAPSA was officially adopted. The new adjusted objectives and functions were given to the UNESCAP-CAPSA by member countries: *"to promote 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 crops agriculture, and to promote research and development related to agriculture to alleviate poverty in the Asia-Pacific region"*.

In the middle of the project's time, by June 30, 2004 Dr Nobuyoshi Maeno completed his term as Director of the Centre. UNESCAP Secretariat is presently in the process of selecting the new Director, which will be appointed around December 2004.

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[*] Chief, Poverty Reduction Section, Poverty and Development Division, UNESCAP, Bangkok, Thailand.

This workshop is one of the activities of the Centre aimed to achieve the objective and function above mandate by member countries, especially to find new development of secondary crops as feed crops, funded by the Government of Japan.

I am looking forward to the outcome of your discussions and wish that we all will have a fruitful and productive workshop.

Thank you.

Introduction

Prospects of Feed Crops in Southeast Asia: Alternatives to Alleviate Poverty through Secondary Crops' Development

Erna M. Lokollo[*] *and Budiman Hutabarat*[**]

Introduction

The demand for food consumption in Southeast Asia changes as income, population and other socio-economics characters change. Virtually all of the population increase will take place in developing countries, and much of it in the urban areas. The rapid urbanization of developing Southeast Asia and associated changes in lifestyles will have profound effects on food preferences and hence on demand. A IFPRI-IMPACT study shows that a growing and urbanizing population with rising incomes will increase global demand for cereals by 35 per cent between 1997 and 2020 to 2,497 million tons and for meat by 57 per cent to 327 million tons (Andersen-Lorch, *The Unfinished Agenda,* 2001). Almost all of the increase in demand will take place in developing countries. By 2020, developing countries as a group are forecast to demand twice as much cereals and meat as developed countries.

As meat demand increases, feed grain utilization also increases because feed grains are raw materials for animal feed. The development of these grains provides a new market opportunity for the crops, which finally can affect the growers/farmers who plant them. Feed grain utilization per capita has been increasing rapidly at 3.4 per cent per year. Demand for feed grains (indirect demand) is increasing by around 5 per cent per year, and demand for direct consumption of cereals is increasing by around 2.3 per cent per year. Accordingly, total demand for these cereals, which are used for human consumption and feed, especially maize, sorghum and millet, could increase by around 6 per cent per year. A large difference in the growth rates implies a rapid change in demand structure of these crops toward more for feed and less for direct human consumption. In many Asian countries, maize is used mostly for feed (Hutabarat, 2003). According to the previous study with the same methodology conducted in South Asian countries, technological factors also influence the demand for feed. Technological factors include intensive fish farming and livestock.

Increasing demand and prices of feed would imply increasing the opportunity to generate income from farming the feed crops. It would induce commercialization of the feed crops and would also facilitate farm diversification, which could potentially increase and stabilize farm incomes (Hutabarat, 2003).

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 feed crop farming may result in a reduction in staple food production. Some governments may consider this opportunity as a threat to national food security, some do not have policies to tap the opportunity, and some are even against the possibility. Therefore, it is important to elucidate

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the real opportunities, constraints and policy options for developing feed crop farming in Asian countries through comprehensive research. This study is a continuation of a similar study conducted in South Asian countries in 2002-2003.

Objectives

The general objective is to elucidate and analyze potentials, weaknesses, opportunities, constraints and policy options for the development of feed crop farming with emphasis placed on secondary crops in Southeast Asian developing countries in balance with the rapid development of the livestock and fish culture industry in Southeast Asia.

The specific objectives are:

(i) To analyze 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 (secondary crops) in the participating countries;

(iii) To propose possible cooperation schemes for 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 the participating countries.

Intended impacts and results

To understand the dynamics and future trends of demand and supply for feed crop products, to gain knowledge on potentials, weaknesses, opportunities and constraints for expanding feed crop farming in the participating countries, to utilize the research as a valuable reference for setting up a regional cooperation scheme among ESCAP member countries, and to formulate the strategies and policy options to promote the sustainable development of feed crop farming in the participating countries.

Basic concepts and methodological framework

For a comparison of the participating countries, the study adopts the same concepts and develops the same econometric analysis tools using time series data. This is combined with SWOT analysis as a management tool to better interpret the econometric results.

Feed

Feed is the range of food or feeding stuffs available to an animal. Feeding stuffs is one of the range of potential feeds available to farm livestock. Amongst these would be fresh forages, conserved forages (e.g. 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 are maize, rice, sorghum, wheat, barley, cassava, fish meal and copra meal. Non-conventional feedstuffs are defined as by-products derived from the industry due to the processing of the main products and those feeds which have not been traditionally used in animal feeding and/or not normally used in commercially produced rations for livestock.

Concentrates

A concentrate is an animal feeding stuff, which has a high feed value relative to its volume. It is a low-fiber, high-energy feed that is concentrated by a factory-blended source of nutrients needed to increase the nutritional adequacy of feed supplements.

Feed crops

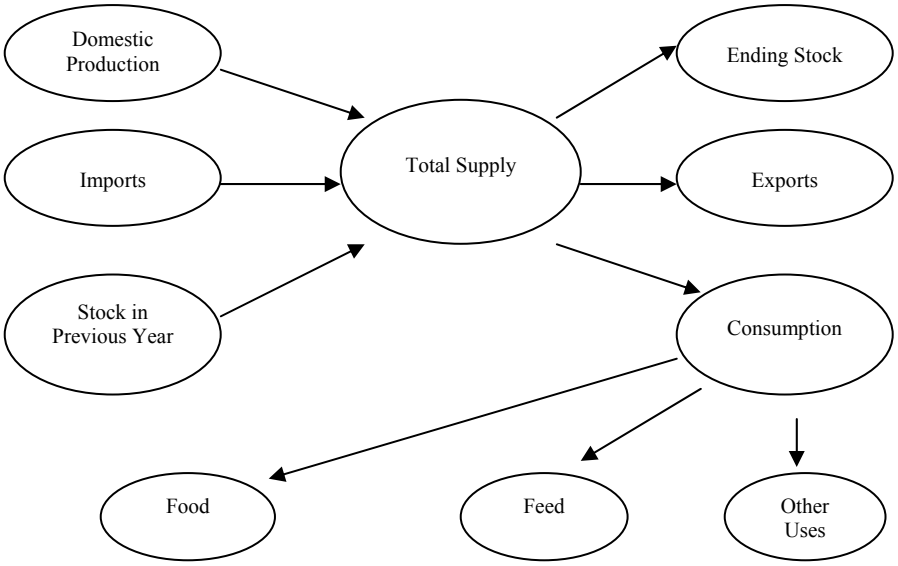
Feed crops are the crops that are utilized fresh or processed for feeding animals.

Supply and demand of feed crops

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 and consumption of feed crops. In addition, it is equally crucial to evaluate whether the effort is feasible from a managerial point of view, as commodity development programmes entail complicated decision-making in the production, marketing and processing stages. The study will be conducted by utilizing standard economic theory of supply and demand, complemented with information from farmer and crop grower groups in the framework of SWOT analysis.

Total supply of a commodity is a summation of domestic production with some imports and its stock in the previous year, as depicted in Figure 1.

Figure 1. Supply of and demand for feed crops



The total supply is then used for consumption, some exports and some to be stocked at the end of the year. Total consumption is made up from food for humans, feed for animals (livestock and fish), and other uses.

Model formulation

The model used to generate parameters of equations is based on a system of supply and demand relationships. The system is closed in equilibrium, where total supply equals total demand in a particular country. This is adopted and modified from the World Food Model (WFM) and IMPACT model proposed respectively by Yanagishima (2002), Rosegrant *et al*. (1995), and Rosegrant (1999).

Domestic production

Crop production is assumed as the product of estimated harvested area and yield response functions. Harvested area is specified as a function of a crop's own price, the price of other competing crops, and a trend growth factor:

$$AH_{it} = \alpha_i PP_{it}^{\varepsilon_{ii}} \prod_j \left(PP_{jt}^{\varepsilon_{ij}} \right) \left(1 + g_{it} \right) \quad (1)$$

For $_{i, j}$ = All cereals included in the model

Yield is a function of the commodity prices, the prices of inputs (such as fertilizer and labour), and a trend growth factor reflecting technological improvements:

$$YH_{it} = \beta_i PP_{it}^{\varepsilon_{ii}} \prod_k PI_{kt}^{\varepsilon_{jk}} \left(1 + g_{it} \right) \quad (2)$$

Hence production is:

$$QH_{it} = AH_{it} x YH_{it} \quad (3)$$

Where,

AH	=	crop area
YH	=	crop yield
QH	=	quantity produced
PP	=	producer price
PI	=	price of factor or input k
i, j	=	commodity index
t	=	time index
g	=	growth rate
ε	=	price elasticity
α, β	=	area and yield intercepts

Total demand

Total use of a commodity is the sum of food, feed and other uses

$$QC_{it} = QF_{it} + QL_{it} + QE_{it} \quad (4)$$

For food use

$$QF_{it} = \gamma_i PC_{it}^{\varepsilon_{ii}} \prod_j \left(PC_{jt}^{\varepsilon_{ij}} \right) x \left(INC_t \right)^{\eta_i} POP_t \quad (5)$$

Where, $INC_t = INC_{t-1} x \left(1 + g_t \right)$ and (6)

$POP_t = POP_{t-1} x \left(1 + g_t \right)$

Demand for feed

Other than milled rice:

$$QL_{it} = \gamma_i \prod_j PP_{jt}^{\varepsilon_{ij}} G.AC_t \left(1 + g_{it} \right), \text{ where } G.AC_t = \Sigma_m w_m QH_{it} \quad (7)$$

for m = all meats in the model and milk and
w = use of feed cereal per unit of meat

Milled rice:

$$QL_t = \gamma \prod_j PP_{jt}^{\varepsilon_j} R.QH_t \left(1 + g_{it} \right) \quad (8)$$

for j = all the cereals considered in the model

Demand for other uses

$$QE_{it} = \gamma_i \left(QF_{it} + QL_{it} \right)^{\alpha_i} QH_{it}^{\delta_i} \left(1 + g_{it} \right) \quad (9)$$

for i = all the cereals included in the model

Ending stock

For a net importing country,

$$ES_{it} = a_i \left(QC_{it} / PC_{it} \right)^{\alpha} \quad (10)$$

For a net exporting country,

$$ES_{it} = b_i \left(QH_{it} / PP_{it} \right)^{\beta} \quad (11)$$

Where,
QC = total demand
QF = demand for food
QL = demand for feed
QE = demand for other uses
PC = consumer price
INC = per capita income

POP	=	total population
GAC	=	basic feed requirement of cereals
RQH	=	rice production
ES	=	ending stock

Trade equation

Import and export equations are subject to the country's net trade position. Gross imports for a net importing country and gross exports for a net exporting country are determined on the basis of commodity balances, while alternate specifications are used to compute the "minor" flows, i.e. gross imports for a net exporting country and gross exports for a net importing country.

Gross imports

For a net importing country, imports are required to balance the domestic market, $M_{it} = QC_{it} + ES_{it} - QH_{it} + X_{it} - ES_{it-1}$.

For a net exporting country, imports are the larger level of a demand specified minimum access (MQ) or an amount related to the total (QC).

$$M_{it} = \text{Max}\left(MQ_{it,} QC_{it}\right)^{\alpha} \tag{12}$$

or M_{it} maybe estimated as $M_{it} = a_0 QC_{it}^{\alpha_1} \left(PW_{it} / PP_{it}\right)^{\alpha_2} INC_t^{\eta}$

α_i , η = elasticities of import demand with respect to total consumption, prices and income

Gross exports

For a net exporting country, exports are the exportable surplus remaining after domestic demand has been satisfied.

$$X_{it} = QH_{it} + ES_{it-1} + M_{it} - QC_{it} - ES_{it} \tag{13}$$

For a net importing country, exports are linked to changes in world prices relative to domestic prices.

$$X_{it} = b_0 QH_{it}^{\beta_1} \left(PW_{it} / PP_{it}\right)^{\beta_2} INC_t^{\eta} \tag{14}$$

Where,

M	=	import volume
X	=	export volume
PW	=	world price
MQ	=	specified minimum access level under the Uruguay Round
β_i, η	=	elasticities of export supply with respect to total production, price and income

Equilibrium

Total supply = Total demand

$$QH_{it} + ES_{it-1} + M_{it} = QC_{it} + ES_{it} + X_{it} \quad (15)$$

Future trends in production and consumption:

The supply and demand models estimated previously produce estimated elasticity that might be employed to forecast changes in production and consumption in the future. By further investigating the general form of functions,

$$Y = f(X_1, X_2, X_3, \ldots\ldots, X_n) \quad (16)$$

Where, Y = dependent variable

X_i = explanatory or pre-determined variable; i = 1, ……., n

Then it is possible to obtain changes in Y, which are caused by changes in each of the explanatory variables and the elasticity with respect to each of these variables. This is shown in equation (17):

$$dY = \varepsilon_1 dX_1 + \varepsilon_2 dX_2 + \varepsilon_3 dX_3 + \ldots\ldots\ldots\ldots + \varepsilon_n dX_n \quad (17)$$

Where, ε_i = the elasticity of each of the independent variables with respect to Y in the equation being considered,

dY = percentage change in Y

dX_i = percentage change in the exogenous variable i

By using formulae 17, the change in supply and demand can be estimated by combining a point elasticity estimate with a forecast of the change in the explanatory variable.

Planning strategy

Solely technical matters do not within the determine the expansion of technology and its adoption as shown in area and production increases. Often it is curtailed by management problems on the farms, the market and within the processing industry. Each decision maker, at every level, should have a common goal as to how the performance of an organization can be improved to guarantee the successful achievement of production and agro-industrial development of feed crops. The question being faced is why are businesses 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 strategic decision should be subject to analysis, whereby attention should be given to aspects such as:

Whether the decision can be executed with the existing condition?

What opportunities are available now and in the foreseeable future?

What are the threats from competitors, regulatory bodies, technological changes, or shifts in customer preferences?

What are the unique strengths and internal abilities and how should they be used as leverage in developing competitive advantage?

What are the weaknesses and how can they be improved?

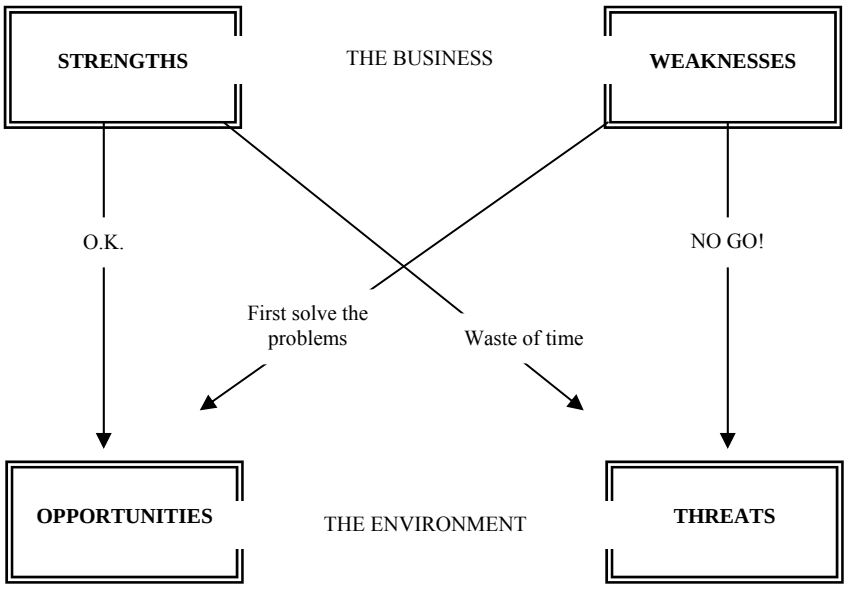
This can be identified and analyzed using SWOT (strengths, weaknesses, opportunities and threats) analysis. SWOT can be applied to each stage of decision-making: production, marketing and processing.

SWOT analysis is a management tool that should be used on a regular basis. The analysis is a simple but very effective analytical method for an organization to measure its own *Strengths and Weaknesses* and to identify, in the target environment, the characteristics of that environment that can be classified as either *Threats or Opportunities.*

All elements associated with an activity have to be analyzed carefully and the decision maker will rate them as either a strength or weakness, or a threat or opportunity. While working on the analysis, the decision maker will find that it is often not easy to assign an element to a particular group.

The strategic aspect of SWOT enables a decision maker to judge whether a company will be able to expand current production, or that first, solutions have to be found for a number of problem areas. The analyst will place the business and the environment in one "frame" and draw lines between the four squares:

Figure 2. Decision-making through SWOT analysis



If the majority of the strengths of the business correspond with the opportunities of the market, the decision maker will not encounter too many problems on his way. He can start developing an entry strategy.

If the list of weaknesses is very long and the list of strengths also long, the list of environmental strengths will be very long as well. The business should not get involved with expanding production of the commodities being analyzed.

If however, the strengths of the market correspond with the weaknesses of the business or if, due to the weaknesses of the business the list of threats is too long, the company will first have to work on improvements in the organization before becoming involved with expanding its activities. Whilst finding solutions for the weaknesses of the business, the list of weaknesses will become shorter, the list of strengths will become longer and automatically, a lot of the threats in the environment will become opportunities.

If the weaknesses can not be solved, the decision will have to be made not to get involved in production expansion, or to look for other commodities or activities where the situation may be completely different. A new analysis will have to be undertaken in this case.

With the SWOT analysis in hand and the proper conclusions drawn, the analyst is now ready to take a justified decision and develop a strategy that should lead to successful product expansion.

Participating countries, organization and implementation

The participants in this project are Indonesia, Malaysia, the Philippines and Thailand, which are among the low-income group of ESCAP member countries in the South Asian subregion. The four countries neighbour one another and hence, could take advantage of regional cooperation for the development of secondary crops. As proposed, this study is conducted mainly in upland semi-arid agro-ecological areas, which are the focus area of UNESCAP-CAPSA.

The project was implemented in collaboration with partner institutes of the participating countries, where UNESCAP-CAPSA developed country study guidelines in cooperation with the regional advisor. The Centre was also responsible for the coordination of planning and implementing the project and for disseminating the findings. The total duration of the project was one year and a half, starting from July 2003 to December 2004. The project activities consist of three elements: (i) country study; (ii) workshop; and (iii) publication and dissemination.

The country studies were conducted by the respective national experts based on the guidelines prepared by the Centre in close consultation with the regional advisor. The guidelines set the scope, concepts and method of the country studies and the project schedule. The national experts were requested to produce draft reports of country studies and present them in the regional workshop. The country reports are then finalized by accommodating all relevant and valid suggestions and criticism raised at the workshop to produce final reports for publication. The final reports should also include executive summaries. From the materials contained in the country reports, complemented by other sources, an integrated report is prepared by the Centre in cooperation with the regional advisor. Publication and dissemination of the reports is completed by the Centre. As part of the dissemination, in addition to the regional workshop, where selected policy makers and researchers were invited, the national experts were also requested to present the findings of their country studies in their own countries.

The organization of the project was as follows:

Overall Coordinator and Supervisor:	Dr. Nobuyoshi Maeno, Director, UNESCAP-CAPSA
Team Leader:	Dr. Erna M. Lokollo, Programme Leader, Research and Development, UNESCAP-CAPSA
Regional Advisor:	Dr. Budiman Hutabarat, Senior Researcher, Indonesian Center for Agricultural Socio Economic Research and Development (ICASERD)
National Experts:	
Indonesia:	Dr. Dewa K.S. Swastika, Senior Researcher, Indonesian Center for Agricultural Socio Economic Research and Development (ICASERD)

Malaysia:	Mr. Tunku Mahmud Bin Tunku Yahya, Senior Research Officer/Deputy Director, Economic and Technology Management Centre, Malaysian Agricultural Research and Development Institute (MARDI)
The Philippines:	Dr. Danilo C. Cardenas, Chief, Science Research Specialist, DOST and Director, Socio Economics Research Division, Philippines Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD)
Thailand:	Ms. Chamras Rojanasaroj, Senior Economist, Bureau of Agricultural Economic Research, Office of Agricultural Economics (OAE), Ministry of Agriculture and Cooperatives

Prior to the implementation of the project, the coordination pre-planning meeting involving the regional advisor and the team leader along with the director of the Centre was held at the Centre on 28 July 2003 to discuss the agenda as follows:

(i) Brief review by the director of CAPSA.
(ii) Review of the project objective.
(iii) Technical guidelines for country studies.
(iv) Report outline.
(v) Planning meeting, and
(vi) Other matters.

The team leader and regional advisor then refined the results of the pre-planning meeting. These revised materials were used and discussed later in the planning meeting in the forms of:

(i) Report of the pre-planning meeting that contains tentative references to the planning meeting, schedule of the country study, outline of country and integrated reports.
(ii) General reference of the workplan.
(iii) Basic concepts and analytical framework.

This was discussed in more detail later at the planning meeting that was held at the Centre on 27-28 August 2003. All the national experts, the regional advisor and team leader along with the director of the Centre were present at the meeting. The regional advisor presented the overview of the project that includes the background and justification, schedule of tasks and the proposed outline of country reports. The team leader explained about conceptual framework and model formulation for empirical estimation, and the national experts were asked to finalize their workplan of the country study and start the country study in September 2003.

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Consolidated Country Reports

The Status and Prospects of Feed Crops in Indonesia

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Introduction

Background

In developing countries, there has been a dramatic rise in the consumption of livestock-based food products. This is a result of demand changes caused by changes in the diets of billions of people, through population pressure, urbanization, and income growth (Hutabarat, 2003). Increases in livestock product demand have been reflected in feed grain utilization, which has also rapidly increased, since feed grains are the main raw materials for the feed industry. The feed industry uses coarse grains, pulses, roots and tuber (CGPRT) or their semi-processed products as the main components. Consequently, this provides an opportunity for market expansion of these crops.

Among CGPRT crops, maize is the most popular ingredient of manufactured feed in the world, especially in tropical regions. In Indonesia, maize is the main component of the feed industry, accounting for about 51 per cent of feed ingredients. This is because maize contains high energy and its nutrient content is appropriate for animal feed, especially for poultry and swine. Efforts to substitute maize with other crops is likely to be unsuccessful (Tangendjaya *et al*., 2003). Fresh soybean is a more expensive commodity and needs intermediate processing in order for it to be used for feed. The most suitable soybean product that is commonly used in the feed industry is soybean meal, which is imported. Cassava is a bulky commodity and also needs some intermediate processing. Dry cassava (*gaplek*), however, has a low protein content so it needs additional sources of protein in order to reach an adequate protein content for feed. Sorghum is considered viable to partly substitute maize, but its availability in Indonesia is very limited. Therefore, this study is focused primarily on maize, while other CGPRT crops are referred to wherever appropriate.

In terms of utilization, data showed that most maize in Indonesia is used for food consumption either as direct or processed food. In some provinces maize is consumed as a staple food as well as rice (Bastara, 1988; Subandi and Manwan, 1990). However, low yields of maize result in low national production, so that Indonesia can not meet the rapid increase in domestic demand for maize, which is in line with the booming poultry and food industries. Therefore, Indonesia has had to continuously import maize at an average of about 1 million tons annually for the last 15 years. This study aims to investigate the status and future prospects of maize development as a main feed crop in Indonesia.

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Subjects of study

The subjects of this study are: (i) feed crop production and supply and their determinants; (ii) feed crop consumption and demand and their determinants; (iii) feed crop imports and exports and their determinants; and (iv) the potentials and constraints of feed crops development with emphasis on CGPRT crops, especially maize.

Objectives

The objectives of this study are: (i) to analyze historical dynamics and future trends of supply and demand for feed and feed crops; (ii) to evaluate potentials, weaknesses, opportunities, and constraints for expanding feed and feed crops in Indonesia; and (iii) to formulate policy options to promote the sustainable development of feed crop farming in Indonesia.

Expected output

The expected outputs of this study are: (i) better understanding of the dynamics and future trends of supply of and demand for feed and feed crops in Indonesia; (ii) better understanding of the potentials, weaknesses, opportunities and constraints for expanding feed crop farming in Indonesia; (iii) strategies and policy recommendations to promote feed crop farming in Indonesia; and (iv) reference for setting up a regional cooperation scheme for trade and development of feed crops among Asian countries.

Methodology

Conceptual framework

As per capita income increases, the demand for animal origin food increases, while the demand for grains for food decreases. An increase in demand for animal products provides a market for the livestock industry, as well as the feed industry. Rapid growth of the poultry industry in Indonesia (before the economic crisis) resulted in substantial growth in the demand for feed. As a major component of feed, demand for maize for feed was estimated to grow in an increasing trend. Domestic maize production cannot satisfy demand. To meet the increasing domestic demand, Indonesia must import maize from the world market, which has lead Indonesia to be a net importing country for the last two decades.

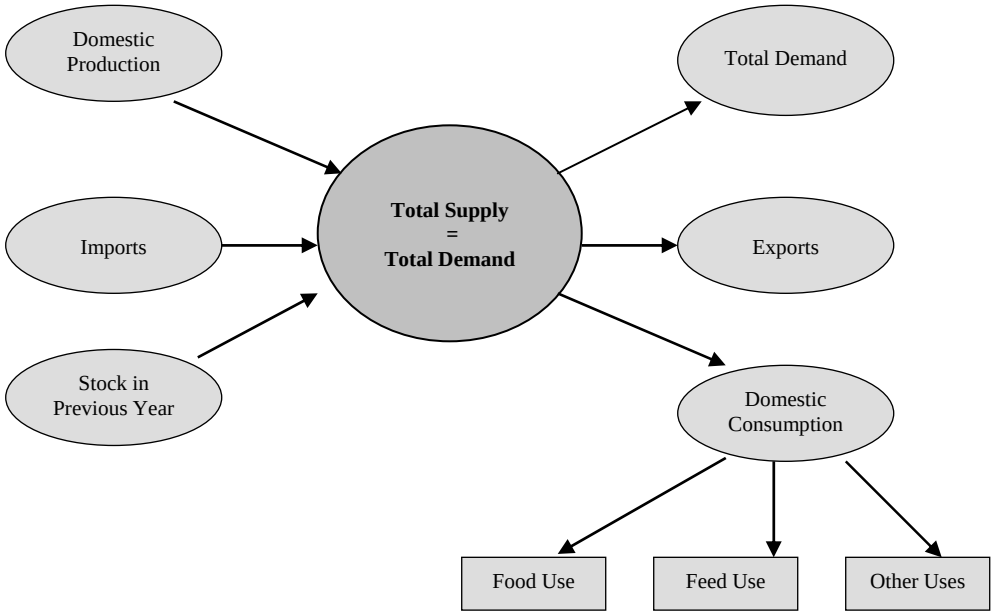
Analytical framework

The analytical framework is developed based on the economic theory of supply and demand balance. The total supply of feed crops is basically the sum of domestic production, imports, and stock from the previous year. Given the theoretical relationship that supply and demand should be equal at equilibrium, total supply, which is equal to total demand, is used for consumption, some exports, and some to be stocked at the end of the year (Figure 1).

In this study, the supply-demand system of feed and maize as a main feed crop is formulated using econometric models. The models included in the system are: (i) harvested area function of maize in Indonesia; (ii) maize yield function; (iii) maize production as a product of maize area and its yield; (iv) supply of maize in Indonesia; (v) maize demand for the feed industry; (vi) demand for maize for direct human consumption; (vii) demand for maize for the food industry; (viii) demand for maize for other uses in Indonesia; (ix) world price of maize; (x) equation for world maize exports; (xi) price of imported maize in Indonesia; (xii) domestic price of maize; (xiii) imports of feed components; (xiv) domestic feed production; (xv) demand for

feed; (xvi) projection of maize and feed production; and (xvii) projections of demand for maize and feed. In addition, following Sianipar and Entang (2001) and Adnyana (2004), SWOT analysis is employed in order to seek better understanding of the potentials, opportunities and constraints to develop maize production in Indonesia.

Figure 1. Supply of and demand for maize as a feed crop



General and socio-economic features

General economy

The agricultural sector plays a substantial role in the early development stage of the country, as shown by the highest absorption of labour employment compared to other sectors (Table 1). Besides absolute labour employment of the agricultural sector being the largest, the role of this sector has declined over time, while those of other sectors have become more important. However, the economic crisis that began in 1997 greatly affected all sectors. Impacts became greater along with rising prices of goods, especially those imported, and were more serious in urban than in rural areas. In general, the crisis expanded poverty, but there is no correlation with the initial level of poverty. Most of the urban areas greatly affected by the crisis were where rural areas in the same province were also severely hampered.

Table 1. Labour employment by sector, 1971-2001 (persons)

Sector	Year				Growth (%/yr)		
	1981	1991	1997	2001	1981-1991	1991-1997	1997-2001
Agriculture	31,593,314	41,205,791	35,848,631	39,743,908	2.69	-2.29	2.61
(%)	54.66	53.92	41.18	43.77			
Industry	390,661	564,599	896,611	12,086,122	3.75	8.01	91.61
(%)	0.68	0.74	1.03	13.31			
Construction	6,021,929	7,946,350	11,214,822	3,837,554	2.81	5.91	-23.52
(%)	10.42	10.40	12.88	4.23			
Trade	61,666	150,660	233,237	17,469,129	9.34	7.56	194.18
(%)	0.11	0.20	0.27	19.24			
Transportation	2,146,210	2,436,594	4,200,200	4,448,279	1.28	9.50	1.44
(%)	3.71	3.19	4.83	4.90			
Finance	8,553,919	11,430,655	17,221,184	1,127,823	2.94	7.07	-49.41
(%)	14.80	14.96	19.78	1.24			
Service	1,796,112	2,493,424	4,137,653	11,003,482	3.33	8.81	27.70
(%)	3.11	3.26	4.75	12.12			
Others	7,238,990	10,195,106	13,297,418	1,091,120	3.48	4.53	-46.48
(%)	12.52	13.34	15.28	1.20			
Total	57,802,888	76,423,266	87,049,841	90,807,516	2.83	2.19	1.06
(%)	100.00	100.00	100.00	100.00			

Source: CAS, 1971-2001.

Role of the agricultural sector

The agricultural sector maintains an important role in the economy of the country indicated by its contribution to Gross Domestic Product (GDP). Although the share of the agricultural sector to GDP declined over time it was still significant, except compared with those of industry and trade. The food crop sub-sector is still the biggest contributor to GDP within the agricultural sector (Table 2).

Table 2. Share of gross domestic product based on 1993 constant price, 1970 - 2002 (per cent)

Sector	1971	1981	1991	1996	1997	2000	2002
Agriculture	38.47	21.58	19.26	15.59	15.00	16.64	15.94
Food crops	*18.54*	*12.06*	*10.59*	*8.22*	*7.73*	*8.68*	*8.07*
Estate crops	*4.26*	*2.56*	*2.86*	*2.52*	*2.52*	*2.69*	*2.65*
Livestock	*3.23*	*1.85*	*1.91*	*1.74*	*1.74*	*1.77*	*1.77*
Forestry	*10.00*	*3.63*	*2.22*	*1.56*	*1.48*	*1.61*	*1.56*
Fisheries	*2.44*	*1.48*	*1.69*	*1.54*	*1.53*	*1.89*	*1.89*
Industry	6.96	10.70	19.85	23.55	24.10	23.59	23.63
Mining	14.42	12.00	10.50	9.18	8.93	9.77	9.32
Construction	8.03	16.45	8.06	9.48	9.51	8.64	8.93
Utilities	0.47	0.71	0.95	1.18	1.27	1.65	1.76
Trade, hotel and restaurant	13.98	19.34	16.64	16.95	17.11	15.95	16.24
Transport	3.39	4.39	5.84	5.97	6.09	7.30	7.89
Finance	2.33	2.86	4.06	4.86	4.82	6.90	7.02
Services	11.94	11.97	14.84	13.22	13.17	9.56	9.28
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: CAS, 1973-2002 (data computed).

The economic crisis of 1997 significantly affected the domestic livestock industry in the country. It affected both the production and consumption of livestock products. Population growth of swine during the economic crisis was negative (Table 3). Negative growth rates were also observed in populations of dairy cattle, broiler and layer. In the same period, production of eggs, milk, beef, pork and broiler also declined (Table 4). Per capita milk consumption was

relatively constant during the economic crisis, whereas egg, beef and chicken meat lessened (Table 5).

Table 3. Population of livestock in Indonesia, 1970-2001

Year	Swine (heads)	Dairy cattle (heads)	Layer (birds)	Broiler (birds)
1970	3,169,000	59,000	706,000	n.d.a.
1975	2,707,000	90,000	3,903,000	n.d.a.
1980	3,155,000	103,000	22,940,000	n.d.a.
1985	5,700,375	175,638	31,874,064	13,017,600
1990	7,135,643	293,878	37,228,434	34,463,215
1995	7,720,156	341,334	59,393,587	593,368,316
1997	8,232,839	334,371	70,622,771	641,373,816
1998	7,797,558	321,992	38,861,311	354,003,503
2000	5,356,834	354,253	69,366,006	530,874,055
2001	5,866,837	368,490	66,927,833	n.d.a.
Growth (%/yr)				
1970-1975	-3.10	8.81	40.77	-
1975-1980	3.11	2.74	42.51	-
1980-1985	12.56	11.26	6.80	-
1985-1990	4.59	10.84	3.15	21.50
1990-1997	2.06	1.86	9.58	51.84
1997-2001*	-8.12	2.46	-1.33	-6.11
Average growth	2.19	6.17	17.03	14.39

Source: CAS, 1970-2002 (computed).
Note: * 1997-2000 for broiler; n.d.a.= no data available.

Table 4. Production of livestock products in Indonesia, 1970-2001

Year	Eggs	Milk	Beef	Pork	Broiler
1970	58,600	29,270	n.d.a.	n.d.a.	n.d.a.
1975	112,200	51,110	n.d.a.	n.d.a.	n.d.a.
1980	262,600	78,380	n.d.a.	n.d.a.	n.d.a.
1985	369,900	191,930	227,400	132,700	114,460
1990	484,000	345,600	259,220	123,810	261,360
1995	736,060	433,442	311,970	177,820	551,745
1997	765,033	423,665	353,652	146,781	515,298
1998	529,827	375,382	342,598	134,794	285,010
2000	783,317	495,647	339,941	162,398	515,003
2001	793,796	505,023	338,636	174,422	516,286
Growth (%/yr)					
1970-1975	13.87	11.79	-	-	-
1975-1980	18.54	8.93	-	-	-
1980-1985	7.09	19.62	-	-	-
1985-1990	5.52	12.48	2.65	-1.38	17.96
1990-1997	8.75	4.63	3.77	7.51	16.12
1997-2001	0.78	-0.46	2.54	-3.76	-1.36
Average growth	9.34	9.51	2.45	2.26	7.83

Source: FAO, 1970-2001.
Note: n.d.a = no data available.

Table 5. Per capita consumption of livestock products in Indonesia, 1970-2000

Year	Egg	Beef	Chicken meat	Milk
	(kg/capita/year)			
1970	0.5	1.7	0.5	n.d.a
1975	0.7	1.9	0.7	4.1
1980	1.4	1.7	1.2	4.2
1985	1.8	1.7	1.9	4.3
1990	2.1	1.7	2.8	4.4
1995	3.0	1.9	4.4	4.4
1997	3.0	2.1	4.4	4.5
1998	2.0	1.9	3.0	4.5
2000	3.1	2.0	3.9	4.5
Growth (%/year)				
1970-1975	6.96	2.25	6.96	-
1975-1980	14.87	-2.20	11.38	0.35
1980-1985	5.15	0.00	9.63	0.35
1985-1990	3.13	0.00	8.06	0.35
1990-1997	5.23	3.06	6.67	0.25
1997-2000	1.10	-1.61	-3.94	0.24
Average growth	6.14	0.21	6,94	0.30

Source: FAO, 1970-2000.
Note: n.d.a = no data available.

Role of trade

Until 1975, Indonesia was a net exporter of maize, but in subsequent years became a net importer. Only in 1990 did Indonesia have net exports of about 135 thousand tons (Table 6). In 2000, maize imports reached a peak of 1.26 million tons. Except in 1990, Indonesia's maize export volumes were lower than those of imports due to increasing demand for feed in which maize is the main component. Increasing domestic maize production could be carried out through either planting area expansion or yield improvement. Adoption of high yielding varieties, both hybrids and composites, may expand domestic production and reduce dependency on imports.

However, there are some constraints in adopting new technologies, such as a lack of suitable agricultural land for the expansion of planted areas, low incentives for grain quality improvement, and relatively high prices of inputs mainly fertilizers and pesticides. These constraints have caused a relatively low maize yield in Indonesia. Compared to Thailand, China, Argentina and United States, Indonesia has the lowest maize yield of only 2.6 tons/ha.

World maize exports are dominated by the main maize producing countries such as United States, China and Argentina. On the other hand, maize importing countries are Japan, Korea, Mexico, Indonesia and the Philippines. Increased imports of maize are mainly due to the expansion of food and feed industries.

Table 6. Imports and exports of maize in Indonesia, 1970-2001

Year	Production	Import		Export	
	('000 tons)	('000 tons)	(%) *	('000 tons)	(%) *
1970	2,825.22	0	0.00	285.83	10.12
1975	2,902.89	0	0.00	50.72	1.75
1980	3,525.60	33.80	0.98	14.89	0.37
1985	4,329.50	50.00	1.24	3.54	0.08
1990	6,734.03	9.10	0.34	146.21	2.17
1997	8,770.85	1,098.40	12.52	19.01	0.22
2000	9,677.00	1,264.60	13.07	28.23	0.29
2001	9,347.00	1,035.80	11.08	91.00	0.97
Growth (%)					
1970-1975	0.54	-	-	-29.24	-
1975-1980	3.96	-	-	-21.74	-
1980-1985	4.19	8.15	-	-24.97	-
1985-1990	9.24	-28.88	-	110.47	-
1990-1997	3.85	98.33	-	-25.28	-
1997-2001	1.60	-1.46	-	47.92	-
Average growth	3.97	27.56	-	6.04	

Source: FAO, 1970-2001.
Note: * = percentages relative to production.

Demand for feed and feed crops

Consumption structure

In general, maize consumption in Indonesia can be grouped into four categories such as: (i) direct human consumption; (ii) raw materials for the feed industry; (iii) raw materials for the food industry; and (iv) other uses (seed, loss, etc.). FAO data (1970-2001) indicates that maize demand for direct human consumption continuously declines as rice becomes the main staple food in the Indonesian diet. This change was made possible after rice self-sufficiency was achieved in 1984. The demand for maize for direct human consumption even experienced negative growth during 1985-1997. However during the economic crisis the demand increased at 2.86 per cent/year. In contrast, maize demand for the feed industry dramatically increased at 6.59 per cent/year during the same period except during 1997-2001, when it declined at 4.87 per cent/year. The demand for maize from the food industry remains the highest growing at 12.21 per cent/year, even though this experienced negative growth in periods of 1975-1985 (Table 7). In 2001 for example, about 58 per cent of the domestic maize demand was for the food industry. Finally, the demand for other uses like seed or the loss during post-harvest handling is relatively small.

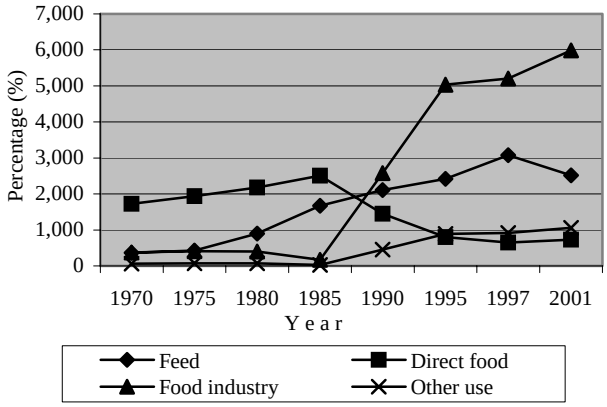
Table 7. Balance sheet of maize in Indonesia, 1970-2001 ('000 tons)

Year	Total supply*)	Maize Demand				
		Feed industry	Direct consumption	Food industry	Other uses	Total*)
1970	2,539.4	368	1,729	376	66	2,539.4
%		14.49	68.09	14.81	2.60	100
1975	2,852.2	431	1,943	406	72	2,852.2
%		15.11	68.12	14.23	2.52	100
1980	3,544.5	899	2,175	400	71	3,544.5
%		25.36	61.36	11.29	2.00	100
1985	4,376.0	1,670	2,509	167	30	4,376.0
%		38.16	57.34	3.82	0.69	100
1990	6,596.9	2,112	1,454	2,580	450.9	6,596.9
%		31.99	22.03	39.08	6.89	100
1997	9,850.2	3,075	652	5,205	918	9,850.2
%		31.22	6.62	52.84	9.32	100
2000	10,913.4	2,285	716	6,726	1,187	10,913.4
%		20.94	6.56	61.63	10.88	100
2001	10,291.8	2,518	730	5,988	1,057	10,292.5
%		24.46	7.09	58.18	10.27	100
Growth						
1970-1975	2.35	3.21	2.37	1.54	1.54	2.35
1975-1980	4.45	15.84	2.28	-0.33	-0.33	4.44
1980-1985	4.32	13.18	2.90	-15.99	-15.99	4.30
1985-1990	9.15	4.81	-10.34	72.86	72.86	8.57
1990-1997	1.81	5.51	-10.82	10.54	10.54	5.88
1997-2001	3.41	-4.87	2.86	3.57	3.57	1.10
Average growth 1970-2001	4.12	6.59	-2.52	12.21	12.21	4.64

Source: FAO, 1970-2001.
Note: *) = computed

There has been a significant change in the consumption of maize from direct food to processed food and feed industries (Figure 2). Thus, maize is no longer considered as an inferior food because it is processed into manufactured food through the food industry. It implies that maize has a good market prospect for both feed and food.

Figure 2. The use of maize in Indonesia, 1970-2001



Source: Author's own calculation.

Maize demand behaviour

The demand model used in this estimate explained quite well the behaviour of maize demand as raw material for the feed industry as exhibited by the coefficient of determination, R2 = 0.82. Signs of parameter estimates were also as expected with respect to explanatory variables. Variables that significantly determine the demand behaviour of maize for the feed industry are: (1) domestic price of maize; (2) domestic price for the soybean; (3) lagged demand for the feed industry; and (4) a dummy variable for the economic crisis (Table 8).

Table 8. Maize demand behaviour for the feed industry in Indonesia

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	3,821.4592	0.0001		
Price of feed (Rp/kg)	PF_t	0.0556	0.7953	0.0003	0.0017
Domestic price of maize (Rp/kg)	PM_t	-812.6942	0.0737	-0.2157	-1.4764
Domestic price of soybean (Rp/kg)	PS_t	-391.4055	0.0013	-0.2395	-1.6389
Lagged maize demand for feed ('000 tons)	DF_{t-1}	0.8539	0.0001		
Dummy (0 = before; 1 = during and after crisis)	D_t	-791.2193	0.0414		
Pr > F < 0.0001; Adjusted R^2 = 0.8208; DW = 1.778					

Source: Author's own calculation.

In addition, the demand behaviour of maize for direct food consumption was also well explained by explanatory variables included in the model with R2 = 0.90. Lag demand and consumers' taste and preferences are the only variables that significantly determine the behaviour of maize demand for direct human consumption. This indicates that maize as food for direct consumption maybe inferior compared with rice for example. This phenomena is also shown by maize demand behaviour for direct food that is highly responsive to income per capita both in the short- and long-term with an income elasticity of –1.05 and –3.21 respectively (Table 9). This means that as income per capita increases demand for maize for direct food will rapidly decline.

Table 9. Maize demand behaviour for direct food in Indonesia

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	1,695.6674	0.3399		
Domestic price of maize (Rp/kg)	PM_t	-184.0750	0.7500	-0.0665	-0.2041
Price of milled rice (Rp/kg)	PBR_t	154.7505	0.6540	0.0903	0.2772
Per capita income (Rp '000/year)	Inc_t	-0.7211	0.7840	-1.0473	-3.2141
Taste and preference	$Taste_t$	-56.1313	0.2431	-0.0009	0.0000
Lag of maize demand for food ('000 tons)	DH_{t-1}	0.6741	0.0031		
Dummy (0=before; 1=during and after crisis)	D_t	244.0609	0.4155		
Pr > F < 0.0001; Adjusted R^2 = 0.9002; DW = 1.073					

Source: Author's own calculation.

Maize demand from the food industry remains the biggest volume. The econometric model used in this study almost perfectly explains the demand behaviour of maize for the food industry. This is shown by the R^2, which is equal to 0.98. All signs and magnitudes of parameter estimates are as expected. Among the explanatory variables included in the model, the demand for maize for the food industry is significantly influenced by: (1) domestic price of maize; (2) price of wheat flour; (3) price of cooking oil; (4) per capita income; and (5) consumers' tastes and preferences (Table 10). Maize is no longer an inferior good if it is processed into manufactured food through the food industry. This is exhibited by income elasticity of 1.56 and

5.73 respectively, in the short- and long-term. Based on this elasticity, if income per capita increased by 10 per cent then the demand for maize processed food would immediately increase at about 15.63 per cent and about 57.33 per cent respectively, in the short- and the long-term.

Table 10. Maize demand behaviour for the food industry in Indonesia

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	-14,284.0000	0.1691		
Price of manufactured food (Rp/kg)	PMF_t	1,394.0503	0.2113	0.5772	2.1166
Domestic price of maize (Rp/kg)	PM_t	-3,962.0248	0.0593	-0.6573	-2.4103
Price of wheat flour (Rp/kg)	PWF_t	4.5417	0.1083	0.0013	0.0046
Price of sugar (Rp/kg)	PSG_t	-1.3718	0.5565	-0.0005	-0.0020
Price of cooking oil (Rp/kg)	PCO_t	-1,026.4945	0.0711	-0.4690	-1.7199
Per capita income (Rp '000/year)	Inc_t	13.4419	0.2086	1.5634	5.7329
Wage in industrial sector (Rp/kg)	WI_t	-46.0257	0.8602	-0.0721	-0.2643
Taste and preference	$Taste_t$	716.9015	0.1400	0.0049	0.0190
Lag of maize demand for food industry ('000 tons)	DFI_{t-1}	0.7273	0.5551		
Dummy (0 = before; 1 = during and after crisis)	D_t	-4,655.4231	0.2123		
$Pr > F < 0.0001$; Adjusted $R^2 = 0.9764$; DW = 1.716					

Source: Author's own calculation.

Behaviour of feed demand

Demand for feed is simultaneously determined by feed price, price of chicken meat, chicken population, and a dummy variable for the crisis, with adjusted R^2 of 0.98 and F-Stat of 0.0001. Even though statistically not significant, its short-term and long-term elasticity show that demand for feed is highly responsive to chicken meat price fluctuation, both short-term and long-term, with elasticity of 4.32 and 4.87 respectively (Table 11).

Table 11. Demand behaviour for feed in Indonesia

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	205.7788	0.6617		
Price of feed (Rp/kg)	PF_t	-0.0778	0.5463	-0.0405	-0.0456
Price of chicken meat (Rp/kg)	$Pmeat_t$	1.8385	0.9435	4.3200	4.8654
Population of chicken ('000 birds)	$PopC_t$	0.0042	0.0001	0.9311	0.9360
Lag of demand for feed ('000 tons)	FDm_{t-1}	0.1121	0.4449		
Dummy (0 = before; 1 = during and after crisis)	D_t	-114.7252	0.5610		
$Pr > F < 0.0001$; Adjusted $R^2 = 0.9750$; DW = 2.242					

Source: Author's own calculation.

Import of feed components

Some feed components such as soybean meal, fish meal, meat bone meal, wheat bran etc, are imported. Among these feed components, soybean meal is the most popular ingredient used in feed rations. Tangenjaya *et al*. (2002) reported that soybean meal made up almost 21 per cent of broiler's feed ingredients. FAO data showed that during the period of 1985-1994, soybean meal imports fluctuated sharply with an average of 205.45 thousand tons, and tended to increase at a rate of 12.32 per cent per annum. Similarly to soybean meal, imports of all feed components also fluctuated with an average of 362.90 thousand tons. It tended to increase at a rate of 6.23 per cent per year.

By using econometric models for the period of 1985-1994, imports of soybean meal were simultaneously determined by price of soybean, price of feed, exchange rates, feed

production and a lagged variable of soybean meal imports. The elasticity shows low response to imports of soybean meal with respect to all explanatory variables (Table 12).

It is likely that the econometric model for all imported feed components has a better result compared to soybean meal alone. Imports of feed components are determined by the price of imported feed components, domestic prices of feed, exchange rates, feed production, and lag of imports of feed components. It is highly significant with the F-statistic at 0.0008. All signs of parameter estimates are as expected and highly significant with a probability of t-statistic < 0.05.

Imports of feed components are not elastic with respect to the price of imported feed components. In contrast, imports of feed components are responsive to domestic prices of feed, exchange rates, and domestic feed production, as exhibited by their respective elasticity of greater than one (Table 13).

Table 12. Import model of soybean meal (ISmt)

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	1.4826	6.0850	-	-
Domestic price of soybean	PS_t	0.1489	0.1614	0.0007	0.0012
Domestic price of feed	PF_t	0.6146	2.5022	0.0017	0.0031
Exchange rate of Rp to US$	ER_t	-3.4344	2.4615	-0.0294	-0.0536
Domestic feed production	FPR_t	1.4730	1.3771	0.0126	0.0230
Lag of soybean meal import	Ism_{t-1}	0.4514	0.3150	-	-
Pr > F < 0.0834; Adjusted R^2 = 0.7602; DW = 2.28					

Source: Author's own calculation.

Table 13. Imports of feed component (IFCt)

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	42.9948	0.0002	-	-
Price of imported feed component	$PIFC_t$	-1.8130	0.0171	-0.0029	-0.0036
Domestic price of feed	PF_t	3.0978	0.0251	4.8431	6.0006
Exchange rate of Rp to US$	ER_t	-1.6426	0.0006	-7.9467	-9.8460
Domestic feed production	FPR_t	0.4294	0.0035	2.0766	2.5729
Lag of imported feed component	IFC_{t-1}	0.1929	0.0283	-	-
Pr > F < 0.0008; Adjusted R^2 = 0.9901; DW = 2.242					

Source: Author's own calculation.

Supply of feed and feed crops

Maize production and supply

Domestic production of maize contributes more than 90 per cent to domestic maize supply. Less than 10 per cent of maize supply came from imports. As indicated maize supply is highly dependent on domestic production. Meanwhile, the harvested area of maize fluctuated during the period of 1970-2001.

For more than three decades (1970-2001), maize production has shown significant growth of 3.97 per cent per annum, although harvested area grew at only a very low rate (0.39 per cent/year), as shown in Table 14. High production growth of maize was attributed to the significant growth of yield (3.57 per cent per year), indicating good progress of technology, especially the increasing use of hybrids. The rapid growth of production, however, failed to satisfy domestic demand, causing a rapid increase in net imports.

Supply was steadily increasing from about 2.54 million tons in 1970 to about 10.34 million tons in 2001, growing at an average rate of 4.32 per cent per annum. This growth was much lower than that of the livestock population, especially layer and broiler chickens. It means that, in future the demand for maize for feed will grow very fast in line with the growth of the livestock population.

Table 14. Harvested area, production and supply of maize in Indonesia, 1970-2001

Year	Harvested area ('000 ha)	Production ('000 t)	Yield (t/ha)	Net imports ('000 t)	Supply ('000 t)
1970	2,938.6	2,825.2	0.96	-285.83	2,539.39
1975	2,444.8	2,902.9	1.19	-50.72	2,852.20
1980	2,481.8	3,525.6	1.42	18.91	3,544.51
1985	24,39.97	4,329.5	1.77	46.46	4,375.96
1990	31,58.09	67,34.03	2.13	-137.11	6,596.92
1997	33,55.22	87,70.85	2.61	1,079.39	9,850.24
2000	3,493.5	9,676.9	2.77	1,236.37	10,913.37
2001	3,279.7	9,347.2	2.85	944.8	10,291.80
Growth					2.35
1970-1975	-3.61	0.54	4.31	-	4.44
1975-1980	0.3	3.96	3.65	-	4.3
1980-1985	-0.34	4.19	4.55	-	8.56
1985-1990	5.3	9.24	3.74	-	5.89
1990-1997	0.87	3.85	2.95	-	1.1
1997-2001	-0.57	1.6	2.18	-	4.64
Average growth	0.39	3.97	3.57	20.47 [a]	4.64

Source: CAS, 1970-2001.
Note: [a] = during period of 1980-2001.

Maize production behaviour

The results of the analysis show that the area planted with maize was significantly influenced by a lag of its own price, soybean price, peanut price, and a dummy variable for the economic crisis. An increase in maize price one year resulted in an increase in area planted with maize the following year. This means that maize farmers are not able to respond to an increase in maize price in the same year. The decision to grow maize is based on their experience with prices the previous year. The short-term and long-term elasticity showed that maize area was least responsive with respect to all variables used in the model, with elasticities of less than one.

The model reveals that soybean is not a competitive crop for maize. This might be due to maize and soybean being planted in different seasons, due to different water requirements (Muhadjir, 1988; Saleh *et al*., 2000; Kasno *et al*., 2000). In contrast, peanut is likely to be a competitive crop for maize, shown by negative coefficient and elasticity.

The effect of the dummy (economic crisis) variable on area planted with maize was positive meaning that during the economic crisis there was an increase in area planted with maize. The severe devaluation of the rupiah to the US dollar caused the price of imported maize to rise. Therefore, the domestic price of maize grain increased which encouraged farmers to grow maize (Table 15).

Table 15. The analysis of maize area response in Indonesia (A_t)

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	427.4321	0.7081		
Lag of maize price (Rp/kg)	PM_{t-1}	1,205.5610	0.0463	0.7393	-
Soybean price (Rp/kg)	PS_t	423.2828	0.0248	0.6573	-
Peanuts price (Rp/kg)	PP_t	-190.8920	0.0106	-0.6071	-
Dummy (0 = before; 1 = during and after crisis)	D_t	1,049.4300	0.0026		
Pr > F < 0.0175; Adjusted R^2 = 0.5076; DW = 2.5427					

Source: Author's own calculation.

Maize yield is simultaneously determined by a lag of maize price, lag of fertilizer price, wage rates, progress of technology, and a dummy (economic crisis) variable. Maize yield is least responsive with respect to all explanatory variables, as shown by its short-term and long-term elasticities which are less than one (Table 16).

Table 16. The response of maize yield with respect to output and inputs prices (Y_t)

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	0.4584	0.1540		
Lag of maize price (Rp/kg)	PM_{t-1}	0.1604	0.1122	0.1449	0.1916
Lag of fertilizer price (Rp/kg)	$PFert_{t-1}$	-0.1157	0.3700	-0.0614	-0.0812
Wage rates (Rp/0.5 man day)	W_t	-0.0130	0.6594	-0.0433	-0.0573
Time as proxy of technology	T	0.0498	0.0233	-	-
Lag of maize yield	Y_{t-1}	0.2437	0.3993	0.2398	0.3170
Dummy (0 = before; 1 = during and after crisis)	D_t	0.0401	0.7585	-	-
$Pr > F < 0.0001$; Adjusted $R^2 = 0.9886$; DW = 1.7993					

Source: Author's own calculation.

Feed production and supply

Since there are no imports of compound feeds, the supply solely comes from domestic production and stock which is very small. A boom in the poultry industry (layer and broiler chickens) occurred in the mid 1980s. Feed production and its supply followed the development of the poultry industry. In 1970, feed production was only 14 thousand tons, while in 1985 it was 1.06 million tons (Table 17). It steadily increased to about 4.5 million tons in 2001.

Compared to feed demand, the feed market before the economic crisis was almost balanced. However, since 1997 (during and after crisis) the demand for feed has declined and therefore the feed market is likely in over supply. The decline in demand for feed might be attributed to the closure of many poultry farms during the economic crisis.

Table 17. Supply of and demand for feed in Indonesia, 1970-2001

Year	Production ('000 t)	Stock ('000 t)	Supply ('000 t)	Demand ('000 t)
1970	14	0.1	14.1	13
1975	88	0.3	88.3	84
1980	447	0.8	447.8	425
1985	1,061	4.4	1,065.4	1,007
1990	1,598	7.3	1,605.3	1,546
1995	3,350	49.9	3,399.9	3,145
1997	4,445	84.8	4,529.8	3,017
1998	2,086	142.8	2,228.8	1,665
2000	4,497	74.8	4,571.8	2,497
2001	4,496	200.0	4,696.0	2,466
Growth				
1970-1975	44.43	24.57	44.33	45.23
1975-1980	38.41	21.67	38.36	38.30
1980-1985	18.87	40.63	18.93	18.83
1985-1990	8.54	10.66	8.54	8.95
1990-1997	15.74	31.60	15.97	10.02
1997-2001	0.29	23.92	0.90	-4.92
Average growth 1970-2001	21.3728	25.95	21.49	19.58

Source: Livestock Statistics, 1970-2001.

Feed production behaviour

The results of the analysis showed that feed production is simultaneously determined by the price of feed, domestic price of maize, domestic price of imported feed components, demand for maize for feed, interest rates and a dummy variable for the economic crisis with the determination coefficient of 0.95. In addition, the signs of all parameter estimates were confirmed with economic theory (Table 18).

The short-term and long-term elasticity showed that feed production is least responsive to its own price and interest rates. However, it is responsive to domestic maize price, maize demand for feed, and domestic price of imported feed components.

Table 18. The analysis of feed production model (FPR_t)

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	1,128.1662	0.4243		
Price of feed (Rp/kg)	PF_t	0.4994	0.1455	0.2093	0.2546
Domestic price of maize (Rp/kg)	PM_t	-728.81	0.1237	-1.8058	-2.1965
Demand for maize for feed ('000 tons)	DF_t	1.3407	0.0001	1.2513	1.5220
Domestic price of imported feed components (US$/kg)	$DPICF_t$	-0.0337	0.3297	-1.1054	-1.3445
Interest rate (%/year)	IR_t	-93.9463	0.0253	-0.2409	-0.2930
Lag of feed production ('000 tons)	FPR_{t-1}	0.1779	0.2882		
Dummy (before and after crisis)	D_t	-203.20	0.6919		
Pr > F < 0.0001; Adjusted R^2 = 0.9503; DW = 2..214					

Source: Author's own calculation.

Development of farming technologies

Many efforts have been made to increase maize production in Indonesia through the improvement of production technology. The most popular component of technology that has been quickly and widely adopted by farmers in Indonesia is high yielding varieties (HYVs), consisting of open pollinated varieties (OPVs) and hybrids. The activities of research and development undertaken by the Indonesian Public Research Institutes and Multinational Companies have produced a lot of HYVs; both composites (OPVs) and hybrid varieties. Up until 2001, at least 37 OPVs and 47 hybrids have been released in Indonesia (Nugraha, *et al*., 2002). All OPVs were bred by Indonesian Research Institutes, while most hybrids were bred by multinational companies. About 10 hybrids, namely Semar-1 to Semar-10 were bred by Indonesian Research Institutes. Since the 1990s, some of the released HYVs have not only had higher yields, they have also been resistant to downy mildew. This additional superiority has significantly contributed to the increase in maize yield in Indonesia.

Apart from varieties, some research on cultural practices has also been conducted. The results of this research has been disseminated through the agricultural extension programme. To speed up the transfer of technology, since 1995, the Indonesian Agency for Agricultural Research and Development (IAARD) formed the Assessment Institutes of Agricultural Technology (AIAT) in each province. The mandate of AIAT in each province is to generate location specific mature technologies and disseminate them to the farmers.

Trading of feedstuffs and feed crops

Domestic trade

Demand for maize from the domestic market steadily increases every year. This is caused by the advantage of maize with it's multipurpose characteristics such as, direct

consumption and as a raw material for feed and food processing. This has caused the demand for maize to progressively increase, which is derived by the increasing demand for livestock products. The increasing population, changes in consumption patterns, and society tastes and preferences have caused national meat consumption to continuously increase. Growth of meat consumption in Indonesia is mostly down to broilers. The increase in demand for chicken meat and the population of broilers trigger the demand for feed, and in turn maize.

Nationally, maize domestic production may not have comparative advantage compared with the world market due to the production structure in different areas in Indonesia differing widely. Farm households' capital position, agro-ecosystems and seasonal variability are among factors that determine the comparative advantage of domestic maize production. However, for a specific location, especially in the main production areas, domestic maize production shows significant comparative advantage. Feed industries are mostly located in North Sumatra, Lampung, West Java, East Java and South Sulawesi. Inter-island trading is intensified by the support of appropriate sea transportation, as well as land transportation.

Some results of studies which have been conducted by Kariyasa and Adnyana (1998), Nurkhalik (1999), Sadikin (2002) and Simatupang (2002) indicate that in the main production areas of Indonesia, producing maize has comparative advantage. In other words, if maize production is managed properly, especially in suitable areas, it has the opportunity to reduce foreign exchange expenditure due to local maize being able to satisfy domestic demand.

In the feedstuffs' market, the accelerating increase in the price of feed far exceeds the increasing trend in price of maize. This matter can be also seen from the price ratio between maize and feed that was 0.78 in 1980 down to 0.22 in 1996 (Purba, 1999). On the other hand, the continuity of supply is also another factor affecting the feed market since most of the feed industries highly depend on imported raw materials, especially soybean meal and maize. Since 1994, the share of imported maize has been more than 30 per cent, even in 2000 the use of imported maize and domestic was almost the same at 47.04 per cent and 52.96 per cent respectively.

Indonesia imported about 660 thousand tons of maize on average increasing at 11.28 per cent per year during the period of 1990-2001. In the same period, Indonesia also exported 116 thousand tons per year, a declining 4.2 per cent annually. However, Indonesia is still a net importing country for maize, even though the share is relatively small, only 19.6 per cent from the total requirement during 1970-2001. The share of imported maize during this period increased with growth at about 11.81 per cent per year. The main use of maize imports is to fulfil domestic supply for raw materials for the feed industry. Meanwhile, use of imported maize in the food industry is still limited. On the contrary, the use of domestic maize in the feed industry declined by 3.77 per cent per year (Tables 19). This condition indicates that being highly dependant upon imported maize may not be beneficial for the feed industry or livestock raising in Indonesia. Moreover, within the last ten years maize trade in the world market has been very small (Kasryno, 2002).

Table 19. Percentage of imported and domestic maize for the feed industry in Indonesia, 1970-2001

Year	Share (%)	
	Import	Domestic
1970	0.00	100.0
1975	0.00	100.0
1980	3.20	96.80
1985	2.54	97.46
1990	3.63	96.37
1991	12.64	87.36
1993	18.29	81.71
1994	40.29	59.71
1995	34.04	65.96
1996	15.82	84.18
1997	30.36	69.64
1998	20.59	79.41
1999	30.60	69.40
2000	47.04	52.96
2001	34.97	65.03
Average	19.60	80.40
Growth (%/year)	11.81	-3.77

Source: Kariyasa, 2003.
Note: The use of imported maize for non-feed industry is about 15 per cent (computed).

International trade

In the world market, the trade volume of maize dramatically increased during the period of 1960-1980, with the highest volume reached in 1980 (82 million tons), about 20 per cent of world production (Kasryno, 2002). However, since then the maize trade volume has continuously declined even though production increased. In 2000 and 2001, the volume of exported maize was only 82 million and 79 million tons or 13.86 per cent and 12.85 per cent of world production respectively (Table 20). The dependence of developing countries on imported maize is progressively mounting due to the rapid expansion of the poultry industry. This situation indicates that in future maize will not be easy to obtain in the world market. Again, this situation may not be beneficial for the feed industry nor domestic poultry businesses.

Table 20. Maize export volume in main exporting countries, 1990-2001 ('000 ton)

Year	Country					World	
	USA	Argentina	China	Hungary	Indonesia	Total	%[1)]
1990	52,172	2,998	3,405	156	146	72,039	14.90
1991	44,558	3,898	7,783	494	33	66,161	13.38
1992	43,236	6,093	10,340	2,525	150	73,842	13.84
1993	40,365	4,871	11,098	169	61	67,817	14.23
1994	35,877	4,154	8,740	181	37	65,147	11.45
1995	60,240	6,001	113	601	79	78,222	15.13
1996	52,410	6,425	159	129	27	71,754	12.18
1997	41,792	10,979	6,617	1,192	19	73,066	12.49
1998	42,125	12,442	4,687	2,109	634	76,095	12.36
1999	51,975	7,890	4,305	1,708	91	78,903	13.00
2000	47,971	10,847	10,466	1,007	28	82,124	13.86
2001	47,944	10,910	5,998	1,569	91	78,910	12.85
Average	46,722	7,292	6,143	987	116	73,673	13.31
Share (%)	63.42	9.90	8.34	1.34	0.16	100.00	-
Growth (%/year)	0.48	10.59	1.02	23.35	-4.20	1.49	-0.87

Source: FAO, 2002 (computed).
Note: [1)] percentage w.r.t. world production.

The main maize producer in the world is the United States of America. During 1990-2001, USA produced about 40 per cent of total world production, increasing at 4.38 per cent per year (Table 21). The second biggest maize producer is China with a volume of about 19 per cent of world production increasing at 2 per cent per year. Other maize producing countries are Brazil and Mexico with shares of about 5 per cent and 3 per cent on average respectively. Meanwhile, Indonesian maize production is very small compared with these countries of only about 1 per cent.

Table 21. Maize production in five main producer countries in the world, 1990-2001 ('000 ton)

Year	Country						World
	USA	China	EEC	Brazil	Mexico	Indonesia	
1990	201,532	97,214	2,4216	21,348	15,664	6,734	483,329
1991	189,866	99,148	28,911	23,624	16,530	6,256	494,359
1992	240,719	95,773	31,184	30,506	17,245	7,995	533,526
1993	160,985	103,110	31,704	30,056	18,631	6,460	476,681
1994	255,293	99,674	29,590	32,488	19,141	6,869	569,212
1995	187,969	112,362	30,368	36,267	17,005	8,246	517,068
1996	234,527	127,865	35,576	32,185	16,000	9,307	589,174
1997	233,867	104,648	39,386	32,948	18,922	8,771	584,920
1998	247,882	133,198	36,436	29,602	16,934	10,169	615,460
1999	239,549	128,287	37,522	32,038	17,788	9,204	606,946
2000	251,854	106,180	38,774	31,879	19,000	9,677	592,501
2001	241,485	114,254	40,820	41,439	19,000	9,165	614,234
Average	223,794	110,143	33,707	31,198	17,655	8,238	556,451
Share (%)	40.22	19.79	6.06	5.61	3.17	1.48	100.00
Growth (%/year)	4.38	2.30	5.17	6.97	2.11	3.75	2.56

Source: FAO, 2002 (computed).

Except the United States, it is likely that the main maize producing countries in the world are not necessarily maize exporters (Table 20). This is caused by maize consumption in these countries also being high, so that the main target of domestically produced maize is to satisfy domestic demand. In the period of 1990-2001, the share of the United States in the international trade of maize was the highest in the world (63.42 per cent). Thereby, the trade volume of maize is very much determined by the trade policy of USA. Argentina and China shared about 9 per cent and 8 per cent respectively. Furthermore, during the period of 1990-2001, the volume of maize traded in the world market was close to 73.7 million tons or 13.31 per cent of total world production. The volume is declining by about 0.87 per cent on average per year. This indicates that the world maize market is a thin market. Therefore, any country that immediately increases its imports will significantly affect the price of maize in the world market.

World imports during 1990-2001 were equal to 73.09 million tons and tended to increase 1.45 per cent annually. Japan is the main importing country (22-24 per cent), followed by Republic of Korea (10.11 per cent), Taiwan (7.20 per cent), Mexico (4.92 per cent), and Malaysia (2.78 per cent). Indonesian maize imports are very small or about 0.9 per cent of total world imports (Table 22). World trade of feed components, during 1970-2001 reached 186.5 million tons for exports and about 91.23 million tons for imports. Imports and exports of the world feed trade were not rapidly increasing, being 0.10 per cent and 0.31 per cent respectively (Tables 22 and 20).

Table 22. Maize import volume in main importing countries, 1990-2001 ('000 ton)

Year	Country						World
	Japan	Rep. of Korea	Taiwan	Mexico	Malaysia	Indonesia	
1990	16,008	6,158	4,785	4,104	1,480	9	73,632
1991	16,646	5,477	5,321	1,422	1,464	323	65,831
1992	16,382	6,612	4,983	1,306	1,816	56	72,304
1993	16,863	6,207	629	211	2,058	494	68,951
1994	15,930	5,749	5,316	2,747	1,969	1,118	63,212
1995	16,580	9,035	6,288	2,687	2,383	969	76,964
1996	16,004	8,679	5,900	5,843	2,227	617	71,103
1997	16,097	8,313	5,742	2,519	2,745	1,098	72,358
1998	16,049	7,111	4,474	5,212	1,841	313	72,845
1999	16,606	8,115	4,575	5,546	2,200	618	75,912
2000	16,111	8,715	5,000	5,348	2,249	1,265	81,896
2001	16,222	8,482	5,100	6,174	1,975	1,036	82,079
Average	16,291	7,388	5,259	3,593	2,034	660	73,091
Share (%)	22.29	10.11	7.20	4.92	2.78	0.90	100.00
Growth (%/year)	-0.11	3.65	-0.48	11.22	2.80	11.28	1.45

Source: FAO, 2002 (computed).

Maize exports, imports and price behaviour

As mentioned earlier, Indonesia is a net importing country for maize and chicken meat and this tends to rapidly increase annually. The utilization of maize in Indonesia is mainly for food and feed industries. However, the share of imported maize is relatively very small or about 7.7 per cent of total domestic consumption.

Based on the econometrical model, the behaviour of maize imports was influenced by variables such as: (1) imported price; (2) domestic price; (3) exchange rate of rupiah to US dollar; (4) Indonesian GDP; and (5) lagged volume of maize imported (Table 23). The econometrical model used in this study could explain quite well the expected behaviour of maize imports as exhibited by a coefficient of determination (R^2) at around 0.85. In addition, the signs of parameter estimates were also as expected. The elasticity showed that the quantity of imported maize was less responsive to imported maize price and GDP. Meanwhile, it was responsive to exchange rates both in the short- and the long-term, and to domestic maize prices in the long-term, as shown by its elasticity of greater than one.

Table 23. Maize imports behaviour

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	368.0278	0.0185	-	-
Imported price of maize (US$/ton)	IP_t	-0.4863	0.2736	-0.0002	-0.0003
Domestic price of maize (Rp/kg)	PM_t	0.7073	0.3554	0.9497	1.5332
Exchange rate of Rp to US$ (Rp/US$)	ER_t	-0.2218	0.0005	-1.6931	-2.7334
Gross Domestic Product (Rp. billion)	GDP_t	0.0015	0.0017	0.4736	0.7646
Lag of maize imports ('000 tons)	M_{t-1}	0.3806	0.0321	-	-
Dummy (0 = before; 1 = during and after crisis)	D_t	262.2728	0.3340	-	-
$Pr > F < 0.0001$; Adjusted $R^2 = 0.8478$; DW = 2.159					

Source: Author's own calculation.

The behaviour of world maize prices on the other hand, was significantly influenced by the quantity of maize exported, volume imported, and price in the previous year. The increasing imports of maize are derived by rapid increases in feed demand. The world price was responsive to export and import quantities in the long-term. However, these two variables had less significant short-term effects on the world price of maize (Table 24).

Table 24. World price of maize behaviour

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	-207.6836	0.5806		
Quantity of world maize export ('000 tons)	XW_t	-0.0329	0.2026	-0.1578	-1.4590
Quantity of world maize import ('000 tons)	MW_t	0.0361	0.1643	0.1727	1.5962
Lag of world price of maize (US$/kg)	PW_{t-1}	0.8918	0.0001		
Pr > F < 0.0001; Adjusted R-Square = 0.9542; DW = 2.404					

Source: Author's own calculation.

The import price of maize to Indonesia was significantly determined by the world price of maize and the rupiah exchange rate to the US dollar. Particularly, the import price of maize was highly responsive to fluctuations in world prices both over the short- and long-term with elasticities of 1.83 and 5.31 respectively. On the contrary, import prices of maize exhibited a low response to the rupiah exchange rate with elasticities of only 0.02 and 0.04 for the short- and long-term respectively (Table 25).

Domestic maize price behaviour was significantly determined by total domestic demand, total domestic supply, and import price of maize. Even though only slightly responsive, the domestic price will tend to increase as domestic demand increases. Other variables like domestic total supply, import price of maize and lag price show weak influence on the domestic price of maize. In the long-term, domestic maize price was responsive to the import price with an elasticity of 1.34 (Table 26). The main factor determining this domestic price behaviour is tight market links between the international maize market and the domestic market. This is also strengthened by an increasing trend in maize imports.

Table 25. Imported price of maize behaviour

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	-909.5502	0.0258		
World price of maize US$/kg	PW_t	1.9668	0.0001	1.8341	5.3097
Exchange rate of Rp to US$ (Rp/US$)	ER_t	0.0918	0.0509	0.0152	0.0439
Lag of imported price of maize (US$/kg)	IP_{t-1}	0.6546	0.7406		
Pr > F < 0.0001; R-Square = 0.8512; DW = 1.234					

Source: Author's own calculation.

Table 26. Domestic price of maize behaviour

Variable label	Variable name	Parameter estimate	Pr > |t|	Elasticity	
				Short-term	Long-term
Intercept	Intercept	1.7613	0.0060		
Domestic total supply of maize ('000 tons)	Qs_t	-0.0297	0.3852	-0.4045	-0.5732
Domestic total demand for maize ('000 tons)	Qd_t	0.0007	0.1005	0.3567	0.3579
Imported price of maize (US$/kg)	IP_t	0.0305	0.4124	0.9439	1.3377
Lag of domestic price of maize (Rp/kg)	PM_{t-1}	0.2944	0.2253		
Dummy (0 = before; 1 = during and after crisis)	D_t	0.1459	0.4321		
Pr > F < 0.4470; Adjusted R-Square = 0.3327; DW = 2.039					

Source: Author's own calculation.

Supply and demand projections

In the future, domestic maize production is projected to increase from about 9.54 million tons in 2002 to about 12.92 million tons in 2015, or grow at a rate of 2.36 per cent per year. However, the growth of projected domestic demand for maize is much higher (5.39 per cent per year), so that the maize deficit is projected to continuously increase. Based on this projection, Indonesia will always experience deficit conditions in maize supply of more than 3 million tons annually. There should be some breakthroughs to improve the technology of maize farming, or to extend area planted with maize in order to extend maize production.

On a feed side, production is projected to increase from about 4.55 million tons in 2002 to about 5.35 million tons in 2015, or grow at a rate of 1.25 per cent per annum. The projected production (supply) is higher than its projected demand. However, since the growth of projected demand is much higher (5.40 per cent per year), the surplus is projected to sustain until 2008. However, starting in 2009 Indonesia will face deficits in feed production of about 0.11 million tons increasing to 1.6 million tons in 2015 (Table 27).

Table 27. Projected production, demand and balance of maize and feed in Indonesia, 2002-2015 ('000 t)

Year	Projected Production		Projected Demand		Balance	
	Maize	Feed	Maize	Feed	Maize	Feed
2002	9,540.69	4,549.16	9,736.75	3,524.80	-196.06	1,024.36
2003	9,744.46	4,606.03	10,011.12	3,699.76	-266.66	906.27
2004	9,958.89	4,663.60	10,349.05	3,888.26	-390.16	775.34
2005	10,184.49	4,721.90	10,765.22	4,091.38	-580.73	630.52
2006	10,421.80	4,780.92	11,277.72	4,310.25	-855.92	470.67
2007	10,671.41	4,840.68	11,908.83	4,546.11	-1,237.42	294.57
2008	10,933.91	4,901.19	12,685.96	4,800.29	-1,752.05	100.90
2009	11,209.97	4,962.46	13,642.90	5,074.23	-2,432.93	-111.77
2010	11,500.27	5,024.49	14,821.25	5,369.48	-3,320.98	-344.99
2011	11,771.68	5,087.30	15,620.12	5,659.43	-3,848.44	-572.13
2012	12,049.49	5,150.89	16,462.04	5,965.04	-4,412.55	-814.15
2013	12,333.86	5,215.27	17,349.34	6,287.15	-5,015.48	-1,071.88
2014	12,624.93	5,280.46	18,284.47	6,626.66	-5,659.54	-1,346.20
2015	12,922.88	5,346.47	19,270.01	6,984.50	-6,347.13	-1,638.03
Growth (%/year)	2.36	1.25	5.39	5.40	30.67	-34.09

Source: Author's own calculation.

Measures to meet excess demand

In order to meet the excessive demand for maize, the government decided to import from the world market and since the 1990s Indonesia has become a maize net importer (Kasryno, 2002). In 1991 the amount imported was about 323 thousand tons and in 2000 increased to 1.26 million tons or during 1990-2000 the volume of imported maize was equal to 20.35 per cent of national production on average (Anonymous, 2002).

Government and private company initiatives

Mass guidance for palawija crop production (*Bimas Palawija*) has been one of the government programmes to increase domestic maize production since 1973. *Bimas Palawija* in fact was a production technology package in combination with a credit package for farmers who grow secondary crops including maize. Another policy is the use of hybrid seeds that is expected to increase yield and farmer's on-farm income significantly. The use of hybrid seeds

started in 1983. In 1998, maize again received much attention from the government through the so called programme of *GEMA PALAGUNG*, a kind of special effort to substantially increase maize production, together with rice and soybean. However, the various policies which have been implemented by the government to the present day, have not substantially increased maize production.

Research and development on maize is carried out by the Indonesian Cereal Research Institute (ICRI) located in Maros, South Sulawesi with the coordination of the Indonesian Center for Food Crops' Research and Development (ICFORD). The main research out of ICRI is a new superior maize variety and its production technology such as Integrated Crop Management (ICM) for each specific agro-ecosystem. Composite maize research programmes are directed to released new maize varieties that are adaptable to less favourable areas. Recently, ICRI has given high priority to research on Quality Protein Maize (QPM) in collaboration with CIMMYT in Mexico. This programme is focused to release new varieties of QPM especially for the eastern part of Indonesia such as NTB, NTT and all of Sulawesi.

In order to speed up the process of adoption and diffusion of new maize varieties and their production technology, ICFORD has coordinated a link and match research programme between National Research Institutes under ICFORD with the Assessment Institute for Agricultural Technology (AIAT) in 28 provinces. Maize is also incorporated in the crop livestock system (CLS) and has become one of the core location specific technology assessment programmes at AIAT. Therefore, in terms of maize research and development programmes, vertical as well as horizontal dissemination programmes are well organized.

Potentials, opportunities and constraints to feed crop expansion

SWOT analysis is applied in order to seek better understanding of the potentials and constraints of maize production expansion. The analysis comprises various steps following Sianipar and Entang (2001); and Adnyana (2004)

After exercising all steps of SWOT analysis, the most important internal and external factors were identified. They are: (1) a well developed hybrid seed industry (strength); (2) inappropriate post-harvest handling (weakness); (3) strong domestic demand from the feed industry (opportunity); and (4) increasing maize imports are a threat to domestic maize production. Following he identification of four internal and external factors, some strategies for developing domestic maize production are formulated as: (1) increasing maize yield by utilizing hybrid seeds to satisfy strong domestic demand (SO); (2) enhancing domestic maize production by utilizing hybrid seeds to reduce dependence on imported maize (ST); (3) improving maize grain quality by adopting proper post-harvest technology to satisfy domestic demand (WO); and (4) developing grain quality of maize by adopting appropriate post-harvest technology to partially substitute imported maize (WT), as presented in Table 28.

Table 28. Strategy formulation of maize production in Indonesia, 2004

INTERNAL FACTOR / *EXTERNAL FACTOR*	**STRENGTHS** Well developed hybrid seed industry	**WEAKNESS** Inappropriate post-harvest handling
OPPORTUNITIES Strong domestic demand for maize.	*STRATEGY: SO* Increasing maize yield by utilizing hybrid seeds to satisfy strong domestic demand.	*STRATEGY: WO* Improving maize grain quality by adopting proper post-harvest technology to satisfy domestic demand.
THREATS Increasing trend of maize imports.	*STRATEGY: ST* Increasing domestic maize production by utilizing hybrid seeds to reduce dependence on imported maize.	STRATEGY: WT Improving grain quality of maize by adopting appropriate post-harvest technology to partially substitute imported maize.

The goals of domestic maize production are set based on the results of the SWOT analysis, and are as follows: (1) competitive domestic maize production in terms of production costs and grain quality; and (2) improvements in maize farmers' income. It implies that efficient maize production characterized by good quality grain will improve maize farmers' on-farm income. To attain the goals, four strategies are established consisting of four policy options and eight programmes. The policy options are: (1) promotion of hybrid seed application; (2) intensive application of appropriate maize post-harvest technology; (3) expansion of area planted with hybrid maize; and (4) maize grain quality improvement. The programmes comprise: (1) maize intensification; (2) soft credit for maize production; (3) farmers training on post-harvest handling; (4) provision of post-harvest machinery through farm credit; (5) maize intensification; (6) farmers' groups consolidation, especially farm management; (7) post-harvest handling field school; and (8) grain quality promotion (Table 29).

Table 29. Ultimate goals, strategies, policy options and development programmes of maize production in Indonesia, 2004

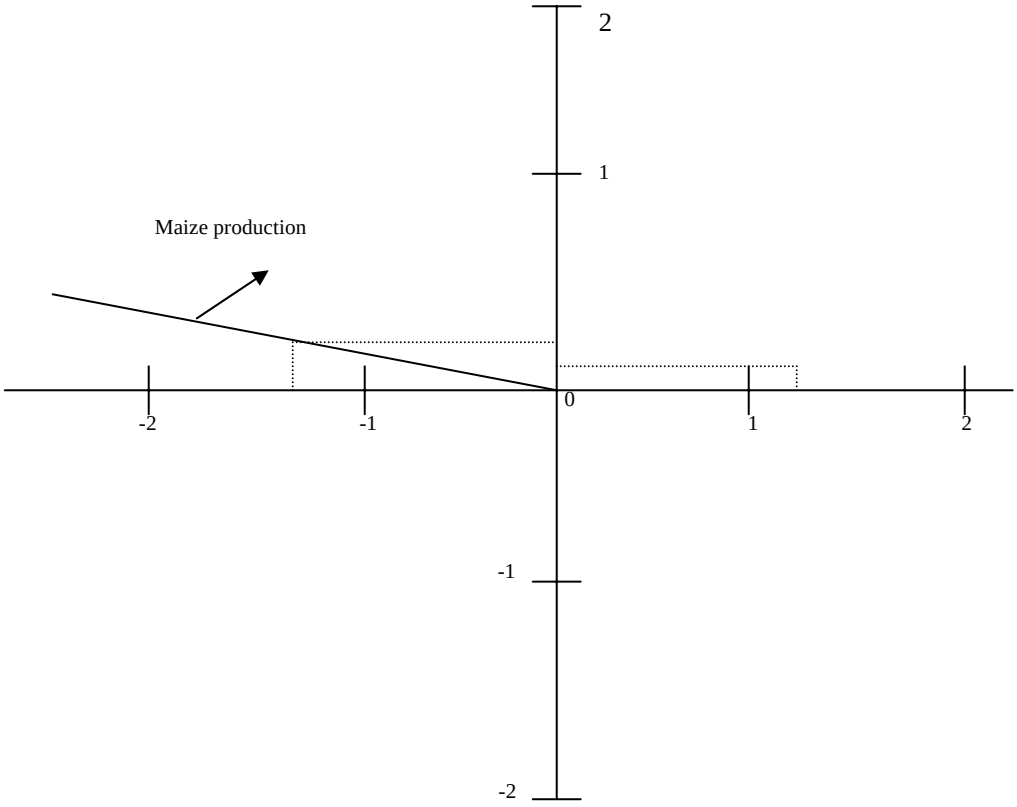
No	Goal	Strategy	Policy options	Programme
1.	Competitive domestic maize production in terms of production cost and grain quality.	**SO** Increasing maize yield by utilizing hybrid seeds to counter strong domestic demand.	Promotion of hybrid seed use.	1. Maize intensification. 2. Soft credit for maize production.
2.	Improvement of maize farmers' income.	**WO** Improving maize grain quality by adopting appropriate post-harvest technology to satisfy domestic demand.	Intensive application of appropriate maize post-harvest technology.	1. Farmers training on post-harvest handling. 2. Provision of post-harvest machinery through farm credit.
		ST Increasing domestic maize production by utilizing hybrid seeds to reduce dependence on imported maize.	Expansion of area planted with hybrid maize.	1. Maize extensification. 2. Farmers' groups consolidation.
		WT Improving grain quality of maize by adopting appropriate post-harvest technology to partially substitute imported maize.	Maize grain quality improvement.	1. Post-harvest handling field school. 2. Grain quality promotion.

Mapping the status of the maize production system in Indonesia is carried out based on the net value of total weighted value (TNB) of each internal factor and external factor (Table 30 and Figure 3). The value of TNB of internal factors is equal to -1.36 revealing that domestic maize production is weak, such as characterized by farmers' capital constraints, small land holdings, and poor post-harvest handling. The external factors' TNB value exceeds that of internal factors (0.36) implying that maize production systems in Indonesia have more opportunities, such as strong domestic demand, than threats, to development.

Table 30. Performance mapping of domestic maize production

Industry	Internal factor	External factor
Domestic maize production	-1.36	0.36

Figure 3. Performance map of maize production in Indonesia, 2004



Conclusion and policy implication

Conclusion

Based on the comprehensive discussion of the results, there are some conclusions that can be drawn.

1. During the early stage of economic development, Indonesia remained self-sufficient in maize production at least until 1975. The booming poultry industry has triggered rapidly increasing demand for maize since to 1980s. This increasing demand for maize is derived by dramatic increases in meat demand especially chicken meat, which is relatively cheaper compared to beef, pork and other types of meat. An increasing population and better income is the main source of increasing meat demand.
2. Domestic maize production remains unable to meet rapidly increasing demand either at present nor in the future. This is due to various factors such as: (1) maize belongs to secondary crops after rice, therefore, the government of Indonesia (GOI) has given less priority to this crop; (2) maize is usually grown after rice in irrigated areas so that there are many competing crops for land, while maize grown on dryland or less favourable environments is usually of low productivity; (3) maize in most cases is less competitive compared to other crops such as vegetables, groundnut, and other high-value crops on irrigated land after rice; (4) low productivity is one of the most important aspects that makes this crop less competitive; and (5) technological breakthroughs are limited only to hybrid seeds, and these varieties usually only respond to many inputs and are only adaptable to favourable areas such as irrigated areas with good drainage systems.
3. To meet the rapid growth of domestic demand for maize as one of the largest feed components, the government then imported maize from the world market at a continuously increasing amount. Even though the volume of imported maize is still relatively low or about 10 per cent of total maize consumption it is increasing at 11 per cent annually. Meanwhile, total maize consumption (for food and feed) increased by almost 5 per cent per year.
4. Most imported maize is used by the feed industry with more than a 51 per cent share of feed components, while soybean meal accounts for about 18 per cent. Indonesia is a net importing country for soybean meal. This indicates that the domestic feed industry is heavily dependant upon imported raw materials, especially maize and soybean meal.
5. The economic crisis temporarily affected the chicken industry during 1998-2000. Almost all economic sectors felt the crisis except the agricultural sector. Since the imported maize is mostly allocated for the feed industry, which accounts for less than 10 per cent, it did not substantially affect domestic maize production. During the crisis, the food crop sub-sector experienced positive growth, which indicates that agriculture is the most resilient sector during an economic crisis.
6. Yield response of domestic maize production was determined by a lag of maize price, lag of fertilizer price, wage rate, production technology and a dummy variable of economic crisis. The positive parameter estimate of maize price indicates that farmers tend to increase yield through technology intensification, as maize price increases are based on prices in the previous year as well. Maize yield is less responsive to its explanatory variables, shown by its respective elasticity.
7. There was a significant change in the demand structure of maize, from direct consumption as food to feed and food industries. Increasing demand for livestock products and manufactured maize is mainly due to an increase in per capita income.
8. Maize demand from the feed industry was negatively responsive to the price of soybean in the long-term and also responsive to its own domestic price and

significantly determined by its demand the previous year. The economic crisis was likely to have had a highly negative impact on maize demand from the feed industry.

9. The economic crisis had a positive impact on direct consumption of maize, indicated by increasing direct consumption of maize due to income reduction and rice becoming more expensive.
10. The demand for feed is strongly determined by the chicken population. However, although maize demand for feed was not statistically determined by the price of the chicken meat, it is responsive to meat prices, both in the short- and long-term.
11. In the world market, since the 1980s, the dependence of developing countries on imported maize has been progressively increasing. This was due to the rapid expansion of the broiler and layer industry. This situation indicates that in future, maize may not be easily imported from the world market. In turn, this will not benefit the feed industry or the domestic poultry industry.
12. Until 2015, domestic maize production is projected to increase from about 9.54 million tons in 2002 to about 12.92 million tons in 2015, or grow at about 2.36 per cent annually. However, the growth of projected domestic demand for maize is much higher (5.39 per cent per year), so that the maize deficit is projected to continuously increase. There needs to be breakthroughs to improve the technology of maize farming, or extend the area planted with maize in order to speed up maize production.
13. Indonesia and other Southeast Asian countries will experience the most significant increase of maize imports, even though the consumption level of livestock products is still low.

Policy implications

GOI protective policies on rice and sugarcane influence the growth rate of domestic maize production. If GOI relaxes its policy intervention and protection on these two commodities, maize production is predicted to grow at a higher rate than the existing growth. The policy implication of this trend should be coupled with inducement in R&D and enhancing maize production technology especially the use of hybrid seeds and integrated crop management (ICM). Therefore, the GOI budget for R&D should be immediately increased from less than 0.5 per cent to at least 1.0-1.25 per cent of the total budget annually.

The results of policy simulation showed that credit and fertilizer subsidies have positive impacts on increasing maize and feed supplies as well as their respective demand. On the other hand, rupiah depreciation and import tariffs for maize have a positive impact on increasing maize production, but result in a reduction in demand for maize, following a reduction in feed production and its supply. The implication is that the GOI should provide farmers with soft credit and impose maize import tariffs to protect maize farmers.

Another important implication of the results is that government policy does not only affect domestic supply of and demand for maize and feed, it also affects prices of maize and other feed components in the world market, since maize has a thin market. Thus, it indicates the presence of strong links between domestic policy and the international market.

The results of the SWOT analysis showed that domestic maize production should be directed to various goals and objectives such as: (1) competitive domestic maize production in terms of production costs and grain quality; and (2) improve maize farmers' income. It implies that efficient maize production characterized by good quality grains will improve maize farmers' on-farm income. To attain the goals, strategies are established that consist of four policy options. The policy options are: (1) promotion of hybrid seed application; (2) intensive application of appropriate maize post-harvest technology; (3) expansion of area planted with hybrid maize; and (4) maize grain quality improvement.

The action programmes that are necessary are comprised 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 extensification by utilizing fallow land and areas of young estate tree crops; (6) farmers' groups consolidation especially on-farm management; (7) post-harvest handling field school; and (8) promotion of grain quality management.

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Comments on Country Report of Indonesia: "Prospects of Feed Crops in South East Asia: Alternatives to Alleviate Poverty through Secondary Crops' Development"

Kusuma Diwyanto[*]

Introduction

1. The report presented by Dr. Swastika has been well prepared and orderly written using good analyses methods. The data and information reported were taken from competent sources, hence, scientifically this paper could be used as basic information by decision makers in taking a national-scope decision in agricultural development. The report is well presented in full detail, hence, very easy to understand. However, in this instance, discussion will focus on several related aspects of corn's role in the livestock industry in Indonesia.
2. Around 85-90 per cent of feed produced in Indonesia is for poultry (broiler and layer) production. With the increase in poultry production, the demand and production of poultry feed will also increase. This has been proven with the increase in poultry feed in the early 1970s with the initialization of Bimas Ayam (poultry Mass Guidance) and also importation of hybrid chickens to Indonesia. It was forecasted that in 2004 the production of poultry feed will reach over 7 million tons and will increase further.
3. The corn proportion of poultry (broiler and layer) feed composition, could reached 50 per cent of total rations. This is normal as the birds need energy and the major source is corn. It is apparent that other sources of energy could be derived from sorghum, cassava or fat, however, limitations in production, price, nutrient composition and substitution innovation of feed sources up to now regarded corn as major source in poultry feed.
4. The contribution of corn cost in poultry feed price could be calculated as the percentage cost of corn in the feed formula. According to Tangenjaya (2002), the price of feed was Rp 1,750 for broiler and Rp 1,400 for layer in 2002 with the inclusion of 55 per cent and 47 per cent corn in the ration, respectively, and when the price of corn was Rp 1,200/kg, the contribution of corn reached 37-40 per cent. The next highest cost in the feed formula is soy waste. The contribution of corn cost till now is still constant, although the price of corn fluctuates heavily.
5. The use of corn as an energy source in poultry rations not only happens in Indonesia but also in other countries. To emphasize the importance of corn in supporting the poultry industry, lets review available data of boiler producing countries in the world and make comparison with corn producing countries. USDA (2000) indicated seven major broiler exporter countries were included in the list of countries that produce corn in the world. Most interesting is with reference to Thailand that could become a world

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exporting country of broiler chickens and compete with other countries including USA and Brazil. On the contrary, Thailand does not produce soybean for inclusion in poultry feed, but has the capacity to produce corn in large quantities. Indonesia could follow Thailand's step in developing the broiler industry, as both countries have similar agricultural potential, but Indonesia has even more potential agricultural land compared to Thailand.

Table 1. Corn and broiler exporting countries in the world

Broiler exports (million tons)			Corn production (million tons)		
1.	USA	2,554	1.	USA	239,719
2.	China/HK	1,363	2.	China	128,000
3.	Brazil	876	3.	European Union	27,145
4.	European Union (France, Netherlands, United Kingdom)	853	4.	Brazil	32,000
			5.	Mexico	19,000
5.	Thailand	283	6.	Argentina	15,500
6.	Hungary	130	7.	India	10,500
7.	Canada	85	8.	Africa	9,500
			9.	Canada	9,096
			10.	Yugoslavia	7,000
			11.	Indonesia	6,100
			12.	Egypt	6,100
			13.	The Philippines	4,500
			14.	Thailand	4,100

6. Initially – around 20-30 years ago – corn was still a major food source and second to rice. At present, this has shifted. Analysis of Kasryno *et.al* (2002) using the past 20 years data showed that the use of corn in Indonesia has shifted from food to feed use. The same situation happened in USA that utilizes 85 per cent of its corn for poultry feed, then for the food industry and alcohol industry fuel. However, it should be noted that only 10 per cent of corn produced in Indonesia is utilized for the feed industry. Therefore, it is important to conduct an in depth study to verify available data so that the recommendations endorsed do not contradict reality under field conditions.
7. Rameke (2004) reported that China was a major corn importer in 1994 and in 1995 emerged as a major exporter. China's exports accelerated to 15.2 million metric tons (mmt) for marketing year 2002/2003, up from 8.6 mmt in 2001/2002, squeezing US exports out of South Korea, Indonesia, Malaysia and other important markets. However, Chinese exports are expected to fall sharply in 2004 as rising Chinese corn prices indicate a tightening of China's market. USDA Agricultural Baseline projections indicate that due to continued growth in corn consumption and limited capacity for production Chinese imports will fall to 5 mmt by 2013/2014. USA corn exports will increase due to less competition from China.

Demand and production

8. The corn production data used in the study has been derived from data published by the government; however, the accuracy is somewhat questionable. The trend of production and consumption of corn till 2015 showed the increased production is in line with increased consumption. However, it has been forecast that Indonesia will continue to import large quantities of corn if alternative steps are not taken. This was based on the development of the poultry feed industry that will grow in future and also the increases in corn production. According to GPMT (Gabungan Pengusaha Makanan Ternak = Feed Producer Union), in 2020, national feed production will reach 20 million tons and

this will require 10 million tons of corn. At present Indonesia imports 1.6 million tons of corn, but surely without increases in national production, national food security will be jeopardized.

9. Increased production can be obtained by pushing intensification and extensification. Intensification through planting of high yielding varieties like composite, hybrid or transgenic corn could be conducted. However, planting of hybrid corn is relatively small to the total scale of land area planted by farmers owing to relatively small land size. This condition is still far below that in Thailand or even China. The low level planting of high yielding corn varieties or hybrid corn is shown by the low production capacity of corn (below 3 tons/ha). However, it is questionable whether intensification using high yielding varieties like composite breeds, hybrid, or transgenic corn will increase farmer's income as well as their welfare (note: to date the use of transgenic varieties can not be implemented yet in Indonesia).
10. Over the past 10 years not much change has been observed in the expansion of planted area. Extensification may have a chance through enlarging the area planted with corn through the utilization of "non-functional land areas" that are relatively large. However, land areas like this may face many challenges, from soil fertility and ecology problems, or even the non-presence of supporting facilities. It is considered an opportunity to utilize crop plantation (estate crop) areas through an integrated systems approach if there is a replanting area of 4 per cent per annum and mixed cropping could be implemented over the initial four years before the canopy of the estate crops covers the ground and increases shade. In the long run a total of 16 per cent of the total estate crop area could be utilized for corn production. From oil palm plantation areas only, at present around 5 millions ha exist. The potential of the expansion of corn plantations in that area could cover 1 million ha. This will increase corn production by 3 million tons or twice the present production capacity. In these plantation crop areas, the infrastructure of roads is good, and management is relatively easier. As an illustration, there are at present 3.3 million ha of rubber plantation areas, millions of hectares of coconut plantation areas and a few million hectares of other industrial crops. An alternative solution through integrated corn plantation systems should be deeper explored, as this has not been discussed deeply in the SWOT analysis.

Cost of corn production

11. Compared to the cost of corn production in the US and Argentina as major producers of corn (Table 2), the cost of production in Indonesia is highly competitive. According to Tangenjaya (2002) the cost of production of corn in Indonesia is only Rp 950/kg therefore, farmers will receive profit > 50 per cent in 3-4 months. The low income of farmers planting corn is due to the small land size owned by the farmers (< 0.3 ha, whereas in the US it may reach > 300 ha and in Argentina > 700 ha/farmer). Simatupang (2002) indicated that even under heavily fluctuating world prices of corn (at present $ 115) and a fluctuating rupiah rate against the US$, the cost of corn production in Indonesia is still competitive. Hence, there is no argument for not providing "protection or subsidies" to producers or corn farmers in the country.

Table 2. Cost of corn production in USA, Argentina and Indonesia (Rp/kg)

Variable	USA*	Argentina*	Indonesia**
Machinery pre-harvest	80.0	102.1	42.9
Seed	72.7	87.4	97.5
Fertilizer	126.0	36.3	113.2
Herbicide	83.3	31.7	-
Insecticide	20.0	1.8	10.0
Post-harvest machinery	159.2	171.1	27.1
Labour	-	-	295.6
Total cash input	541.0	430.1	586.3
Land hire	355.0	173.9	311.7
Total cost	896.0	604.0	818.0

12. Marketing of corn is in fact not a problem as almost all corn produced could be absorbed by feed mills. In the last ten years, Indonesia has been importing corn to meet the demand of feed mills. The annual production capacity of Indonesian feed mills at present is 7 million tons and the demand for corn is 3.5 million tons, of which Indonesia still imports 1.5 million tons. Therefore, logically, domestic production in Indonesia only reached 2 million tons. Following the information from feed mills, the price of locally produced corn is not different than that of imported corn, as the domestic price is influenced by world prices. If the domestic price of corn is higher than the world price, feed mills will import corn and the reverse is also true. The problem with domestic corn, as complained by feed mills and also farmers, is the low quality of corn that determines the price, as post-harvest treatment at the farm level is still not an effective and efficient custom. Hence, it is well in place that the study also looked at the drying, storage and marketing of corn that needs to be accounted for, to reach competitive corn prices and quality.

Competitive advantage of the poultry industry

13. Paul Aho, a poultry economist from the USA, indicated that for a country to successfully compete in the global poultry market, several pre-conditions (condition sync qua non) have to be met including:
14. Low feed costs are determined by low costs of feed ingredients and the most common for poultry is corn. Labour costs in Indonesia could be considered the lowest among ASEAN countries, hence, a comparative advantage for Indonesia. The control of poultry technology in Indonesia has also developed through the adoption of the latest technology available in the world. The capacity of Indonesia to absorb poultry technology and information as a developing nation is rapid. Vertical integration has also been implemented through PIR (Peternakan Inti Rakyat – nucleus credit scheme) approach as many small livestock farmers are already united with large companies and the farm size is also growing. The profit obtained per bird may be less, however, a higher total profit could be obtained by the increased farm size.
15. Problem factors or challenges still encountered in the field are in the production sphere, poor infrastructure and the high production costs related to many taxes imposed. Liberal trade and the recent inconsistency towards stable regional autonomy policy are burdens that need special attention if the poultry industry is to grow further. On the other hand, it will support the development of a corn agro-industry. The support of the central government through policies directed towards domestic industry is needed.

Recommendations for the future

16. The tendency of increasing demand for meat and eggs as a result of better welfare (income, education, information flow) as well as the increasing size of the population will consequently cause the poultry industry and the demand for corn to grow. The world supply of corn was relatively limited in 2003 (production 613 million tons and consumption 647 million tons) and still there is controversy towards the use of transgenic corn.
17. Currently, the production of corn is reported at 11 million tons, with demand from feed mills at around 3.5 million tons, however, there is still the need to import 1.5 million tons, suggesting that 9 million tons of corn is used for other purposes (possibly ruminant feed, raw materials for the food industry, direct consumption or misleading data). It is possible to prevent further corn competition for ruminants (dairy and beef). There is an indication of inefficiency in ruminants utilizing grain as a feed compared to monogastrics.
18. There is also a need to study the substitution of corn with other feedstuffs, i.e. cassava or oil palm factory waste. Previous studies indicate prospective pictures on the use of palm oil residues through biological treatment (feed enrichment) that could replace part of the corn used in layer rations to 30 per cent. If the proportion of corn in poultry rations could be reduced significantly and domestic production of corn increases, the problem of corn for Indonesia could be solved.
19. As a bonus in developing the integrated corn/estate crop systems, and the intensification of a special area as developed in Gorontalo and West Kalimantan, residues for feed will be available. The technology to utilize agricultural and agro-industry residues is available, hence, the development of corn could also be considered as a development approach of the cattle industry. The recommendation to further develop corn in Indonesia should preferably be based on an integrated approach, even at the production stage (seed production, planting design, irrigation etc.)., “zero waste” management and “zero cost” as crop/animal integration systems, utilization of products and residues, possibility of substitution, post-harvest aspects, marketing and supporting policies.
20. If the production of corn is sufficient, and supported by the availability of rice-bran, at least 60-70 per cent of the feed ingredients required by the poultry industry in the country will be available, hence, the capacity to compete in a regional or even global sense. To take the concept into realization, it is expected to join the vision and mission of the central and regional government, livestock businesses and feed mill agents or executors, research institutions and other supporting institutions towards similar goals and perspectives.

Prospects of Feed Crops in Malaysia

Tunku Mahmud bin Tunku Yahya[*] *and Sarmin bin Sukir*[**]

Introduction

Background and justification

Feed crops or annual crops have achieved limited success as a contributor of employment, income generation, and import substitution and export promotion in Malaysian agriculture. A few commodities dominate the agricultural output of Malaysian agriculture and this can be summarized as follows:

- Commodities such as oil palm, rubber, cocoa and coconut account for about 70-80 per cent of agricultural output and area.
- About 10-15 per cent is accounted for by paddy.
- The remaining area and output are from other commodities.

The other commodities comprise crops such as fruits, vegetables, floriculture and other annual crops including feed crops.

Objectives

The general objectives of this research are to elucidate and analyze potentials, weaknesses, opportunities, constraints and policy options for the development of feed crop farming with emphasis placed on coarse grains, pulses, roots and tuber (CGPRT) crops in Southeast Asian developing countries in balance with the rapid development of the livestock and fish culture industry in Southeast Asia. The specific objectives may be further broken down into:

1. To analyze historical dynamics and future trends of demand and supply for feed crop products;
2. To evaluate potentials, weaknesses, opportunities and constraints for expanding feed crop farming with emphasis placed on secondary crops in the participating countries;
3. To propose possible cooperation schemes for trade and development of feed crops/products among Southeast Asian countries; and
4. To formulate policy options to promote sustainable development of feed crop farming in the participating countries.

Scope of the study and commodity coverage

The scope of the study is limited to the dominant non-ruminant sector of the livestock industry. The major commodities commonly used for animal feed such as maize and soybean cannot be grown economically in this country and thus, substantial amounts are imported. Since maize is the major component in poultry and swine feed, special focus will be given to it rather than the other commodities.

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Methodological approach

Conceptual framework

Economic theory will be used to construct the model and identification of explanatory variables. The simplest functional forms that are consistent with the a priori specifications will be used.

Definition

Feed

Conventional feedstuffs are feedstuffs that have been traditionally used for decades such as maize, rice and cassava. Non-conventional feedstuffs are defined as by-products derived from the industry.

Concentrates

Concentrates are animal feeding stuffs, which have a high feed value relative to their volume. They are a low fibre, high energy feed that is concentrated by nutrients needed to increase the nutritional adequacy of feed supplements.

Feed crops

Feed crops are crops that are utilized as fresh or processed for feeding animals.

Data

The data on prices is expressed in Ringgit Malaysia (RM). The exchange rate used is pegged at RM 3.80 to US$ 1 (United States dollar).

Analytical Approach

The supply of maize as food (sweet corn) will be explored, followed by its demand and the market clearing identity. The demand for grain maize as feed will follow. As Malaysia does not produce grain maize, the supply of grain maize for Malaysia is the world supply of grain maize.

Model formulation

The model formulation will be as follows:

a) Maize for food - domestic supply
b) Maize for food - domestic demand
c) Market clearing identity
d) Forecast of the demand of maize as food

$$DHt = DHt - 1(1 + \sum_{i==1-3}^{j=1-3} (\gamma\gamma i \rho j))$$

Where,

DHt	=	demand of maize for food in year t
DHt-1	=	demand of maize for food in year t-1
$\gamma 1$	=	elasticity of demand of maize for food w.r.t. its own price
$\rho 1$	=	growth rate of price of maize
$\gamma 2$	=	elasticity of demand of maize for food w.r.t. price of maize flake
$\rho 2$	=	growth rate of price of maize flake

γ3	=	elasticity of demand of maize for food w.r.t. income
ρ3	=	growth rate of income

e) Forecast of the supply of maize for food

$$SFt = SFt - 1(1 + \sum_{i=1-3}^{j=1-3} (\varepsilon\varepsilon i\rho j))$$

Where,

SFt	=	supply of maize for food in year t
SFt-1	=	supply of maize for food in year t-1
$\varepsilon 1$	=	elasticity of supply of maize for food w.r.t. its own price
ρ1	=	growth rate of price of maize
$\varepsilon 2$	=	elasticity of supply of maize for food w.r.t. acreage
ρ2	=	growth rate of acreage
$\varepsilon 3$	=	elasticity of supply of maize for food w.r.t. acreage lagged 1 year
ρ3	=	growth rate of acreage lagged 1 year

f) Maize for feed - domestic demand

g) Forecast of the demand of maize for feed

The model used is as follows:

$$DFt = DFt - 1(1 + \sum_{i=1-2}^{j=1-2} (\alpha\alpha i\rho j))$$

Where,

DF_t	=	demand of maize for feed in year t
DF_{t-1}	=	demand of maize for feed in year t-1
$\alpha 1$	=	elasticity of demand of maize for feed w.r.t. its own price
ρ1	=	annual growth rate of price of imported grain maize
$\alpha 2$	=	elasticity of demand of maize for feed w.r.t. price of feed
ρ2	=	annual growth rate of price of feed
$\varepsilon 3$	=	elasticity of supply of maize for food w.r.t. acreage lagged 1 year
ρ3	=	growth rate of acreage lagged 1 year

h) Maize for feed - domestic supply

All of the maize requirement for feed is met by imports. Although Malaysia's imports of maize are quite substantial i.e. about 2.4 million tons, this is still small compared to the largest importer i.e. Japan at 16.2 million tons. Malaysia is a price taker and has no major influence on the price of maize in the world market.

Sources and coverage of data

Data used in the model is time series data collected from various sources. The acreage and production figures are from the Department of Agriculture, import and export figures from Malaysia External Trade Development Corporation (MATRADE) and the rest from the statistics department.

General and socio-economic features

Population

Between 2000 and 2003, the rate of population growth was 2.0 per cent growing from 22.08 million in 2000 to 23.42 million in 2003. In 2005 it is projected to increase to 26.16 million. The working age group of 15-64 will constitute 64.2 per cent, with 31.5 per cent under 15 and 4.3 per cent in the age group of 65 and above.

General economy

Malaysia is an open economy and growth is influenced by developments in the international economy. The Gross Domestic Product (GDP) at current prices in 2003 was RM 385.8 billion (US$ 101.5 billion). The services sector accounted for 54 per cent of the GDP, manufacturing 30.6 per cent, agriculture 8.2 per cent, and mining 7.2 per cent. The major exports are semiconductors and electronic products, petroleum and petroleum products, palm oil, wood and wood products, rubber and textiles. The major imports are machinery and transportation equipment, basic manufactures, chemicals, fuel and food. Per capita income in 2003 was RM 14,343 (US$ 3,774).

Agricultural sector

The Malaysian agricultural sector can be primarily grouped into the agro-industrial sub-sector comprising oil palm, rubber, cocoa and timber; the food sub-sector comprising paddy, fruits and vegetables, livestock and fishery and a miscellaneous group consisting of tobacco, pepper, coconut, sugarcane, cassava, sweet potato, maize, tea and coffee; and another sub-sector that consists of the `newly emerging' agro-industries such as floriculture, sago, aquarium fish and aquatic plants.

During 2000-2003, the agricultural sector recorded an average growth of 1.5 per cent per annum. Growth was contributed largely by the food sub-sector, which grew at 4.0 per cent per annum and a negative 0.1 per cent for the agro-industrial sub-sector.

Contribution of trade

For the year 2003, Malaysia's external trade balance registered a surplus of RM 75 billion (US$ 19.7 billion) as compared to RM 51.5 billion (US$ 13.6 billion) the previous year. Electrical and electronic products continued to be Malaysia's largest export earner at RM 194.8 billion or 50.9 per cent of total exports revenue, followed by palm oil and palm oil based products (RM 27.7 billion), timber and timber-based products (RM 16.6 billion), crude petroleum (RM 15.7 billion) and liquefied natural gas (LNG) at RM 13.3 billion. Malaysia imports substantial amounts of intermediate goods at RM 223.5 billion or 72.7 per cent of total imports, followed by capital goods (RM 42.7 billion) and consumption goods (RM 18.9 billion).

Commodity balance sheets

The export of food items increased from RM 6.4 billion in 2000 to RM 8 billion in 2003. The import of food items increased from RM 11.4 billion in 2000 to RM 13 billion in 2003. The major import item in 2003 was feeding stuff for animals at RM 2.2 billion, followed by cereal and cereal preparations (RM 1.9 billion).

Review of current situation

Livestock production and product consumption

The estimated output value of livestock in 2003 was RM 5.89 billion (US$ 1.55 billion). The poultry industry contributed RM 4.27 billion where poultry meat accounted for RM 3.06 billion and eggs RM 1.21 billion. Broiler chicken production was largely undertaken by integrators, who collectively produced 75 per cent of total production. The self-sufficiency levels (SSL) for poultry and eggs in 2003 were 123 per cent and 109 per cent respectively. Per capita consumption of poultry meat and eggs in 2001 was 28.52 kg and 293 eggs respectively.

The swine industry contributed about RM 1.22 billion in 2003 and the SSL was 100 per cent. Per capita consumption of pork in 2001 was 7.4 kg and it forms a major part of the diet for about 30 per cent of the population.

The value of beef production in 2003 was RM 384 million and for mutton RM 21 million. The SSL in 2003 was 22 per cent for beef and 8 per cent for mutton. Per capita consumption of beef and mutton in 2001 was 5.3 kg and 0.79 kg respectively.

Aquaculture and inland fisheries

In 2001, fish output was about 1.4 million tons valued at RM 5.45 billion. Inshore fisheries accounted for 75.5 per cent of total fish production, while deep-sea fishing and aquaculture contributed about an equal percentage of the remainder. The SSL for fish in 2003 was 90 per cent. Average per capita consumption of fish in Malaysia is higher than poultry at 53 kg.

Utilization of feed crops and feed ingredients

The major ingredients in poultry feed include maize (42-50 per cent), soybean meal (25-32 per cent), rice bran (7-16 per cent) and fish meal (5 per cent). The major ingredients in swine feed include maize (40-45 per cent), soybean meal (15-30 per cent), rice bran (12 per cent) and wheat pollard (5-10 per cent). For ruminant feeds (dairy, beef, goats and sheep), locally produced feedstuffs are mostly used. Palm kernel cake (PKC), palm oil mill effluent (POME), oil palm fronds (OPF) and native grasses are among the major ingredients used.

Historical growth in consumption and production of feedstuffs and feed crops

In 2003, imports of feeding stuffs for animals jumped to RM 2.2 billion and constituted about 17.2 per cent of the RM 13 billion total imports of food commodities, thereby becoming the new leader (Mid-Term Review). About 50 per cent of the imported value for feeding stuffs was for grain maize, 24-26 per cent for soybean and another 20-23 per cent was for soybean meal. The prepared animal feed industry exports its products and in 2003, the export value was RM 515 million (US$ 136 million).

In 2002, Malaysia exported 1.5 million tons of PKC amounting to RM 285.5 million (US$ 75 million). About 84 per cent of the amount went to the European Union, and the rest to South Korea, Australia, New Zealand, Viet Nam and Japan.

Agro-industrial and feedstuff processing industries and policies

Currently there are 47 feed mills operating in Malaysia with 38 located in Peninsular Malaysia and 9 located in Sabah and Sarawak. There are also home mixers with production at 275,000 metric tons (Raghavan, 2000). The latest development is towards an integrated poultry operation.

The government does not restrict raw material importation. R&D on alternative feed sources from new materials and agricultural by-products will be given priority. Also, offshore production of raw materials for feed production will be encouraged.

Agricultural policies

The Third National Agricultural Policy (NAP3) covers the period 1998 to 2010 and seeks to provide the gradual but effective transformation of the agricultural and forestry sectors. Specifically, the objectives of the policy are:

a. Enhance food security;
b. Increase productivity and competitiveness in the sector;
c. Deepen linkages with other sectors;
d. Create new sources of growth for the sector; and
e. Conserve and utilize natural resources on a sustainable basis.

The agroforestry approach views agriculture and forestry as mutually compatible and complementary and therefore provides a scope for joint development that can bring about mutual benefits. The product-based approach is to reinforce and complement the cluster-based agro-industrial development as identified in the Second Industrial Master Plan (IMP2), 1996-2005.

Production policies

Under NAP3, feed crops fall under the Other Economic Crops Product Group. The policy states that where viable, production of commodities will be encouraged for import substitution and for supplying quality raw materials for further development of downstream activities. R&D and necessary support will be further provided to enhance the development of high value-added products. Reverse investment is encouraged to secure adequate supply of quality raw materials with the cheaper cost of production in other countries.

Price policies

The Guaranteed Minimum Price (GMP) given to rice is not extended to other commodities and thus the forces of supply and demand determine the output prices of other commodities. For poultry, there is a ceiling price, which curtails the retail price below it. Efforts are also made to ensure that the growth of money supply is consistent with price stability.

General marketing and trade policies

External trade is of great importance to the development of the Malaysian economy and Malaysia places high importance on a strong, open and viable trading system {General Agreement on Tariff and Trade (GATT) 1993}. The main objectives of Malaysia's trade policies are:

i) Improved market access for Malaysia's exports of primary commodities and manufactured products;
ii) The development and promotion of exports of higher value-added and resource-based products;
iii) Expansion of trade with major trading countries;
iv) Diversification of trade into nontraditional markets, particularly developing countries;
v) Strengthening of intra-ASEAN trade through closer economic and trade cooperation; and
vi) Expansion of trade and investment links with the East Asian region.

Monetary and exchange rate policies

During the 2001 to 2005 plan period, the government is to ensure that the growth of money supply is consistent with price stability and adopt a prudent fiscal policy. Strong economic fundamentals such as a stable exchange rate (pegged at RM 3.8 to US$ 1), a sufficiently high level of savings, a strong external account with high external reserves, a manageable fiscal deficit and sustainable level of debt are needed.

State trading enterprise

The Federal Agricultural Marketing Authority (FAMA), was set up to strengthen the marketing and distributive channels for agricultural produce. The ongoing contract farming and strategic arrangements with major supermarkets will also continue.

Policy reforms initiative

Malaysia is currently at a turning point of disengaging itself from labour-intensive and low technology products to high technology and knowledge-based economic activities. The Government has established the policy framework for this transformation under the Third Outline Perspective Plan (OPP3), Knowledge-based Economy Master Plan (KEMP) and IMP2. To enhance the innovative and technological capacity and capability, the Science and Technology Policy II will also be implemented.

Demand for feedstuff and feed crops

Consumption structure and characteristics

The consumption of feeding stuffs by non-ruminants is largely maize (50 per cent of the import value for animal feeds), and soybean meal (23 per cent). The rest comprise rice bran, broken rice, copra cake, groundnut cake, rapeseed cake, cassava flakes and pearls, wheat pollard, fishmeal and other residues. About 95 per cent of the feedstuffs used in non-ruminant feeds are imported.

The consumption of feeding stuff by ruminants is largely fresh forages (native grasses), concentrates and by-products of oil palm such as PKC, OPF and POME.

Consumer price behaviour

Consumers of feedstuffs are largely the feed millers/integrators and to a smaller extent the home mixers. Since most of the feedstuffs are imported, their prices are determined by supply and demand in the world market. The consumers of poultry products are protected by the ceiling price imposed by the Government.

Response to government policies and market and non-market forces

The response towards Government policies has been good as reflected by the move towards bigger and more efficient poultry and swine producers that will be able to compete in the world market. Nevertheless, there are smallholders rearing poultry and swine and the Department of Veterinary Services (DVS) continues to monitor their performance. As the domestic market is almost saturated, the increasing demand for poultry products from Brunei Darussalam, Hong Kong and Singapore is an added booster to the poultry industry in terms of market expansion.

Development of products

Deboned meat and special cuts of poultry with attractive packaging and improved marketing strategies have brought much success to the processors and retailers. The development of various products from poultry such as ready to eat nuggets, burgers, sausages, frankfurters, bologna, pepperoni and salami encouraged further the development of the small and medium scale meat processing factories. The presence of supermarkets and hypermarkets has further boosted the marketing of these products. To those that prefer eating out, eateries such as Kentucky Fried Chicken (KFC), Kenny Rogers, Marybrown, A&W, Satay and Chicken Rice have been very successful in promoting their products to capture this segment of the market.

Projection to 2015

The results of the model are presented below:

Maize for food - domestic demand

$$\text{LogMFood}_t = 3.5249 - 0.5723\text{LogPPM}_t - 0.7083\text{LogPMF} + 1.5026\text{LogPCI} + 0.4554\text{LogAR(2)}$$
$$\qquad\qquad\qquad\qquad (-1.0853) \quad (-2.827^*) \qquad\quad (0.7125) \quad (0.9598)$$

$R^2 = 0.6751$

DW = 1.9595

t-statistic in parenthesis

* significant at 5 per cent level

Where,

MFood_t	=	quantity of maize demanded for food in year t (tons)
PPM_t	=	producer price of maize for food in year t (RM/t)
PMF_t	=	price of maize flake in year t (RM/t)
PCI_t	=	per capita income in year t (RM)
AR(2)	=	autoregressive variable lagged 2 periods

The above model uses 15 years of data from 1986 to 2000 and the Ordinary Least Squares (OLS) regression was used to run the model. The quantity of maize demanded for food is regressed against three independent variables as specified in the model formulation i.e. producer price of maize, price of maize flake and per capita income using the linear form and log-linear form. The model is modified by regressing the quantity of maize demanded against the three independent variables above and the autoregressive variable lagged 2 periods, using the log-linear form. The results show that 68 per cent of the variation in the quantity of maize demanded for food is explained by the above variables. The negative signs obtained for the producer price of maize and the price of maize flakes follow the a priori expectations. As this model is in log form the coefficients of the independent variables are the elasticities. A 1 per cent decrease (increase) in the producer price of maize would lead to 0.57 per cent increase (decrease) in quantity demanded and thus, the own price elasticity of maize for food is inelastic. A 1 per cent decrease (increase) in the price of maize flakes would lead to 0.71 per cent increase (decrease) in the quantity demanded and also is inelastic for maize for food w.r.t. the price of maize flakes. In terms of income elasticity, it is very elastic, i.e. a 1 per cent increase (decrease) in income would lead to about a 1.5 per cent increase (decrease) in the quantity of maize for food.

Using the elasticities from the results above, and the growth rates of the three variables, a forecast of the demand for maize as food in the year 2015 was found to be 27,308 tons. The quantity demanded in 2015 is found to be more than the quantity supplied for the same period.

Maize for feed - domestic demand

logMFeed = 16.7563 – 0.1972LogPGM – 0.1381LogPPFeed + 0.2812LogAR(1)
+ 0.5076LogAR(2) (-0.478) (-0.2819) (0.7961)
(1.2859)
R^2 = 0.7906
DW = 2.2607
t-statistic in parenthesis
Where,

MFeedt	=	quantity of maize demanded for feed in year t (tons)
PGMt	=	price of imported grain maize in year t (RM/ton)
PPFeedt	=	price of prepared feed in year t (RM/ton)
AR1,2	=	autoregressive variables lagged one and two periods

The above model uses 12 years of data from 1989 to 2000 and the OLS regression was used to run the model. The above model was accepted after several runs using the linear and the log-linear forms. The above results show that the log-linear form where the quantity of maize demanded for feed is dependent on the price of imported maize, the price of prepared feed, and the autoregressive variables lagged 1 and 2 years. The results show that 79 per cent of the variation in the quantity of maize demanded for feed is explained by the above variables. The sign obtained for the price of imported maize is negative and follows the a priori expectation. As this model is in log form the coefficients of the independent variables are the elasticities. A 1 per cent decrease (increase) in the price of imported maize would lead to 0.19 per cent increase (decrease) in quantity of maize demanded, i.e. very inelastic. Similarly, a 1 per cent decrease (increase) in the price of prepared feed leads to a 0.14 per cent increase (decrease) in the quantity of maize demanded. The autoregressive variables or the quantity of maize demanded in the previous one and two years have a positive influence on the current quantity of maize demanded.

Using the forecasting method described previously, the demand for maize as feed in 2015 was made. The results for 2015 indicate that the demand for maize as feed will increase to 2.78 million tons. Based on the current (2004) import price of RM 790 per ton, the import values for maize in 2015 will be RM 2.20 billion.

Supply of feedstuff and feed crops

Production structure and characteristics

The world market ensures that competitive prices with good and consistent quality can be obtained. Malaysia imports a substantial amount of maize and soybean from China and Argentina respectively.

The supply of feeding stuffs for the ruminants are native grasses from idle land or open fields and by-products from the oil palm industry i.e. PKC, POME and OPF.

Producer price behaviour

Feed crop prices

As there is currently no feed crop grown in the country, there are no established markets for them. Experience in the past has shown that prices of feed crops such as maize or cassava are usually not competitive.

Product prices

In the past, the production of cassava leads to starch production and the refuse obtained from the process is used as swine feed. The price of cassava refuse is not as competitive as the price of the imported cassava refuse.

Response to government policies and market and non-market forces

During 2001-2003, the Ministry of Agriculture received a total of 156 project proposals (113 in aquaculture, 29 for food crops and 14 for livestock). There is however no project proposal for feed crops.

Development of farming technologies and production arrangements

The Rice and Industrial Crops Research Centre of MARDI conducts research on food and feed crops such as maize, cassava and groundnut. The High Yielding Varieties (HYV) of grain maize released were Suwan 1 (4t/ha) and Suwan 3 (4.5t/ha) and among the sweet corn were Thai Supersweet (13t/ha), Manis Madu (13t/ha) and Masmadu (17t/ha) (Zaharah, 1992). The yields quoted for grain maize are in dried form while the yields for sweet corn are in wet form. In the case of cassava, Black Twig is the popular variety for starch production and Medan for food. Lately the Sri Kanji 1 and Sri Kanji 2 have up to 27 per cent more starch than Black Twig and the edible Sri Pontian outperformed the Medan variety by more than 30 per cent in yield. These varieties can be obtained directly by the smallholders at MARDI or through the extension agents under the Department of Agriculture.

Projection to 2015

The results of the model are presented below:

Maize for food domestic supply

$$\begin{aligned}\text{LogMS t} = {} & -4.4033 + 1.078\text{LogMAt} + 0.3283\text{LogPPMt} + 0.2369\text{LogMAt-1} \\ & \quad (9.073^{**}) \qquad (3.187^{*}) \qquad (1.979) \\ & -0.4929\text{LogAR(1)} + 0.2178\text{LogAR(2)} + 0.3120\text{LogAR(3)} \\ & \quad (-0.824) \qquad (0.623) \qquad (0.925)\end{aligned}$$

Adjusted $R^2 = 0.9032$
DW = 2.283
t-statistic in parenthesis
* significant at 5 per cent level
** significant at 1 per cent level

Where,

MS t	=	domestic maize production for food in year t (tons)
PPMt	=	producer price of maize for food in year t (RM/t)
MAt	=	domestic maize acreage for food in year t (ha)
MAt -1	=	domestic maize acreage for food lagged 1 year (ha)
AR1,2,3	=	autoregressive variables lagged one, two and three periods

The model uses 15 years of data from 1986 till 2000 to run the model using OLS. Domestic maize production was first regressed against three independent variables i.e. producer price, maize acreage and maize acreage lagged one year using the log linear form. Then, several autoregressive variables were included in the model, and the results were better. About 90 per cent of the variation in the production of maize for food was explained by producer price, maize

for food acreage, maize for food acreage lagged one year and the autoregressive variables lagged 1 to 3 periods. The significant variables are maize acreage and the producer price of maize for food. The positive signs obtained for producer price, maize acreage and maize acreage lagged one year are consistent with the a priori expectations. A 1 per cent increase (decrease) in the producer price will lead to a 0.33 per cent increase (decrease) in the production of maize for food. The price elasticity is inelastic. For maize acreage, a 1 per cent increase (decrease) in the maize acreage, results in 1.08 per cent increase (decrease) in the production of maize for food.

Using the above model, the forecast results show that the supply of maize for food in 2015 will be 17,880 tons.

Trading of feedstuffs and feed crops

Domestic and international trading

The domestic trading of feedstuffs is based primarily on imported feedstuffs among the livestock producers or feed millers. The prepared animal feed and livestock products are traded domestically as well as internationally. The formation of Free Trade Agreements (FTAs) allows Malaysia to pursue trade with selected countries such as China, Japan and ASEAN countries.

WTO

Malaysia remains committed to the multilateral trading system under the World Trade Organisation (WTO). However, WTO must focus on its core competencies of market access to establish a fair and equitable multilateral trading system.

Direction of trade

As a trading nation and an open economy, Malaysia has chosen to pursue bilateral and regional trading arrangements in order to:

- Maximize every opportunity available to enhance its economic growth; and
- Complement its pursuit of market access in the WTO.

In terms of feedstuffs and feed crops, Malaysia will continue to depend on imported maize, soybean and soybean meal for the livestock industry. China has been the biggest supplier of maize, followed by Argentina and the USA. There are other smaller maize suppliers such as Indonesia, Thailand, Netherlands, Australia, Myanmar, France, South Africa, Taiwan and lately, India.

As for soybean, Argentina remains the top soybean supplier to Malaysia with a 44 per cent market share followed by the USA with 34 per cent of the market share. Other suppliers include China, Brazil and Taiwan.

Export and import behaviour and structure

Malaysia will continue to enhance its competitiveness, creating a niche in specific products, creating global brand names and venturing into non-traditional markets. The focus is on efficient use of labour and capital as well as improvement in skills, managerial capability, information and communications technology (ICT).

Price behaviour

The price behaviour of feedstuffs is not controlled by the Government and thus, depends on market forces. The imported price of maize has fluctuated but this has little effect on the

demand as there are few substitutes. The price of soybean meal also fluctuates but there are substitutes available.

Trade response to market and non-market forces

The trading of feedstuffs is thriving due to the strength of the prepared animal feed and livestock industries. As the global market opens up under WTO, sources of imported raw materials for the domestic animal feed industry will be wider. This will benefit Malaysia as it can source the raw materials from all over the world as long as the price is competitive, quality is good and consistent, and terms of contract are adhered to.

Export and import projections to 2015

Malaysia imports a substantial amount of grain maize for the local non-ruminant feeds. The import demand is similar to the demand for maize for feed as described earlier and is also true for the projection. Malaysia does not produce or export grain maize.

Measures to meet excess demand

Government and private company initiatives

In the 8MP, a total of RM 7.9 billion or 7.1 per cent of the total development expenditure was allocated for agricultural programmes. During 2001-2003, about 66 per cent of the amount was spent for the expansion of industrial and food crops with particular attention on commercial scale production, adoption of new technologies and provision of related support services. A total of RM 3.2 billion will be allocated to agriculture in the remaining plan period to further advance the implementation of ongoing development programmes, strengthen support services as well as create a more conducive environment for greater participation by the private sector in commercial agriculture and the search for new sources of growth.

Production technology

The Ladang Lambor project on grain maize in the early nineties used variety Suwan 1which at best gives a grain yield of 4 tons per hectare. The cost of production ranged from RM 0.36 to RM 0.60 per kg, making it non-competitive with the price of imported grain maize that ranged between RM 0.33 to RM 0.47 per kg.

One possible commodity that can substitute maize is cassava. However, to revive this commodity, a cost-effective drying technology is needed because the high moisture content at harvest for cassava must be dried for storability.

Research and development cooperation

The commercialization aspect of R&D must be given priority, as this will determine its attractiveness to entrepreneurs in the local industry. There must also be cooperation among the R&D institutions around the world working on grain maize. Genetically modified (GM) maize has stirred some concern and calls for discussion and further research on GM maize.

Trade cooperation and liberalization

Local companies will be encouraged to participate in the Multinational Corporations (MNCs) supply chain management network for online and real-time procurement, production and logistic management. Access to global buyers through independent representatives, sales subsidiaries, joint ventures and the establishment of production units will be promoted.

Farmer participation in feed crop development

Feed crop farming

Feed crop farming, unlike food crop farming, is currently not a viable enterprise in Malaysia. It is cheaper to import than to grow here. As 95 per cent of the feedstuffs used for non-ruminant feeds are imported, only 5 per cent is supplied locally. The quality of local feedstuffs must improve in order to be competitive, sustainable and then increase their share in the market.

In the case of ruminants, the by-product from the oil palm industry can play a significant role in the development of ruminant feeds. Besides PKC, POME and OPF, other by-products include oil palm trunks (OPT), palm press fibre (PPF) and empty fruit bunches (EFB).

Response to market development

The supply of local raw materials is still small, irregular and of poor quality. If there is an improvement in the quality and consistency in supply, there could be a shift towards using locally produced by-products or end products.

The market for ruminant feeds offers opportunities for the locally produced raw materials. A MARDI-Japan International Cooperation Agency (JICA) project has developed the technology for the production of OPF pellets and cubed forms. The product is targeted for the export market in countries such as South Korea, Taiwan and middle-eastern countries.

Response to manufacturing development

The food manufacturing industry that includes the manufacture of animal feed, grew at the rate of 2.8 per cent per annum during 2001-2003. The value of sales during the period was RM23.8 billion. The export of processed food amounted to RM 8.72 billion and among the major contributors was animal feed. The industry is being encouraged to consolidate and merge to achieve economies of scale to meet domestic and world demand.

The huge market for 'halal' food worldwide is estimated at RM 200 billion (US$ 53 billion). To meet the objective of developing Malaysia into a regional 'halal' food hub, various measures were implemented to enable the development of a holistic and integrated approach to 'halal' food.

Measures to mobilize farmers' involvement

The Government's agricultural development expenditure will continue to be directed towards greater modernization and commercialization of industrial and food crop production. This will be expedited through increased farm mechanization, modern farming practices, wider adoption of new technologies and upgrading product quality.

Equity consideration

Malaysia will continue to create a bigger and more prosperous middle-income group in addition to increasing the income of the lower income group. The proportion of lower income households, defined as those earning less than RM 1,200 per month (US$ 316), decreased from 33.1 per cent in 1999 to 25.9 per cent in 2002. The share of middle-income households i.e. earnings between RM 1,200 and RM 3,499 (US$ 921) increased from 47.7 per cent in 1999 to 47.9 per cent in 2002.

Poverty alleviation

Poverty line income in 2002 was RM 529 per month (US$ 139) for Peninsular Malaysia. The incidence of rural poverty decreased from 12.4 per cent in 1999 to 11.4 per cent in 2002. It is highest among the agricultural, hunting and forestry workers at 14.5 per cent. Programmes

such as *Skim Pembangunan Kesejahteraan Rakyat* (SPKR) focus on income- generating projects such as petty trading, cottage industries, livestock and aquaculture projects and the commercial production of food crops. During 2001 to 2003, a total of RM 406.2 million was allocated for the various projects under SPKR. In addition to the SPKR, programmes such as *Amanah Ikhtiar Malaysia* (AIM) provided micro-credit loans to poor families amounting to RM 358 million.

Potentials and constraints to feed crop expansion

The potential to feed crop farming under the current situation is bleak. However, the potential to food crop expansion looks good. Food crops can be the core business, while the by-products or end products from food crops can be the secondary business. The prices of the by-products or end products as feedstuffs can be competitive against the imported feedstuffs. Their quality through R&D can be improved so as to be acceptable to the feed millers and the livestock rearers. Food crops that can provide the dual benefits of food and feed have greater potential for survival. Rice is one possibility and while it can be substituted for maize as poultry feed, other factors such as cost and consumer preference for the whitish colour of meat need to be considered. Sweet corn grown for food and the stalk and leaves, used as silage for ruminant feed is another possibility.

The cost of producing feed crops in Malaysia is high due mainly to higher labour costs. As neighbouring countries have lower labour costs, local entrepreneurs are encouraged to tap this advantage and invest in these countries. However, other considerations such as legal and constitutional matters, and repatriation of profits must be considered.

As feed costs constitute about 75 per cent of the cost of producing poultry and swine, feed millers are very cost cautious and will not only monitor the prices of maize, soybean and soybean meal from various sources but also the substitutes that give the best value for money on the feeds. Thus, feed crop producers continue to face competition with limited upside potential for their prices.

The livestock producers at the same time are facing a ceiling price on poultry meat set by the government. As a result, they too are facing restricted upward movement in the output prices. To overcome this issue, they must continue to be efficient and productive in their operation.

Results of SWOT analysis on feed crops

STRENGTHS	**WEAKNESSES**
Production: • Suitable climate for year-round production of feed crops. • Strong institutional support including R&D and extension. • Rice is well established and can be used as animal feed. • Malaysia has abundant OPF from the oil palm plantations that can be used as ruminant feeds.	Production: • Not economical to plant maize and cassava as feed crops. • Serious labour constraints i.e. competition with other sectors. • No large tract of contiguous flat land for mechanized farming of feed crops which could lower the cost of production. • Yield of feed grains not high enough to lower the costs of production. • Unpredictable rain during harvesting period will spoil the harvest of grain maize.
Marketing: • There is good infrastructure (roads, railways, ports and airports) and telecommunications in the country. • The strong manufactured feeds industry offers a ready market for domestically grown feed crops.	Marketing: • There is unorganized marketing system for domestically produced feed crops such as grain maize.
Processing: • Malaysia has experienced and efficient prepared animal feed processors that can source the best raw materials from everywhere. • Malaysia has by-products from the oil palm mills that are good as ruminant feeds.	Processing: • Over-dependence on imports of raw materials often subject to price instability. • Domestically produced feedstuffs such as cassava refuse, rice bran and broken rice are not price competitive with imports.
OPPORTUNITIES	**THREATS**
Production: • Reverse investment in favourable neighbouring countries can be very profitable. • The increasing trend in demand for raw materials such as maize for the animal feed industry is a positive signal to producers.	Production: • A shortage in the supply of maize, soybean and soybean meal in the world market will lead to astronomically high prices. • The spread of diseases such as the Nipah virus or Avian flu can cripple the livestock industry and the animal feed industry.
Marketing: • The implementation of WTO and AFTA will facilitate competitive sourcing of raw materials. • Marketing of poultry products via the huge 'halal' food market in the world will further increase the demand for feed crops. • The increasing retail outlets for ready to eat poultry products such as at KFC, A&W, Satay Chicken Rice etc also indirectly increase the demand for feed crops.	Marketing: • The domestic market for poultry meat, eggs and pork is saturated and new markets are limited. • The growing health conscious consumers may reduce consumption of poultry products and turn to fish and fish products, thereby reducing the demand for animal feed. • The domestic per capita consumption of poultry meat, eggs and pork has reached a plateau and thus may curtail the demand for feed crops.
Processing: • There is increasing demand for PKC as ruminant feed from Europe and Japan.	Processing: • The entry of many processors of prepared feed in the world market, leads to stiff competition and only the most efficient will survive.

Conclusions and recommendations

The potential of feed crops in Malaysia is not bright. Smallholders have many attractive alternative crops such as oil palm, rice, vegetables and fruits to choose from. These crops have ready marketing outlets and the output prices are better than feed crop prices. The plantation owners are sticking with the established crops such as rubber, oil palm and cocoa. Their massive switching has been from rubber to oil palm.

The potential lies in the food crops that have dual uses i.e. for food and feed. Although there are maize hybrids that can give very high yields, this cannot be achieved under a tropical climate. The price of cassava roots is currently too low to attract farmers. Rice is grown for food, and after rice milling, the rice bran or broken rice obtained can be used as animal feed. Sweet corn is grown for food, while the stalk and leaves can be used as silage for animal feed. Nevertheless, these products need to be competitive in terms of price and quality.

The prepared animal feed industry and the livestock industry (namely the non-ruminants) depend on each other for their continued growth. For as long as there is demand for poultry, eggs and pork, the synergy between the two industries will remain. Malaysia is self-sufficient in poultry, eggs and swine production and per capita consumption has reached a plateau requiring that Malaysia seek new markets quickly. Under WTO, there can be greater market access for livestock producers so long as they are able to compete.

While poultry meat is among the cheapest and the most widely eaten animal meat protein, the concern about diseases affecting the industry such as Avian flu, antibiotic residues in poultry meat, the incidence of Salmonella in eggs and also E. coli has triggered a demand for healthy and wholesome poultry meat and eggs. To cater for this segment of the consumers, poultry production may have to change to a less intensive form, free-range type or more 'natural' systems where the number of birds kept is smaller to minimize the spread of diseases and where there is restrictive use of antibiotics. This system will result in higher costs of production and subsequently higher poultry prices. It remains to be seen whether the health conscious consumers are willing to pay a premium price for this type of poultry meat.

Malaysia needs to tap the huge 'halal' food market and poultry meat and eggs have the potential to be in this market. Various measures have already been taken pertaining to efforts to promote Malaysia as a regional 'halal' food hub. Implementation issues or problems should be resolved as quickly as possible.

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 by-products from the oil palm industry such as PPF, EFB and OPT is good and their use should be aggressively promoted for acceptance as ruminant feeds.

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Comments on Prospects of Feed Crops in Malaysia

Ibrahim bin Che Embong[*]

Introduction

The paper presented is very important and timely as the country is looking for feed supplementation and major ingredients for animal feed. Livestock industries in the country have become important for income generation and have a major role in feeding the population. Constraints faced by the industry are hard to resolve in a short period of time. Limitations in genetic materials, land, a workforce, technologies, R&D, financial support and mechanization are very real and critical.

The Malaysian government has therefore decided to implement its agricultural development based on three main concepts, namely mixed farming, integrated agriculture concept and zoning for food production. The country needs to identify viable feed crops that could sustain livestock rearing through various approaches and crop cultivations. The paper presented is useful in providing a practical and realistic solution for the country to move forward in this field. We note that the study has singled out maize as a commodity and feed ingredient to initiate the discussion.

Existing policy

Land constraints

Malaysia has decided to focus its ruminant development within the oil palm industry, either by utilizing land for grazing or palm waste for feed. Both commodities seem to be well matched. The same piece of land can be utilized for both commodities with the oil palm providing shade and feed, and the cattle providing a "weeding service" plus fertilizer to the ground thus reducing the cost of producing both commodities.

In the non-ruminant sector, palm kernel cake was studied and used as much as 30 per cent in replacing corn. Total substitution of treated PKC is not possible as some maize is still needed in non-ruminant diets as there are some elements of maize that are necessary for poultry egg yolk and yellow skin colouring.

Cost element

The Malaysian government is interested with costing and packages for cultivated crops as they may generate income for the small farmers. The paper presented did not highlight the cost element in producing corn either for food or for feed ingredients. Most agricultural products are consumable by animals but one must determine the cost involved. High cost will affect the viability and sustainability of livestock production.

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Feed formulation

The paper also did not elaborate on feed formulations for the farmer to compare the cost of corn against any other ingredients as animal feed.

Current requirement

The results reviewed concerning demand and supply of corn are well established in the literature, but the current requirement is how to solve the country's problems. We are keen to know whether other material such as OPF can replace corn. The viability of the projects may be improved by specifying the selected varieties of maize and its purpose either solely for grain or the whole plant for silage.

Imported material

The author has indicated that Malaysia will have to continue importing corn and soybean meal, formulating rations and re-exporting the ready-made feed. The suggestion is good if the price of corn remains low. However, the fluctuation of corn price and high proportion of corn content in the feed may upset the business.

It is not recommended to import cassava as a source of energy feed as it contains high energy but is low in protein (1.5 per cent). On the other hand, it is suggested to look for cereal crops and process them for their bran, defatted rice bran, wheat bran or corn gluten feed. Locally available coconut refuse from the dry coconut milk manufacturing industry is another potential feed energy source available.

Meat and bone meal

Malaysia has stopped the importation of MBM from the US and EU countries due to the incidence of BSE. Thus, the utilization of MBM is not an option.

Local ingredients

The local feed ingredient PKC, has proven to be an important feedstuff. Recent trials have shown the potential of this feed ingredient, as it can be treated with enzymes to increase digestibility for non-ruminants, and it can replace maize by 10 per cent to 30 per cent in the ration's composition. R&D will probably be able to improve the usage further.

Import and export regulation

There is no tax for either imported raw ingredients nor exported compound feeds. The free flow of products is determined by cost factors.

Misleading facts

- 70-80 per cent of feed ingredients for non-ruminants were imported, not as claimed by the author, 95 per cent.
- In animal nutrition, OPF cannot substitute corn or grass due to it's low protein and high fiber content.
- 20-25 per cent of soybean is utilized in pig and poultry not 14-20 per cent.
- Tapioca chip produced locally is exported.
- Groundnut meal is not used anymore due to problems of rancidity, aflatoxin and poisoning issues.
- Meat and bone meal are not used anymore due to the prevalence of BSE.

Implications

Continuing to import may cause further trade imbalances unless we can ensure high profit with added value from exports. The Malaysian economy will become very fragile and dependent on others.

Malaysia is well known for its SPS measure and transparent disease status. This may be an avenue for the export of quality livestock products.

The results given will not stop further research on corn for animal feed. The issue of viability is the principle concern; research should be undertaken to overcome the obstacles.

Recommendations

Importation of corn

The suggestion for Malaysia to continue importing corn and export processed feed should be reviewed. Since the price of corn is always fluctuating and it's composition in formulated feed is very high, it may cause imbalance in trade.

It is better to utilize more locally available products such as PKC and carry out more R&D to improve the viability of maize cultivation rather than utilizing more imported corn.

Groundnut as feed ingredients

Feed crops may be in short supply or be costly because they are also consumed by the human population. Here, there is competition between humans and animals for the same feed resource. If importation is a must, Malaysian farmers must attempt to use more varieties of feedstuffs which are not directly useable by humans such as oil crop by-products, cotton seed meal, rapeseed meal or sun flower seed meal, whichever is cheaper at that particular season of the year.

Alleviate poverty project

The paper needs to highlight the business plan for corn farming in Malaysia so that the viability is ensured and the operation can be sustainable. Basic costing and real/local parameters are urgently required for the government to formulate a packaged project for poverty alleviation.

Direction

The paper makes a good recommendation, as corn food is a better prospect than corn feed in Malaysia. But the way forward is to continue searching for avenues to produce corn for feed. This may include studying the viability of corn silage for ruminant production and sweet corn grain for human consumption.

Conclusions

It's good to look for new markets for Malaysia's poultry, egg and pork products as these industries are fast growing. Since the feed cost is still high, the cost to produce poultry, pork and eggs is not competitive in the world market. This may hinder the export market or restrict the creation of downstream activities.

Corn cultivation is not cost effective because the soil is marginal soil and not suitable. Good soil is used for other crops such as oil palm and rubber. Mechanization is difficult in the cultivation of corn on this land and will cost the farmers more. However, sweet corn for food is possible and been proven viable. Therefore, the usage of its plant for silage will further improve its viability.

Status and Prospects of Feed Crop Production in the Philippines

Danilo C. Cardenas and Lara Marie M. de Villa[*]

Introduction

Background

Traditionally, the local livestock sector has always played a key role in the growth of Philippine agriculture. Its contribution to the gross value added (GVA) in agriculture, fishery and forestry has been, on average, 21 per cent from 1988-2002 (Table 1). During the same period, the animal inventory has likewise expanded at an average rate of 6 per cent. This trend is expected to continually increase in the coming years despite the constraints posed by an under-developed feed crop sub-sector. And this could be attributed to the increasing consumption of meat, poultry, eggs as well as milk and other dairy products brought about by a rapidly growing population, urbanization, rising incomes and changes in consumer food tastes and preferences. Unfortunately, these changes have been putting undue pressure on our already shrinking agricultural resource base and ultimately limits the country's ability to achieve higher economic growth.

Table 1. Gross value added in agriculture, fisheries and forestry (in million pesos: at constant 1985 prices), Philippines, 1988-2002

Industry	1988	1990	1992	1994	1996	1998	2000	2002	Average
Agricultural crops	84,067	85,870	87,662	92,775	96,418	87,422	99,887	104,150	93,022
Palay	23,138	24,873	24,412	28,182	30,175	22,877	33,134	35,493	28,210
Corn	10,466	10,950	11,009	10,769	9,893	9,111	10,750	10,292	10,523
Coconut	9,008	7,084	6,815	6,831	6,890	6,414	6,520	6,916	6,950
Sugarcane	2,997	3,652	4,871	5,326	4,810	3,938	4,908	5,320	4,567
Banana	2,940	2,698	2,789	2,836	3,011	3,602	4,157	4,435	3,278
Other crops	35,518	36,613	37,766	38,831	41,639	41,480	40,418	41,694	39,494
Livestock	24,522	29,069	31,194	34,113	39,009	42,233	45,258	50,017	36,921
Agri-related activities and services	6,858	7,692	8,154	8,336	7,838	7,676	8,006	8,749	7,863
Fisheries	28,581	30,783	32,375	33,195	34,288	34,498	36,168	40,821	33,825
Forestry	11,264	7,320	4,186	2,971	1,898	1,372	1,372	996	3,640
GVA in agriculture, fisheries and forestry	155,292	160,734	163,571	171,390	179,451	173,201	190,691	204,733	175,271

Source: Adapted from the Philippine Statistical Yearbook, 2002.

Note: Livestock sector includes swine, poultry, cattle, carabao, goats and sheep. Agri-related activities and services include producers of farm machinery, input providers (seeds and fertilizers).

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In the Philippines, as in many developing countries, rapid population growth makes it extremely difficult for agricultural production to keep pace with demand. With an average population growth rate of 2.3 per cent, the current population of 79.5 million is projected to reach 99 million by 2015 (Table 2). Ensuring food security has therefore become a critical national concern as these demographic changes are anticipated to affect both food demand and supply patterns.

Table 2. Population, the Philippines, 1988-2002

Year	Population	Growth rate (%)
1988	58.2	-
1989	59.5	2.4
1990*	60.7	2.0
1991	62.4	2.7
1992	63.8	2.3
1993	65.3	2.3
1994	66.8	2.3
1995*	68.6	2.7
1996	70.0	1.9
1997	71.5	2.3
1998	73.1	2.2
1999	74.7	2.2
2000*	76.5	2.4
2001	77.9	1.9
2002	79.5	2.0
Average	68.6	2.3

Source: NSCB.
Note: *based on census years.

In the last three years or so, the share of food to total personal consumption expenses represented about 53-54 per cent, at constant prices (Catelo, 2004). In terms of family expenditure, food consumed at home declined to 38 per cent while food consumed outside the home increased slightly to 5 per cent in 2000 (NSO, 2000). This can be expected to widen further in the near future considering several developments.

Firstly, as of 2000, urban dwellers comprised 59 per cent of the country's total population. As such, the growth in both urban areas and urban population has resulted in a busy lifestyle, with office work taking much time away from household chores. This has shifted consumption from traditional foods to a fast-food diet to cope with the fast-paced lifestyles. Secondly, the proliferation of a number of fast-food outlets and mini-marts such as those of Jolibee, McDonald's, KFC, Chowking, etc. coupled with rising incomes have likewise caused a shift in the dietary preferences of most Filipinos from the typical cereal-based Asian diet to the more westernized bread-noodles-meat combination (Table 3). Thus, as incomes have risen, the per capita consumption for cereal and cereal products has declined from 367 kg in 1978 to 340 kg in 1993, while the consumption of meat, poultry, eggs and milk increased significantly from 80 kg to 104 kg (Table 4). Thirdly, comparing urban and rural populations, urban dwellers tend to be heavy consumers of prestige foods such as meat, poultry, eggs as well as milk and other dairy products. The amounts consumed by those in the urban areas were reportedly twice the amount consumed in rural areas (FNRI, 1993). This, in many ways, has largely affected the food demand and consumption patterns of most Filipino consumers.

Table 3. Median annual income, median annual expenditure and savings at current prices (Pesos), Philippines, 1988-2000

Year	Median income	Median expenditure	Savings
		(Value)	
1988	26,694	23,431	3,263
1991	41,040	35,140	5,900
1994	55,019	47,378	7,641
1997	74,146	65,856	8,290
2000	88,782	78,954	9,828
Average	64,747	56,832	7,915

Source: NSO.

Table 4. Comparison of mean one-day per capita food consumption (raw, "as purchased"), Philippines, 1978-1993

Food group/sub-group	Consumption				Average	
	Per capita intake (grams)				Intake	Growth rate
	1978	1982	1987	1993	(grams)	(%)
Cereals and cereal products	367.00	356.00	345.00	340.00	352.00	(2.51)
Rice and products	308.00	304.00	303.00	282.00	299.25	(2.85)
Corn and products	38.00	34.00	24.00	36.00	33.00	3.35
Other cereals and products	21.00	18.00	18.00	22.00	19.75	2.65
Starchy roots and tubers	37.00	42.00	22.00	17.00	29.50	(18.94)
Sugars and syrups	19.00	22.00	24.00	19.00	21.00	1.35
Fats and oils	13.00	14.00	14.00	12.00	13.25	(2.20)
Fish and fish products	102.00	113.00	111.00	99.00	106.25	(0.60)
Meat, poultry, eggs and milk products	80.00	95.00	99.00	104.00	94.50	9.34
Meat products	23.00	32.00	37.00	34.00	31.50	15.55
Poultry products	7.00	10.00	9.00	14.00	10.00	29.47
Eggs and egg products	8.00	9.00	10.00	12.00	9.75	14.54
Milk and milk products	42.00	44.00	43.00	44.00	43.25	1.60
Dried beans, nuts and seeds	8.00	10.00	10.00	10.00	9.50	8.33
Vegetables	145.00	130.00	111.00	106.00	123.00	(9.82)
Fruits	104.00	102.00	107.00	77.00	97.50	(8.35)
Miscellaneous	21.00	32.00	26.00	19.00	24.50	2.24
All foods	897.00	915.00	869.00	803.00	871.00	(3.54)

Source: Adapted from FNRI.

In terms of food supply, unabated population growth may unintentionally also be causing a deterioration in food insufficiency and worsen food availability. For instance, our agricultural population, aside from aging, has also declined over the years from 42 per cent of the total population in 1995 to just 39 per cent in 1999. This may partly be attributed to the massive conversion of agricultural lands into residential and other built-up areas (DA-BAS, 1999). If this trend continues, the years to come will result in land and agriculture retirement for the old, with fewer and older people taking over whatever residual agricultural lands remain in the areas that have not yet been converted and/or urbanized. These trends have negative implications for agriculture and food supply in the Philippines. Considering the existing patterns of land conversion, agricultural lands have not only decreased but have also affected agricultural produce. Aside from the direct loss of productive capacity, the successive land conversions that have already taken place have also negatively influenced whatever little agriculture remained (Cardenas, 1997). These externalities have generally taken several forms which imposed additional burdens on existing farming conditions.

Firstly, the migration of a large proportion of the non-farming population has generally reduced the overall profitability of farming by restricting certain farming operations. Secondly, the reduction in farmlands has caused a decline in supporting businesses and forced some farms to remain inefficiently small. At first glance, these effects may lead to a reduction in farm net income, rather than gross output, by seriously degrading existing farming conditions. Added to

these problems are the uncertain conditions under which the remaining farmers live in fear of seeing their future obscured by urban expansion. Consequently, some of them have ceased operating their farms on a full-time basis. Moreover, land conversion has also brought about a basic change in the composition and structure of land ownership, with an increasing proportion being primarily non-farmers. Sociologically, this would imply that more and more of the limited agricultural land resources are continually being acquired by people who have little personal ties to the land. On the other hand, as the would-be urban land prices rise sharply to attract more supply, the new prevailing higher prices make it extremely difficult for landless farmers to acquire their own landholdings. As a result, the property being sold often has to be subdivided into smaller parcels and the size of the average landholding would, thus, continue to shrink. Hence, the remaining farmers cannot be readily expected to just simply expand their level of agricultural operations to meet increasing demands, while economic development activity steadily raises the threshold of viability.

Furthermore, with an increasing population, there is also further decline in productivity arising from the expansion of agriculture towards the uplands leading to the wider use of marginal lands as well as the overuse of other prime agricultural lands, both of which results in early land degradation in some areas. Thus, as farmers try to obtain higher yields from their heavily used farmlands, soil erosion worsens, water becomes scarcer, and pollution increases. The Food and Agriculture Organization (FAO) estimated that for every person added to the population, about 0.05 hectares of land is taken away from agricultural use to meet the land use requirement for settlements, roads, power, recreation, commercial and industrial, and other purposes (as cited by Cabrido, 1994). This implies that the country's capacity to expand agricultural production may well be shrinking and not expanding after all.

Thus, the twin problems of hunger and food insecurity are likely to persist and could even worsen unless some urgent, determined and concerted action is taken. To help avert this grim outlook, a research project on the status and prospects of selected feed crops in Southeast Asia was commissioned by the Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific (CAPSA) to assess their development potentials, strengths, opportunities and constraints so that appropriate strategies and policy options can be formulated for their sustained development.

Objectives

The general objective of the study is to take a closer look at the status and prospects of the domestic feed crop sector in the Philippines as they functionally relate with the expected growth of the local livestock industry. More specifically however, it aims to:

1. Analyze the current status and future trends of the demand and supply of feed crops;
2. Evaluate the strengths, weaknesses, opportunities and constraints for expanding feed crop farming in the Philippines;
3. Identify possible cooperation schemes in the trade and development of feed crops among Southeast Asian countries; and
4. Formulate relevant policy recommendations to promote the sustainable development of feed crop farming in the Philippines.

Scope of the Study

In the Philippines, palay, corn and soybean are the main locally-grown ingredients widely used in the animal feed milling industry. Their demand is likely to increase sharply in the near future given the livestock industry's potential for growth. Other coarse grains such as pulses, roots and tubers, although grown locally, are primarily consumed as food and their

likelihood of being included as feed ingredients is quite low. Hence, the succeeding discussions will dwell largely on the historical dynamics and potentials of these three feed crops.

Organization of the report

This report is presented in six major chapters excluding the literature citation.

1. **Introduction** – Briefly discusses the project rationale, objectives, scope and commodity coverage of the study and organization of the report.
2. **Research methodology** – Contains the conceptual framework of the study, model formulation, sources and coverage of data and limitations of the study.
3. **Profiles of the local livestock, poultry, aquaculture and feed crops sub-sectors** – Presents an overview of the performance of livestock, poultry, aquaculture, feed crops and the feed milling industries over the past 15 years as well as the policies affecting these sectors.
4. **Demand for and supply of feed crops** – Shows the analysis of the current demand and supply for selected feed crops, the factors determining them and projections up to year 2015. It also includes an analysis of the existing trade patterns and import estimation on the selected feed crops.
5. **Measures to meet excess demand** – Identifies and describes measures to ensure adequate supply of feed crops and meet quality standards set by domestic users as well as international suppliers. It specifically discusses farmer participation and government and private company initiatives. Likewise, it also highlights the potentials and constraints of the sector.
6. **Conclusions and recommendations** – This chapter summarizes the key findings of the study and presents formulated policy recommendations for the sustainable development of the feed crop sector.

Research methodology

Conceptual framework

Definitions

Feed crops generally refer to plants utilized and processed for feeding animals. Feeds are the range of food or feedstuffs provided to animals. These include fresh and conserved forages, concentrates and succulent feeds. Feedstuffs can be further classified as conventional and non-conventional feeds. Conventional feedstuffs are those which are traditionally used, are abundant and primarily cultivated to support the livestock and fisheries sectors. These include corn, soybean, palay and cassava, among others. In contrast, non-conventional feedstuffs are by-products derived from processing the main products and feeds which have not been traditionally used in animal feeding or not commercially produced rations for livestock. Concentrates are low-fiber, high-energy feeds with blended nutrients to increase the nutritional adequacy of feed supplements.

Analytical framework

In determining the prospects of the feed crop sector in the Philippines, the impacts of non-market and market forces on the production and consumption of feed crops are vital. This is to establish the interrelated effects and relationship of factors such as technological change, population and income, among others on the supply and demand of feed crops. Using the theoretical relationship of the supply and demand functions, future projections on production to foresee a deficit or surplus in the sector were carried out. In addition, it is crucial to assess and

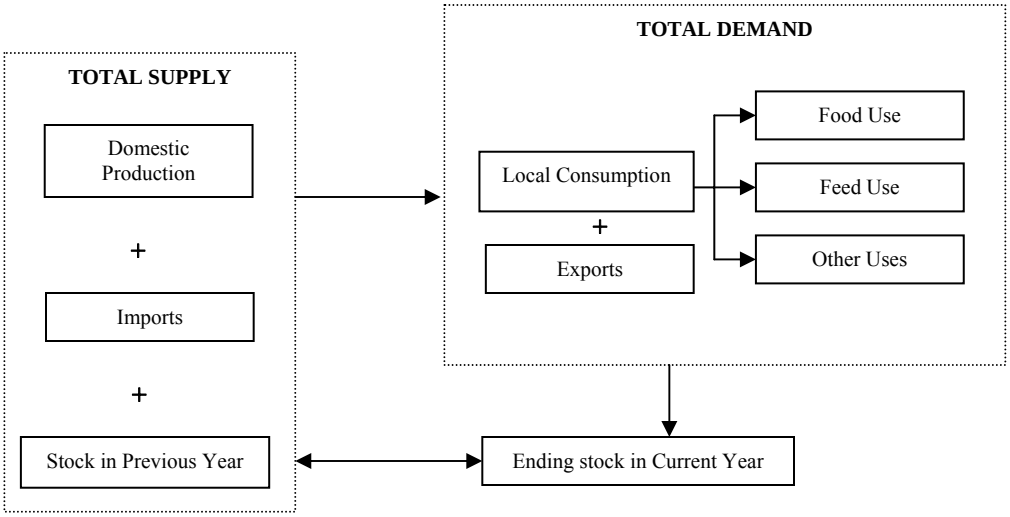
evaluate whether the programmes of the feed crop sector are feasible from a managerial point of view. Hence, the analytical framework is developed based on the standard economic theory of supply and demand complemented by a management planning tool known as the SWOT analysis.

Supply and demand of feed crops

The total supply of a particular feed crop is the summation of the country's local production, imports and the previous year's ending stock (Figure 1). Hence, feed supply is the available feed for the livestock and fishery sectors from local production and imports.

On the other hand, demand for feed crops consists of local demand and international demand or exports. Local consumption can further be classified as demand for food, demand for feed and demand for other uses. Feed crops that were unutilized at the end of the year served as the ending stock of the period.

Figure 1. Supply and demand for feed crops



Model formulation

Domestic production

Total domestic production of a feed crop was derived by the product of the feed crop's area and yield values. This was estimated as follows:

$$QH_{it} = AH_{it} x YH_{it}$$

Where, QH_{it} = total domestic production (kg)

AH_{it} = area harvested (ha)

YH_{it} = yield (kg/ha)

t = year/time

i = feed crop under study

Area harvested

Area harvested was assumed to be a function of the crop's own price and the prices of other competing crops. In some cases, lagged area harvested was omitted in the model if it proves to be collinear with the other independent variables. The area response function is:

$$lnAH_{it} = a + blnFP_{it-1} + clnPC_{it-1} + dlnAH_{it-1}$$

Where,

AH_{it}	= area harvested (ha)
FP_{it-1}	= lagged farm gate price of the feed crop (₱/kg)
PC_{it-1}	= lagged farm gate price of the competing crops (₱/kg)
AH_{it-1}	= area harvested of the previous year (ha)
α	= intercept
b, c, d	= elasticities
t	= year/time
i	= feed crop under study

Yield

Yield response of a crop is a function of the crop's own price, prices of inputs (labour, fertilizers, etc.), and the lagged yield level. However, if lagged yield level is collinear with other independent variables, it was dropped from the model. The yield function was estimated using the formula:

$$lnYH_{it} = a + blnFP_{it-1} + clnPI_{it-1} + dlnYH_{it-1}$$

Where,

YH_{it}	= yield of the crop (kg/ha)
FP_{it-1}	= lagged farm gate price of the feed crop (₱/kg)
PI_{it-1}	= lagged price of the inputs (₱/kg)
YH_{it-1}	= yield of the previous year (kg/ha)
α	= intercept
b, c, d	= elasticities
t	= year/time
i	= feed crop under study

Total demand

The total consumption of feed crops in the Philippines consisted of food use, feed use, and other uses such that the total demand for the crop is given by:

$$QD_{it} = QF_{it} + QL_{it} + QE_{it}$$

Where,

QD_{it}	= total demand (kg)
QF_{it}	= demand for food (kg)

QL_{it} = demand for feed (kg)

QE_{it} = demand for other uses (kg)

t = year/time

i = feed crop under study

Demand for food

Food demand is a function of the price of the commodity under consideration, prices of other competing commodities, per capita income, and total population (Rosegrant *et al*., 1995). Soybean wholesale price was used instead of retail price because demand as food for this commodity primarily entails the processing sector who buy the commodity in bulk. Hence, demand as food for the commodities are given in the following formulae:

$$lnQF_{it} = a + blnRP_{it} + clnRC_{it} + dlnPOP_t + elnINC_t \text{ (Corn \& Palay)}$$

$$lnQF_{it} = a + blnWP_{it} + clnRC_{it} + dlnPOP_t + elnINC_t \text{ (Soybean)}$$

Where,

QF_{it} = demand for food (kg)

RP_{it} = lagged retail price of the feed crop (₱/kg)

WP_{it} = lagged wholesale price of the feed crop (₱/kg)

RC_{it} = lagged retail price of other competing products (₱/kg)

POP_t = population (million persons)

INC_t = per capita income/ per capita gdp (₱)

α = intercept

b, c, d = elasticities

t = year/time

i = feed crop under study

Demand for feed

Demand for feed is a derived demand determined by changes in livestock production (Rosegrant *et al*., 1995) particularly of pork, poultry and eggs primarily because a major part of corn production is utilized as feeds for the swine and poultry industries. Hence, the demand function for feeds is given by:

$$lnQL_{it} = a + blnWP_{it} + clnPORK_t + dlnPOUL_t + elnEGG_t$$

Where,

QL_{it} = demand for feed (kg)

WP_{it} = lagged wholesale price of the feed crop (₱/kg)

$PORK_t$ = pork production (kg)

$POUL_t$ = poultry production (kg)

EGG_t = egg production (kg)

α	= intercept
b, c, d, e	= elasticities
t	= year/time
i	= feed crop under study

Demand for other uses

The demand for other uses, primarily for processing of the feed crops, is a function of the previous year's demand for food and feed demand changes (Rosegrant, *et al*., 1995):

$$lnQE_{it} = a + bln\left(QF_{it} + QL_{it}\right) + clnQH_{it}$$

Where,

QE_{it}	= demand for other uses (kg)
QF_{it}	= demand for food (kg)
QL_{it}	= demand for feed (kg)
QH_{it}	= quantity produced (kg)
α	= intercept
b, c	= elasticities
t	= year/time
i	= feed crop under study

Trade equation

The Philippines is a net importer of agricultural commodities, including cereals and feed crops such as corn, palay and soybean. The widening supply deficits caused by increasing demand for food, feed and other industrial uses of the selected feed crops worsens the country's reliance on imports. Thus, imports are necessary to meet the increasing demand in the domestic market, such that:

$$M_{it} = QC_{it} - QH_{it}$$

Where,

M_{it}	= import volume (kg)
QC_{it}	= total demand (kg)
QH_{it}	= domestic production (kg)
t	= year/time
i	= feed crop under study

Equilibrium

The general status of the feed industry could be analyzed in terms of the equilibrium in demand and supply of feed crops. At equilibrium:

Total supply = Total demand

$$QH_{it} + M_{it} = QC_{it}$$

Where, M_{it} = import volume (kg)

QC_{it} = total demand (kg)

QH_{it} = domestic production (kg)

t = year/time

i = feed crop under study

This was simplified with the exclusion of export volume from the model since the Philippines is not an exporter of feed crops.

Future trends in production and consumption

The elasticity estimates from the supply and demand models were used to project future production and consumption levels. The average growth rates and elasticities of the variables could forecast future trends as illustrated in the equation:

$$dY = \varepsilon_1 dX_1 + \varepsilon_2 dX_2 + ... + \varepsilon_n dX_n$$

Where, $\varepsilon_{1...n}$ = elasticity estimates of the explanatory variables;

dY = growth rates of the dependent variables; and

dX = growth rates of the explanatory variables.

SWOT analysis

SWOT analysis is used to identify and analyze the strengths and weaknesses of the sector, as well as its opportunities and threats. SWOT intends to develop a plan that takes into consideration the various internal and external factors, and maximizes the potential of the strengths and opportunities while minimizing the impact of the weaknesses and threats.

The SWOT framework also aided in further evaluating the supply and demand scenario of feed crops in the Philippines. Likewise, this management tool was a great help in exploring the prospects of expanding the feed crop industry in the near future.

Sources and coverage of data

Secondary data on the profile and status of livestock, poultry, fishery, feed crops and feed milling industries were gathered from the Bureau of Agricultural Statistics (BAS), the Bureau of Animal Industry – Animal Feeds Standard Division (BAI-AFSD) and the Livestock Development Council (LDC) all under the Philippine Department of Agriculture (DA).

The socio-economic and trade data were sourced principally from the National Statistical Coordination Board (NSCB), the National Statistics Office (NSO) and the Philippine Institute for Development Studies (PIDS).

Most of the data used covered the period 1988-2002 with the exemption of some data that is unavailable yearly (i.e. income – survey of the NSO is conducted every three years, etc).

Limitations of the study

The study focused on the top three feed crops used in the livestock sector. Traditional feeds such as roughages, pasture and forage had no existing time series data, hence, these were

excluded from the analysis. Moreover, other coarse grains, pulses, roots and tubers are primarily consumed as food items and typical inclusion of these in feeds is low, thus, these were likewise not included in the analysis.

There is also difficulty in obtaining long-term, time-series data for some of the variables, affecting the ability to generate reliable long-term projections.

Profiles of the local livestock, poultry, aquaculture and feed crops sub-sectors

Livestock production and consumption

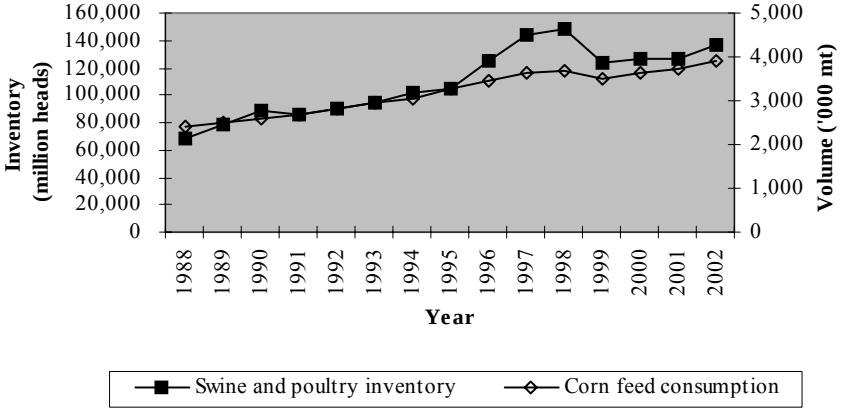
The Philippine livestock sector consists of swine, poultry, cattle, carabao, goat and duck. Most of these animals are raised backyard with the exception of poultry. In 1988, the livestock inventory stood at 88.50 million animals, steadily rising through 1998, declining slightly in 2001 but picking up again in 2002 (Table 5). The bulk of the inventory comes from poultry (80 per cent). In terms of growth rates, poultry, ducks, goats and swine posted the highest increases in the number of animals raised ranging from 3.16 per cent to 5.81 per cent. This was because of greater market orientation and production efficiency as well as the growing consumer demand for the said commodities (NABCOR, 1999).

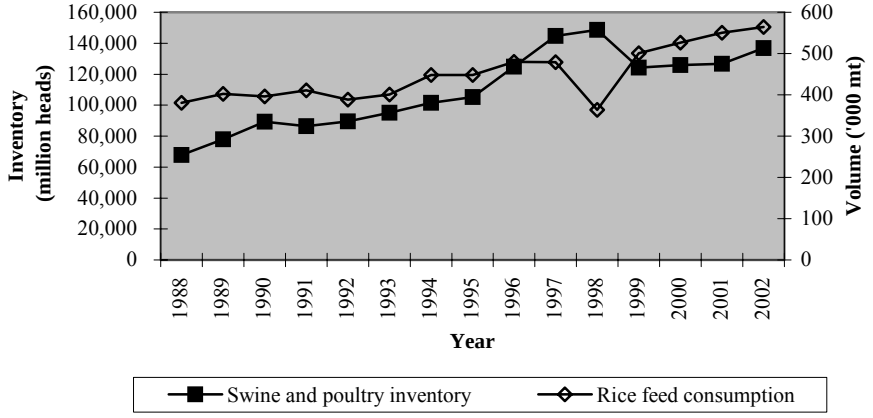
The increasing trends in inventories especially swine and poultry, imply a corresponding increasing demand for feed crops as illustrated in Figure 2 where total livestock inventory from 1988-2002 was observed to be increasing with the consumption of the three major feed crops.

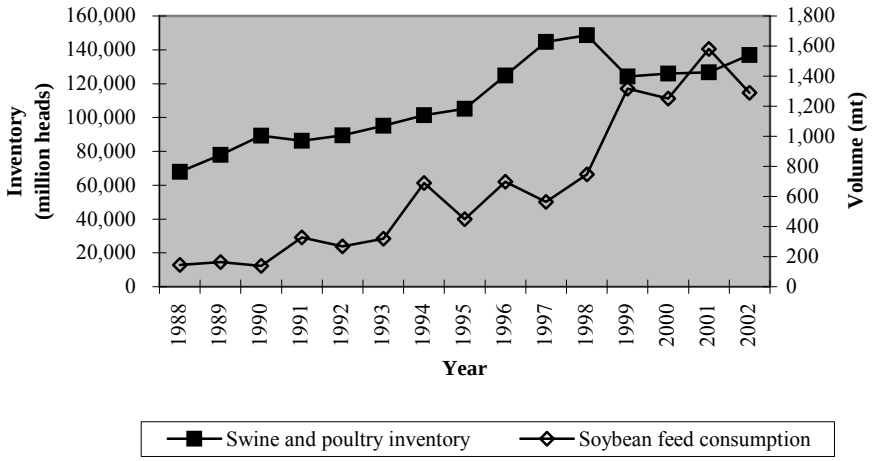
For meat and meat products, pork dominated the meat market capturing an average of 60 per cent share of total meat production from 1988-2002, followed by chicken meat with 24 per cent (Table 6). Supply of pork from 1988 to 2002 expanded by 87 per cent while chicken meat grew by 178 per cent. Although fluctuating in terms of growth rates, the volume of meat production is generally increasing for all types of meat. The rise in poultry production in the late 1990s up to the present was due to increased importation of day old chicks for broilers (BAS, 2002).

Chicken and duck eggs were increasing for the period covered, with chicken egg production increasing annually by 5 per cent (Table 7). As of 2002, domestic production of chicken eggs was 261,000 mt, an increase of 86 per cent from 1988. The increase was also stimulated by increasing primary stock (PS) layer importation.

Figure 2. Cross trend of swine and poultry inventories with corn, rice and soybean feed consumption, Philippines, 1988-2002




160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Inventory (million heads)
600
500
400
300
200
100
0
Volume ('000 mt)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Swine and poultry inventory
Rice feed consumption


160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Inventory (million heads)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Volume (mt)
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Swine and poultry inventory
Soybean feed consumption

Source: BAS.

Table 5. Inventory of livestock and poultry, Philippines, 1988-2002

Year	Poultry		Swine		Cattle		Carabao		Goat		Duck		Total	
	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)	No. of heads ('000)	Growth rate (%)
1988	60,321	-	7,580	-	1,700	-	2,890	-	2,120	-	5,838	-	80,449	-
1989	70,016	16.07	7,908	4.33	1,682	(1.06)	2,842	(1.66)	2,212	4.34	6,500	11.34	91,160	13.31
1990	81,303	16.12	8,000	1.16	1,630	(3.09)	2,765	(2.71)	2,204	(0.36)	7,356	13.17	103,258	13.27
1991	78,240	(3.77)	8,079	0.99	1,677	2.88	2,647	(4.27)	2,141	(2.86)	8,268	12.40	101,052	(2.14)
1992	81,525	4.20	8,022	(0.71)	1,731	3.22	2,577	(2.64)	2,306	7.71	8,348	0.97	104,509	3.42
1993	87,158	6.91	7,954	(0.85)	1,915	10.63	2,576	(0.04)	2,562	11.10	8,707	4.30	110,872	6.09
1994	93,201	6.93	8,226	3.42	1,936	1.10	2,560	(0.62)	2,633	2.77	8,187	(5.97)	116,743	5.30
1995	96,216	3.23	8,941	8.69	2,021	4.39	2,708	5.78	2,828	7.41	9,072	10.81	121,786	4.32
1996	115,782	20.34	9,026	0.95	2,128	5.29	2,841	4.91	2,982	5.45	9,470	4.39	142,229	16.79
1997	134,963	16.57	9,752	8.04	2,266	6.48	2,988	5.17	3,025	1.44	8,923	(5.78)	161,917	13.84
1998	138,521	2.64	10,210	4.70	2,389	5.45	3,013	0.84	3,085	1.98	9,047	1.39	166,265	2.69
1999	113,789	(17.85)	10,397	1.83	2,432	1.77	3,006	(0.23)	3,051	(1.10)	8,614	(4.79)	141,289	(15.02)
2000	115,186	1.23	10,761	3.50	2,477	1.85	3,024	0.60	3,151	3.28	9,243	7.30	143,842	1.81
2001	115,610	0.37	11,063	2.81	2,500	0.92	3,083	1.96	3,223	2.29	10,064	8.88	145,543	1.18
2002	125,250	8.34	11,653	5.33	2.547	1.92	3,120	1.19	3,290	2.07	9,910	(1.53)	155,770	7.03
Average	**100,472**	5.81	9,171	3.16	2.069	**2.98**	**2,843**	**0.59**	**2,721**	**3.25**	**8,503**	4.06	**125,779**	**5.13**

Source: BAS.

Table 6. Production of livestock and poultry (carcass weight), Philippines, 1988-2002

Year	Chicken meat		Pork		Beef		Carabeef		Chevon		Duck meat		Total	
	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)
1988	225.92	-	713.00	-	92.00	-	65.02	-	32.93	-	5.42	-	1,134.29	-
1989	208.46	(7.73)	804.00	12.76	96.00	4.35	69.73	7.25	35.31	7.21	5.75	6.09	1,219.25	7.49
1990	229.27	9.98	896.00	11.44	103.00	7.29	51.18	(26.61)	42.00	18.95	6.09	5.91	1,327.54	8.88
1991	286.87	25.12	845.19	(5.67)	112.30	9.03	48.58	(5.08)	35.31	(15.93)	6.51	6.90	1,334.76	0.54
1992	356.40	24.24	845.26	0.01	115.58	2.92	52.04	7.12	36.52	3.43	7.54	15.82	1,413.34	5.89
1993	364.48	2.27	880.94	4.22	125.89	8.92	52.04	-	40.14	9.91	8.53	13.13	1,472.02	4.15
1994	376.61	3.33	921.76	4.63	135.51	7.64	52.26	0.42	41.96	4.53	9.01	5.63	1,537.11	4.42
1995	399.55	6.09	969.86	5.22	147.46	8.82	50.09	(4.15)	43.28	3.15	9.70	7.66	1,619.94	5.39
1996	455.10	13.90	1,036.52	6.87	160.83	9.07	57.47	14.73	43.61	0.76	10.43	7.53	1,763.96	8.89
1997	496.69	9.14	1,085.54	4.73	176.64	9.83	61.37	6.79	44.03	0.96	10.39	(0.38)	1,874.66	6.28
1998	491.23	(1.10)	1,123.75	3.52	182.63	3.39	65.27	6.36	44.72	1.57	10.48	0.88	1,918.08	2.32
1999	496.43	1.06	1,171.76	4.27	189.93	4.00	68.71	5.27	45.93	2.71	10.47	(0.09)	1,983.24	3.40
2000	533.12	7.39	1,212.54	3.48	190.16	0.12	71.61	4.22	46.73	1.74	10.52	0.47	2,064.68	4.11
2001	587.07	10.12	1,265.89	4.40	182.89	(3.82)	72.28	0.93	46.36	(0.79)	10.94	3.99	2,165.42	4.88
2002	627.10	6.82	1,332.35	5.25	182.81	(0.04)	76.47	5.80	46.48	0.26	11.06	1.07	2,276.27	5.12
Average	408.95	7.90	1,007	4.65	146.24	5.11	59.83	1.65	41.69	2.75	8.86	5.33	1,674	5.12

Source: BAS Selected statistics on agriculture.

Table 7. Chicken and duck egg production, Philippines, 1988-2002

Year	Chicken egg		Duck egg	
	Volume ('000 mt)	Growth rate (%)	Volume ('000 mt)	Growth rate (%)
1988	139.99	-	27.10	-
1989	155.41	11.02	28.75	6.09
1990	165.70	6.62	30.45	5.91
1991	170.81	3.08	33.40	9.69
1992	180.52	5.68	36.75	10.03
1993	202.10	11.95	39.20	6.67
1994	196.00	(3.02)	41.60	6.12
1995	199.90	1.99	47.70	14.66
1996	205.60	2.85	54.50	14.26
1997	222.90	8.41	53.00	(2.75)
1998	227.00	1.84	53.10	0.19
1999	229.88	1.27	52.65	(0.85)
2000	243.38	5.87	53.47	1.56
2001	246.70	1.36	53.90	0.80
2002	260.82	5.72	53.60	(0.56)
Average	203.11	4.53	43.94	5.57

Source: BAS Selected Statistics on Agriculture, 1990, 1993, 1994, 2000.

Fisheries sector

There are three types of fishing in the Philippines (NSO, 2001): (1) Commercial, covering fishing operations that make use of boats weighing more than three gross tons; (2) Marine municipal, covering fishing operations carried out with or without the use of boats weighing three gross tons or less; and (3) Aquaculture, covering fishing operations involving all forms of raising and culturing fish and other fishery species in marine, brackish and freshwater environments. Examples are fishponds, fishpens, fishcages, mussels, oysters, seaweed farms and hatcheries. The report will cover aquaculture only as this is the sub-sector that utilizes feed crops.

Aquaculture is the second largest source of fish after municipal fishing, supplying an average of 33 per cent. In terms of growth rate, however, the aquaculture sub-sector posted the highest at 6 per cent (Table 8). In fact, starting in 1996, aquaculture supplied the highest volume of fish in the market.

Table 8. Production of aquaculture, commercial and municipal fishing, Philippines, 1988-2002

Year	Aquaculture		Commercial fishing		Municipal fishing		Total	
	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Production ('000 mt)	Growth rate (%)
1988	599.5	-	600.0	-	1,068.5	-	2,268.0	-
1989	629.3	5.0	637.1	6.2	1,104.6	3.4	2,371.0	4.5
1990	671.1	6.6	700.6	10.0	1,131.9	2.5	2,503.6	5.6
1991	692.4	3.2	759.8	8.4	1,146.8	1.3	2,599.0	3.8
1992	736.4	6.4	804.9	5.9	1,084.4	(5.4)	2,625.7	1.0
1993	793.6	7.8	824.4	2.4	1,014.0	(6.5)	2,632.0	0.2
1994	869.1	9.5	859.3	4.2	992.6	(2.1)	2,721.0	3.4
1995	940.6	8.2	893.2	3.9	972.0	(2.1)	2,805.8	3.1
1996	1,007.7	7.1	879.1	(1.6)	909.2	(6.5)	2,796.0	(0.3)
1997	984.4	(2.3)	884.7	0.6	924.5	1.7	2,793.6	(0.1)
1998	997.8	1.4	940.5	6.3	891.1	(3.6)	2,829.4	1.3
1999	1,048.7	5.1	948.8	0.9	926.3	4.0	2,923.8	3.3
2000	1,100.9	5.0	946.5	(0.2)	945.9	2.1	2,993.3	2.4
2001	1,220.5	10.9	976.5	3.2	969.5	2.5	3,166.5	5.8
2002	1,338.2	9.6	1,042.2	6.7	988.9	2.0	3,369.3	6.4
Average	908.7	6.0	846.5	4.1	1,004.7	(0.5)	2,759.9	2.9

Source: Philippine Statistical Yearbook, 2002.
BAS.

In aquaculture, the production of milkfish, tilapia and prawn entails the utilization of feeds and feed ingredients. Table 9 shows the trends in production of the three types of species. The production and growth rates of the three species are fluctuating. In terms of volume, milkfish provide the highest production at an average of 184,274 per year, followed by tilapia at half the volume with average growth rates of 2.3 and 2.6 per cent respectively, while prawn had the lowest growth rate at only 0.5 per cent.

Table 9. Trends in production of selected aquaculture, Philippines, 1988-2002

Year	Milkfish		Tilapia		Prawns	
	Production (mt)	Growth rate (%)	Production (mt)	Growth rate (%)	Production (mt)	Growth rate (%)
1988	191,982	-	95,006	-	45,000	-
1989	195,712	1.9	101,648	7.0	47,900	6.4
1990	213,757	9.2	97,423	(4.2)	54,000	12.7
1991	237,122	10.9	96,332	(1.1)	51,430	(4.8)
1992	145,554	(38.6)	110,637	14.8	75,996	47.8
1993	148,965	2.3	96,339	(12.9)	86,096	13.3
1994	161,006	8.1	90,341	(6.2)	90,426	5.0
1995	150,858	(6.3)	81,182	(10.1)	88,850	(1.7)
1996	150,151	(0.5)	79,198	(2.4)	76,220	(14.2)
1997	158,500	5.6	91,831	16.0	40,102	(47.4)
1998	162,400	2.5	72,000	(21.6)	36,798	(8.2)
1999	180,800	11.3	83,800	16.4	37,900	3.0
2000	210,000	16.2	92,600	10.5	40,500	6.9
2001	225,300	7.3	106,700	15.2	40,700	0.5
2002[P]	232,000	3.0	122,400	14.7	35,500	(12.8)
Average	184,274	2.3	94,496	2.6	56,495	0.5

Source: The Food and Agriculture Centennial Book, UA and P, 2000.
Philippine Yearbook 2001 and 2002.
BAS, Selected Statistics on Agriculture, 1997.

From 1988 to 1994, which was the pre-trade liberalization period, growth in the milkfish industry was erratic. The declining growth rate observed from 1988 to 1995 was due to the shift to shrimp production of local milkfish growers and the shortage of milkfish fry (Guerrero, 2000). From 1996 to 2000 a rising trend in production growth rates was observed, but fell again in 2000.

Similarly, from 1989 to 1996, the tilapia industry experienced declining production trends due to limited supply of hybrid tilapia fingerlings for large-scale production. Production, however, grew by 16 per cent in 1997 but then declined by 22 per cent in 1998. Since then, production has again been on the rise.

On the other hand, prawn production showed average annual growth of 13 per cent from 1988 to 1994 attributed to its export demand. After 1994 however, production declined by an average of 9 per cent annually. This is because of losses due to diseases caused by aquatic pollution and the decline in export demand. Nevertheless, prawns still remain a top dollar earner for the country in terms of value.

Feed crops

Corn/maize

Two types of corn are produced in the Philippines - yellow and white corn. In general, yellow corn is used for feeds, while white corn is used for food. Corn area has been decreasing over the past 15 years, from 3.7 million ha in 1988 to 2.4 million ha in 2002 (Table 10). Domestic corn production has remained low at an annual average production of 4.4 million mt. This is insufficient to meet demand, specifically from the livestock and poultry sectors.

Compared with other Southeast Asian countries and the US, the Philippines' average yield for corn in 2002 was only 1.80 mt/ha (Table 11). Although yield levels for yellow corn have been increasing, those of white corn have been decreasing, hence the very low national average corn yield.

Table 10. Corn area harvested, production and yield, Philippines, 1988-2002

Year	Corn					
	Area harvested ('000 ha)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Yield (mt/ha)	Growth rate (%)
1988	3,745	-	4,428	-	1.18	-
1989	3,689	(1.5)	4,522	2.1	1.23	3.7
1990	3,820	3.5	4,854	7.3	1.27	3.7
1991	3,589	(6.0)	4,655	(4.1)	1.30	2.1
1992	3,331	(7.2)	4,619	(0.8)	1.39	6.9
1993	3,149	(5.5)	4,798	3.9	1.52	9.9
1994	3,006	(4.6)	4,519	(5.8)	1.50	(1.3)
1995	2,692	(10.4)	4,129	(8.6)	1.53	2.0
1996	2,736	1.6	4,151	0.6	1.52	(1.0)
1997	2,726	(0.4)	4,332	4.4	1.59	4.7
1998	2,354	(13.6)	3,823	(11.8)	1.62	2.2
1999	2,642	12.2	4,585	19.9	1.74	6.8
2000	2,510	(5.0)	4,511	(1.6)	1.80	3.6
2001	2,555	1.8	4,525	0.3	1.77	(1.4)
2002[P]	2,395	(6.2)	4,319	(4.5)	1.80	1.8
Average	**2,996**	**(2.9)**	**4,451**	**0.1**	**1.52**	**3.1**

Source: BAS.

Table 11. Corn yield comparison of Southeast Asian Countries and the US, 1988-2002

Year	Philippines	Malaysia	Thailand	Viet Nam	USA
1988	1.18	1.78	2.62	1.60	5.31
1991	1.30	1.75	2.71	1.50	6.82
1994	1.53	2.00	2.93	2.14	8.70
1997	1.59	1.85	3.20	2.49	7.95
2000	1.80	2.41	3.69	2.75	8.59
2002	1.80	3.04	3.68	2.86	8.16
Average	1.53	2.14	3.14	2.22	7.59

Source: FAO.

Since yellow corn is a primary feed ingredient, technological improvement is imperative. The recent commercialization of Bt corn, a genetically modified variety, after six years of field trials in the country, will provide the sector opportunities for improvement. This could help boost local supply and consequently keep pace with the growing livestock, poultry, and aquaculture sub-sectors.

The country is a net importer of corn. From 1991 to 1994, which was before the accession of the Philippines to the GATT-WTO, corn imports were low. This was the time when import restrictions were in place for the protection of local corn producers. Imports then dramatically increased in 1995 when the Philippines started to liberalize the corn sector by removing quantitative restrictions as required by WTO. Average imports of corn from 1995 to 2002 were 304,000 mt.

Table 12. Corn supply and utilization accounts, Philippines, 1988-2002

Year[r]	Supply ('000 mt)			Total supply	Utilization ('000 mt)						Total use	Closing stock
	Opening stock[1]	Production	Import		Export	Seed	Waste and processing	Feed	Food	Per capita (kg)		
1988	230.0	4,428.0	25.0	4,683.0	0.1	75.0	1,164.9	2,428.3	1,027.0	17.66	4,695.3	293.00
1989	293.0	4,522.2	173.0	4,988.2	0.1	74.0	1,145.9	2,513.1	1,130.0	18.98	4,863.1	138.20
1990	138.2	4,853.9	345.5	5,337.6	0.1	76.0	1,213.0	2,601.0	845.0	13.92	4,735.1	601.50
1991	601.5	4,655.0	0.3	5,256.8	20.1	72.0	1,164.0	2,677.0	864.0	13.85	4,797.1	459.30
1992	462.3	4,618.9	0.6	5,081.8	-	67.0	1,155.0	2,828.0	970.0	15.20	5,020.0	237.00
1993	235.1	4,798.0	0.7	5,033.7	0.0	63.0	1,200.0	2,954.0	1,009.0	15.45	5,226.0	204.40
1994	207.7	4,519.2	0.9	4,727.8	0.0	60.0	1,092.0	3,044.0	958.0	14.33	5,154.0	216.60
1995	217.3	4,128.5	208.0	4,553.8	0.1	54.0	963.0	3,254.0	735.0	10.71	5,006.1	189.50
1996	189.5	4,151.3	405.4	4,746.3	0.0	55.0	934.0	3,457.0	731.0	10.45	5,177.0	260.40
1997	260.4	4,332.4	307.6	4,900.4	0.0	55.0	939.0	3,631.0	756.0	10.57	5,381.0	322.70
1998	322.7	3,823.2	462.1	4,608.0	0.2	49.0	797.0	3,681.0	834.0	11.40	5,361.2	470.70
1999	470.7	4,584.6	149.5	5,204.8	0.1	53.0	917.0	3,480.0	885.0	11.84	5,335.1	237.90
2000	237.9	4,511.1	446.4	5,195.4	0.3	50.0	902.0	3,650.0	907.0	11.86	5,509.3	189.70
2001	189.7	4,525.0	171.8	4,886.5	0.2	50.0	905.0	3,725.0	943.0	12.10	5,623.2	177.40
2002	177.4	4,319.2	278.2	4,774.8	0.4	48.0	912.0	3,906.0	965.0	12.14	5,831.4	233.00
Average	282.23	4,451.37	198.34	4,931.93	1.43	60.07	1,026.92	3,188.63	903.93	13.36	5,180.98	249.03

Source: DA Corn Program.

Note: [a] Production less total use of corn.

Aside from corn's traditional uses as food and as animal feed, the commodity is also utilized by the manufacturing sector to produce industrial products such as ethyl alcohol, dextrose and glucose, to name a few. However, these products are currently imported and their local production has not yet been fully explored.

Data indicated that in terms of food consumption, the per capita intake of corn and corn products was decreasing from 1978 to 1987, but increased by 50 per cent thereafter.

In 1988, the shares of corn used as food and feed as a proportion of domestic production were 23 per cent and 55 per cent respectively (Table 12). Surprisingly, in 2002, the proportion of feed corn to local production of feed corn increased by 65 per cent from 1988 while food corn share declined by 4 per cent.

Palay

Palay is the most important cereal in the country and is a staple food of most Filipinos. Its by-product, rice bran, is considered as a major feed ingredient. The volume of rice bran is estimated to be 10 per cent of the total palay production. As of 2002, total rice harvested area was 3.6 million ha which is 31.5 per cent of the total area planted to crops (Table 13). The very low rice yield of only 2.89 mt/ha means that the annual average production of rice is only 10 million mt. Significant declines in production were observed in 1998 due to El Niño causing a 24 per cent drop in palay production. Improvements in yield have been observed throughout the 15-year period, with 2002 yield levels at 3.28 mt/ha due mainly to the introduction of hybrid rice. Compared with other Asian countries, the improvement in rice yield means that yield in the Philippines has come close to Viet Nam and has overtaken Thailand and Malaysia (Table 14).

Table 13. Rice area harvested, production and yield, Philippines, 1988-2002

Year	Rice					
	Area harvested ('000 ha)	Growth rate (%)	Production ('000 mt)	Growth rate (%)	Yield (mt/ha)	Growth rate (%)
1988	3,393	-	8,971	-	2.64	-
1989	3,497	3.1	9,459	5.4	2.70	2.3
1990	3,319	(5.1)	9,319	(1.5)	2.81	3.8
1991	3,425	3.2	9,673	3.8	2.82	0.6
1992	3,198	(6.6)	9,129	(5.6)	2.85	1.1
1993	3,282	2.6	9,434	3.3	2.87	0.7
1994	3,652	11.2	10,538	11.7	2.89	0.4
1995	3,759	2.9	10,541	0.0	2.80	(2.8)
1996	3,951	5.1	11,284	7.0	2.86	1.8
1997	3,842	(2.8)	11,269	(0.1)	2.93	2.7
1998	3,170	(17.5)	8,555	(24.1)	2.70	(8.0)
1999	4,000	26.2	11,787	37.8	2.95	9.2
2000	4,038	1.0	12,389	5.1	3.07	4.1
2001	4,065	0.7	12,955	4.6	3.19	3.9
2002	4,046	(0.5)	13,271	2.4	3.28	2.9
Average	3,642	1.7	10,572	3.6	2.89	1.6

Source: BAS

Table 14. Palay yield comparison of Southeast Asian Countries and the US, 1988-2002

Year	Philippines	Malaysia	Thailand	Viet Nam	USA
1988	2.64	2.53	2.15	2.96	6.18
1991	2.82	2.82	2.25	3.11	6.42
1994	2.89	3.06	2.35	3.57	6.69
1997	2.93	3.07	2.35	3.88	6.61
2000	3.07	3.06	2.62	4.24	7.04
2002	3.28	3.09	2.60	4.55	7.37
Average	2.94	2.94	2.39	3.72	6.72

Source: FAO.

Table 15. Rice supply and utilization accounts, Philippines, 1988-2002

Year	Supply ('000 mt)			Total supply	Utilization ('000 mt)						Total use	Closing stock
	Opening stock[1]	Production	Imports		Export	Seed	Feed and waste	Processing	Food	Per capita (kg)		
1988	1,575.0	5,867	181.0	7,623.0	-	166.4	381.0		5,557.6	95.5	6,105.0	1,518.00
1989	1,518.0	6,186	196.0	7,900.0	16.0	171.5	402.0		5,637.0	94.7	6,226.5	1,689.50
1990	1,689.5	6,095	605.5	8,390.0	-	162.8	396.0		5,931.9	97.7	6,490.7	1,899.30
1991	1,899.3	6,326	0.1	8,225.4	10.0	168.0	411.1		5,519.0	88.5	6,108.1	2,120.40
1992	2,120.4	5,970	0.6	8,091.3	35.1	156.9	388.1	238.8	5,578.5	87.4	6,397.3	1,673.10
1993	1,673.1	6,170	202.0	8,045.1	-	161.0	401.1	246.8	5,812.8	89.0	6,621.7	1,444.30
1994	1,444.3	6,892	0.2	8,336.4	-	179.1	448.0	275.7	5,931.5	88.7	6,834.3	1,497.80
1995	1,497.8	6,894	264.2	8,655.6	-	184.4	448.1	275.7	6,326.4	92.2	7,234.6	1,422.30
1996	1,422.3	7,379	866.9	9,668.7	0.0	193.8	479.7	295.2	6,906.9	98.7	7,875.6	1,793.00
1997	1,793.0	7,370	722.4	9,885.3	-	188.5	479.0	294.8	6,949.0	97.1	7,911.3	1,979.40
1998	1,979.4	5,595	2,170.8	9,745.1	0.0	155.5	363.7	223.8	6,715.1	91.8	7,458.1	2,279.30
1999	2,279.3	7,708	834.4	10,822.1	0.3	196.2	501.1	308.3	7,465.6	99.9	8,471.4	2,364.50
2000	2,364.5	8,103	638.8	11,106.0	0.2	198.1	526.7	324.1	7,890.8	103.1	8,939.9	2,166.10
2001	2,166.1	8,472	808.2	11,446.8	0.0	199.4	550.7	338.9	8,072.7	103.6	9,161.7	2,285.10
2002	2,285.1	8,679	1,196.2	12,160.3	0.0	198.5	564.1	347.2	8,441.2	106.2	9,551.0	2,609.30
Average	1,847.14	6,913.78	579.15	9,340.06	4.11	178.66	449.35	288.12	6,582.39	95.62	7,425.80	1,955.84

Source: BAS.

Rice is consumed mainly as food. Other secondary uses such as for processing and feeds comprise only 5 per cent of the total rice supply (Table 15). Although the country exported rice during its self-sufficient years of 1991, 1992 and 1994, the Philippines remains a net importer since local production needs to be augmented to meet domestic demand. Mangabat (1998) noted that the "deficiency years were associated with the occurrence of severe droughts, typhoons and floods. Conversely, the surplus years were related with periods of relatively good weather (Mangabat, 1998)." This shows how the performance of local feed crop production has been very vulnerable to changing weather patterns.

Meanwhile, based on the surveys conducted by FNRI, per capita consumption for rice and rice products was declining at an average rate of 3 per cent for the survey years 1978-1993. In 1993, per capita intake of rice among Filipinos was 282 g per day. This situation proved that although production was increasing, "to some extent, deficiencies in the domestic supply of paddy rice were absorbed by the food sector" (Mangabat, 1998) during those years. However, succeeding years after this period show a rising trend of per capita intake of rice.

Soybean

Soybean is a minor crop in the country, cultivated mainly on small-scale and multi-crop farms. For the past 15 years, the average area planted with soybean was only 2,032 ha with production at 2,224 mt (Table 16). Both area and production were observed to be decreasing as of the mid 1990's. Productivity was low because of the high cost of inputs and low levels of technology adoption (low input use) of farmers which translated to low yield growth. As of 2002, yield was only 1.27 mt/ha, the lowest compared with other Southeast Asian countries and the US. Thailand's yield was higher than the Philippines by 11.5 per cent and Viet Nam by 0.4 per cent (Table 17). The US, the major supplier of soybean products to the country had a yield double that of the Philippines.

Table 16. Soybean area harvested, production and yield, Philippines, 1988-2002

Year	Soybean					
	Area harvested (ha)	Growth rate (%)	Production (mt)	Growth rate (%)	Yield (kg/ha)	Growth rate (%)
1988	5,154	-	6,000	-	1,164	-
1989	4,753	(7.8)	3,939	(34.4)	829	(28.8)
1990	4,050	(14.8)	3,499	(11.2)	864	4.2
1991	2,116	(47.8)	2,284	(34.7)	1,079	24.9
1992	1,652	(21.9)	1,809	(20.8)	1,095	1.4
1993	1,772	7.3	2,133	17.9	1,204	9.9
1994	1,888	6.5	2,361	10.7	1,251	3.9
1995	2,292	21.4	2,983	26.3	1,301	4.1
1996	1,547	(32.5)	1,818	(39.1)	1,175	(9.7)
1997	1,245	(19.5)	1,615	(11.2)	1,297	10.4
1998	869	(30.2)	1,048	(35.1)	1,206	(7.0)
1999	856	(1.5)	1,041	(0.7)	1,216	0.8
2000	774	(9.6)	953	(8.5)	1,231	1.2
2001	737	(4.8)	897	(5.9)	1,217	(1.2)
2002[P]	776	5.3	985	9.8	1,269	4.3
Average	2,032	(10.7)	2,224	(9.8)	1,160	1.3

Source: CGPRT Crops in the Philippines: A Statistical profile, 2001.
BAS.
FAO.

Table 17. Soybean yield comparison of Southeast Asian Countries and the US, 1988-2002

Year	Philippines	Thailand	Viet Nam	USA
1988	1.15	1.32	0.83	1.82
1991	1.09	1.37	0.79	2.30
1994	1.33	1.33	0.94	2.78
1997	1.20	1.43	1.06	2.62
2000	1.23	1.38	1.20	2.56
2002	1.27	1.42	1.27	2.54
Average	1.21	1.37	1.02	2.44

Source: FAO.

On average, local soybean production accounts for only 4 per cent of the total supply. Imports have perennially supplied the domestic needs of the country (Table 18). Soybean is primarily used as an ingredient in the processing of sauces, curds, snack foods, milk and edible oil. Thus, the processing sector uses 73 per cent of the total soybean supply. Soybean used as food comprises 26 per cent, while for feed and waste less than 1 per cent of the total supply. The waste material from processing soybean, however, is used as a main ingredient in the formulation of feeds.

Table 18. Soybean supply and utilization accounts, Philippines, 1988-2002

Year	Supply (mt)			Utilization (mt)						
	Production	Imports	Total supply	Export	Seed	Feed and waste	Processing	Food	Per capita (kg)	Total use
1988	6,000	24,000	30,000	1,000	-	145	21,170	7,684	0.13	29,999
1989	3,939	28,758	32,697	46	-	163	23,835	8,639	0.15	32,683
1990	3,499	24,036	27,535	41	13	137	20,071	7,272	0.12	27,535
1991	2,284	63,247	65,531	-	10	328	47,838	17,356	0.28	65,532
1992	1,809	51,893	53,702	-	7	269	39,202	14,224	0.22	53,701
1993	2,133	61,567	63,700	-	8	319	46,501	16,873	0.26	63,700
1994	2,361	135,523	137,884	-	8	689	100,655	36,531	0.55	137,883
1995	2,983	86,877	89,860	-	10	449	65,598	23,803	0.35	89,860
1996	1,818	137,785	139,603	-	7	698	101,910	36,988	0.53	139,603
1997	1,615	111,052	112,667	-	6	563	82,247	29,851	0.42	112,668
1998	1,048	148,241	149,289	-	4	746	108,981	39,558	0.54	149,289
1999	1,041	262,594	263,635	-	4	1,318	192,454	69,859	0.93	263,635
2000	953	249,185	250,138	-	3	1,251	182,601	66,283	0.87	250,138
2001	897	315,165	316,062	-	3	1,580	230,725	83,753	1.07	316,061
2002	985	257,101	258,086	-	3	1,290	188,403	68,389	0.86	258,085
Average	2,224	130,468	132,693	72	6	663	96,813	35,137	0.48	132,691

Source: BAS.

The feed milling industry

Production capacity

As of 2002, there were 425 registered feed mills in the country, 300 of which are classified as commercial (Table 19). The rest consisted of home mixers and integrators. The number of participating feed-related establishments (mixed feed and feedstuff manufacturers, importers, suppliers, distributors, retailers) in the feed milling industry totaled 4,560 in the same year. Of these, 76 per cent consisted of feed distributors and retailers.

The total rated capacity of all registered feed mills was 20,483.91 mt per eight-hour shift (AFDS, BAI, 2002). Eighty two per cent of this was the registered rated capacity of large-scale feed millers (above 50 mt). On the other hand, those which had rated capacities of 20-50 mt and below 20 mt had a 12 per cent and 6 per cent share of total production capacity respectively. The majority of total registered commercial feed mills belong to those whose production

capacity are less than 20 mt (Table 20), followed by large commercial feed mills with 28 per cent.

Table 19. Registered feed establishments, Philippines, 2002

Establishment	2002
Commercial (mixed) manufacturer	300
Non-commercial manufacturer	125
Feed ingredient manufacturer	69
Importer	369
Supplier	220
Distributor	1,027
Retailer	2,450
Total	4,560

Source: AFSD, BAI.

Table 20. Number of commercial feed mills by size, Philippines, 1990-2002

Rated capacity per 8-hr shift	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
20 and below	124	118	146	171	141	138	106	131	132	132	162	136	143
20.1 - 50	33	43	47	53	55	59	64	68	69	69	74	73	72
50.1 and above	23	28	24	28	31	52	52	69	73	79	83	80	85
Total	180	189	217	252	227	249	222	268	274	280	319	289	300

Source: AFSD, BAI.

For the period 1990-1993, there was an increasing number of commercial feed mills. In 1994 this number declined by 10 per cent because of the Foot and Mouth Disease (FMD) outbreak in swine creating an unstable demand for feed. Since 1995, the number of feed mills has increased, except for a 9 per cent decline in 2001 attributed to the significant depreciation of the peso (AFSD, BAI, 2002). This was because the industry relies highly on imported feed ingredients such as soybean and soybean by-products, wheat and corn meal.

According to BAI (2002), the feed millers have to form associations in order to achieve certain efficiencies and effect some cost savings. In fact, the top ten feed producers are members of the Philippine Association of Feed Millers.

As of 2002, the majority (66 per cent) of the commercial feed mills were located in Luzon, particularly in Central Luzon (30 per cent), Southern Tagalog (22 per cent), and the National Capital Region (14 per cent) (Table 21). These mills had the highest rated capacities per eight hour shift. However, over half of the corn produced in the Philippines comes from Mindanao. Cagayan Valley, the only major corn producing area in Luzon accounts for 25 per cent of total production. Despite this, feed millers locate their plants in Luzon because most of the commercial livestock raisers are in this area. The millers therefore are able to save on transportation costs. In addition, the peace and order situation in Mindanao also contributed to this decision.

Table 21. Geographical distribution of commercial feedmills, rated capacities and corn production by region, 2002

Regions		Capacity		Rated capacity/ 8hr Shift	Distribution	Corn production* ('000 mt)
		No.	%			
NCR		41	13.67	4,555.00	22.37	0.00
I.	Ilocos	8	2.67	1,542.00	7.57	182.27
II.	Cagayan Valley	6	2.00	500.00	2.46	832.33
III.	Central Luzon	89	29.67	7,009.16	34.42	122.67
IV.	Calabarzon/Mimaropa	67	22.33	3,307.50	16.24	103.66
V.	Bicol	10	3.33	332.00	1.63	73.86
VI.	Western Visayas	12	4.00	466.00	2.29	87.25
VII.	Central Visayas	24	8.00	1,311.05	6.44	167.16
VIII.	Eastern Visayas	3	1.00	100.50	0.49	49.67
IX.	Zamboanga Peninsula	4	1.33	57.50	0.28	135.19
X.	Northern Mindanao	8	2.67	228.00	1.12	701.02
XI.	Davao Region	17	5.67	775.60	3.81	181.84
XII.	Soccsksargen	10	3.33	177.00	0.87	885.02
XIII.	Caraga	1	0.33	2.00	0.01	68.24
Total		300	100	20,363.31	100	3,590.18

Source: AFDS, BAI, BAS.

* Total corn production does not add up to BAS corn production data of 4.3 mt of corn (2002). The reason for this is that the regions of ARMM and CAR were not included because they are white corn producers.

Local feed ingredient production

A shift in the production of ingredients for feeds was observed from 1988 to 2001 in favour of zeolite (Table 22). While local feed production using feed supplements/additives/ premixes, and bone meal remained stable, the use of copra meal, corn and corn by-products and minerals substantially decreased. The use of ipil ipil and yeast was discontinued.

Despite the decline in the domestic production of major feed ingredients, the livestock and poultry sectors were able to register positive growth in the past decade, relying on feed substitutes (e.g. wheat). Even wheat for food, which were levied lower tariffs was also used.

Table 22. Local feed ingredient production (in mt), Philippines, 1988-2001

Feedstuff	1988	1992	1997	2001[p]
Feed supplement/ additives/premixes	4,514.00	1,962.20	1,822.38	3,879.42
Bone meal	-	783.40	412.50	679.22
Copra meal	30,521.85	14,031.87	446.00	699.44
Corn and corn products	17,225.00	15,764.21	8,312.96	8,221.42
Fish meal	3,823.03	3,636.45	1,504.05	2,792.40
Ipil ipil	435.00	490.91	-	-
Minerals	16,653.18	3,231.00	6,665.47	7,299.47
Yeast	14.00	1,948.06	-	-
Zeolite	-	1,884.00	5,407.69	4,007.21

Source: AFSD, BAI.

Mixed feed production

In keeping with the growth of the livestock and poultry sectors, the production of commercial mixed feed also steadily grew by 15 per cent from 1988-1999 (Table 23). Highest growth was registered in 1997, where a 48 per cent increase from the previous year's production was observed. This coincided with the increase in the number of feed mills by 21 per cent during the same period. However, in 2000 a decline of 51 per cent from 1999's production was observed because of the downsizing of the poultry industry and the slump in yellow corn production.

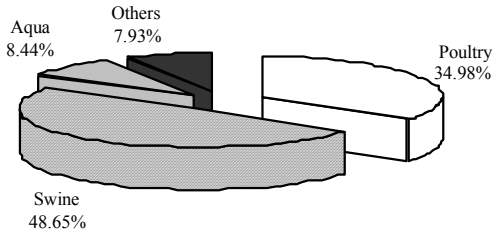
Table 23. Commercial mixed feed production, Philippines, 1988-2002

Year	Production (mt)	Growth rate (%)
1988	932,920	-
1989	962,467	3.17
1990	1,061,079	10.25
1991	1,178,960	11.11
1992	1,362,856	15.60
1993	1,468,545	7.76
1994	1,546,263	5.29
1995	1,637,982	5.93
1996	1,837,162	12.16
1997	2,714,476	47.75
1998	2,854,915	5.17
1999	3,644,433	27.65
2000	1,768,604	(51.47)
2001	2,081,050	17.67
2002	2,925,522	40.58
Average	1,865,149	11.33

Source: Animal Feeds Standard Division (AFSD), Bureau of Animal Industry (BAI).

From 2000-2002, an average increase of 29 per cent annually was posted by the mixed feed sector. The total amount of mixed feed produced amounted to 2.9 million mt as of 2002. During the said period, swine feeds dominated commercial mixed feed production (49 per cent), followed by poultry feeds (35 per cent) and aquaculture feeds (8.5 per cent) (Figure 3). Specialty feeds for cattle, carabao (water buffalo), duck, quail and monkey, among others accounted for 8 per cent of the rest of the mixed feed production.

Figure 3. Commercial feed production by type, Philippines, 2002



Source: Author's own calculation.

Aquaculture and other feeds registered the highest average annual growth at 27 per cent and 25 per cent respectively, from 1988-2002 (Table 24). Poultry feeds, on the other hand, registered an annual growth of 10 per cent, while swine feeds experienced a 16 per cent growth rate.

Table 24. Commercial feed production by type of feed, Philippines, 1988-2002

Year	Poultry		Swine		Aqua		Others		Total	
	Volume (mt)	Growth (%)	Volume (mt)	Growth (%)	Volume (mt)	Growth (%)	Volume (mt)	Growth (%)	Volume (mt)	Growth (%)
1988	457,754		387,759		28,057		66,649		940,220	
1989	442,780	(3.27)	436,905	12.67	27,910	(0.52)	54,872	(17.67)	962,467	2.37
1990	431,483	(2.55)	502,040	14.91	42,658	52.84	84,898	54.72	1,061,079	10.25
1991	503,308	16.65	499,843	(0.44)	57,497	34.79	118,312	39.36	1,178,960	11.11
1992	548,090	8.90	614,149	22.87	54,074	(5.95)	146,541	23.86	1,362,855	15.60
1993	509,358	(7.07)	602,629	(1.88)	55,496	2.63	178,306	21.68	1,345,788	(1.25)
1994	564,408	10.81	596,197	(1.07)	60,645	9.28	173,012	(2.97)	1,394,262	3.60
1995	805,448	42.71	437,912	(26.55)	92,947	53.26	205,575	18.82	1,541,882	10.59
1996	912,826	13.33	505,565	15.45	100,060	7.65	233,824	13.74	1,752,274	13.65
2000	617,708	(32.33)	952,239	88.35	69,934	(30.11)	58,723	(74.89)	1,698,604	(3.06)
2001	812,905	31.60	1,000,011	5.02	140,224	100.51	127,909	117.82	2,081,050	22.52
2002	1,023,344	25.89	1,423,126	42.31	246,999	76.15	232,053	81.42	2,925,522	40.58
Average	635,784	9.51	663,198	15.60	81,375	27.32	140,056	25.08	1,520,413	11.45

Source: AFDS, BAI.
Note: For the years 1997-1999 lost data/unavailable.

Problems confronting the feed milling sector

The Livestock Development Council (LDC) sums up the major problem of the feed milling industry into two aspects: the shortage of raw materials and the problems in procurement of these raw materials.

Shortages of raw materials such as corn is the most important problem of the feed milling industry. This problem widens the gap between supply and demand for feeds, resulting in rising prices for the inputs. The situation is further aggravated by the lack of storage facilities at the feed milling companies. The uncertainty of raw materials from domestic sources (e.g. corn) has caused the underutilization of feed mills.

Small-scale feed millers have difficulty in procuring raw materials. Although NFA is supposed to ensure availability to all, it is usually the big feed milling firms that benefit from the government procurement system for grains. Other procurement-related problems cited by the LDC include volatility of prices due to seasonal supply and perishability of stocks; tight credit, giving companies very little elbow room for adjustments in financial allocations since some suppliers of feed ingredients prefer cash on delivery; late delivery, affecting the operations of the company and causing additional expenses as some companies opt to collect the supplies; and adulteration, including adding low protein fish meal to high protein content fish meal, adding starch to amino acids and vitamin-mineral premixes and adding sand, soil and wire to raw materials to increase the weight and receive higher compensation.

Policies affecting the agro-industrial and feedstuff processing industries

Like other countries, the feed control programme of the Philippines has three phases: laws, regulations and administrative procedures. These three are closely tied together and are used in safeguarding feed users and ultimately public consumers (PCARRD). In the Philippines the major provisions of the feed law are: (1) Registration and guarantees; (2) Labeling; (3) Creation of the Animal Feed Control Division (currently called the Animal Feeds Standard Division by virtue of Executive Order no. II-6 promulgated in 1986) and Animal Feed Control Advisory Committee (now the Animal Feed Standardization Committee) in the Bureau of Animal Industry (BAI); (4) Inspection and sampling; (5) Laboratory analysis and publication of results; (6) Quality control services; and (7) Penalties and other enforcement procedures.

The BAI is mandated to implement these laws and regulations that affect the agro-industrial and commercial feed industry. These are:

1. R.A. 1556, known as the "Livestock and Poultry Feeds Act," and its implementing rules and regulations (Animal Industry Administrative Order Nos. 35, 35A and 40; and General Memorandum Order No. 1);
2. R.A. 3720, as amended by Executive Order No. 175, otherwise known as the "Food, Drugs and Devices and Cosmetics Act," and its implementing rules and regulations; and
3. R.A. 6675, better known as the "Generic Acts of 1998".

These laws and regulations are administered and implemented by the Secretary of Agriculture through the Director of the BAI. On the other hand, the Animal Feeds Standards Division (AFSD) of BAI oversees the manufacture, importation, distribution, advertisement and sale of livestock, poultry, aqua and specialty feeds, veterinary drugs, and chemical feed additives.

"Veterinary drugs and products: are defined under R.A. 3720, as amended by Executive Order No. 175, as "any substance, including biological products, applied or administered to food-producing, companion, aquatic, laboratory and exotic animals, whether used for therapeutic, prophylactic or diagnostic purposes or for medication of physiologic functions or behaviours." This law is described to be more "comprehensive and all-embracing than R.A. 1556, as amended, when it comes to coverage, registration and quality control procedures" (PCARRD).

Agricultural policies

Republic Act 8435 or the Agriculture and Fisheries Modernization Act (AFMA) is the main law aiming to strengthen the agriculture and fishery sectors. The act hopes to achieve this through modernization, greater participation of stakeholders, food security and food self-sufficiency, private sector participation, and people empowerment (DA, 2001).

The Ginintuang Masaganang Ani (GMA) is the banner programme of the Department of Agriculture of the Philippines in order to actualize AFMA. It has several programme components that include production support services, research and development, infrastructure, rural finance, marketing support services, training extension, and programme organization and management. Also, the GMA programme has commodity specific programmes like GMA-Corn, GMA-Livestock, and GMA-Rice, among others. Ultimately, this programme aims to achieve modernized and productive agriculture and fishery sectors able to provide food at affordable prices to all (DA, 2001). However, budgetary constraints hamper the implementation of some sub-programme components.

General marketing and trade policies

Monetary and exchange rate policies

In the 1970s through the early 80s, the government adopted a fixed exchange rate policy in order to promote the growth of the industrial sector which was import-dependent for its inputs. This industry-biased policy negatively affected growth in the agricultural sector. Thus, in the late 1980s and 90s the government started to implement liberalization policies. Currently, the country maintains a managed exchange rate float and inflation rate targeting policy.

State trading enterprise

The sole state enterprise responsible for the procurement and distribution governing the grain sub-sector is the National Food Authority (NFA). It is also the only body with a strong price policy mandate specifically on palay. It also involves actual procurement from small farmers to farmer organizations with a government support price. Likewise, this institution is tasked to monitor and enforce other rules and regulations for the grains business. The NFA is

the government body with the mandate of ensuring stable prices of grains that will be beneficial to both consumers and producers.

Trade policies

Three major trade agreements that are crucial to the agricultural sector are the ASEAN Free Trade Area (AFTA), the Asia Pacific Economic Cooperation (APEC), and the General Agreement on Tariffs and Trade-Uruguay Round (GATT-UR). However, GATT implementation is currently encountering some problems. A contentious issue between developed and less developed countries concerns the subsidies of developed nations to their agricultural sectors.

In general, the Philippines has been complying with its external commitments on the trade agreements. These include provisions on market access and sanitary and phytosanitary measures (SPS). However, the country is lagging behind its domestic commitments, especially on infrastructure support and safety nets to the agricultural sector.

Impact of trade policies on rice

Before the GATT-UR, AFTA-CEPT, and APEC, the Philippine government imposed non-tariff or quantitative restrictions (QRs) on rice importation to protect domestic producers. These QRs were put in place through Presidential Decree (PD) No. 4 and were "reinforced by the Magna Carta for Small Farmers in 1992 (Mangabat, 1998). Mangabat (1998) also cites Department of Agriculture Administrative Order No. 23 issued in 1993 imposing QRs on products directly competing with local produce which included rice and rice products. The rice industry is very much a protected industry. It's tariffication under the WTO was delayed and the Philippines invoked Annex 5 of the WTO agreement, which allows a member country to defer tariffication of QRs for politically sensitive staple foods. On the other hand, high import tariff rates were requested under the AFTA-CEPT. Rice QRs scheduled to be removed and replaced with tariffs in 2004 in compliance with GATT-UR commitments. Under the AFTA-CEPT, no final tariff schedule has been arrived at. The DA though, recommends a beginning tariff rate of 100 per cent in 2005 and ending tariff rate of 50 per cent by 2010 (Mangabat, 1998). Also, only the National Food Authority has the legal mandate to import rice.

Reviewing data on domestic and world rice prices would show that in 2002, the domestic price of rice was 108 per cent higher than world prices (BAS). Given this trend, rice farmers cannot be expected to compete even at high tariffs. A criticism leveled against the government is the lack of proper implementation of safety nets intended to give farmers a chance to compete under an open trade regime. Therefore, a few academicians, policy experts and vocal NGOs, expect a huge loss on the part of farmers if safety net concerns are not addressed. Trade liberalization policies would certainly be disadvantageous to the welfare of rice-based farmers in the country. "Policy simulation results of trade liberalization indicated a significant reduction in farm wealth, which would further impoverish poor farmers," (Brown *et al*., 2003). On the other hand, prolonging the protection of rice puts consumers at a disadvantage because of the higher price of rice. Thus, the role of the government in balancing policies is crucial. Policy directives of the government should aim to lessen the negative impact of trade liberalization on farmers while at the same time considering the interests of the consumers.

Impact of trade policies on corn

Similarly with rice, corn was protected through QRs before the trade liberalization policies of the government. Due to the importance of corn as a primary feed ingredient, it had strong lobbyists (especially livestock and poultry producers) for accelerating liberalization in

this sector. Corn farmers, on the other hand, argue their right to unfair competition and argue for government protection and support.

Unlike rice, corn import liberalization policy used minimum access volume tariff bindings (MAVs) with in-quota and out-quota tariffs. Corn MAV for 2004 is 216,940 mt with 35 per cent tariff. Although corn imports have been liberalized, NFA still imports the bulk of corn for feed.

Corn farmers are also expected to be unable to compete under a liberalized trading regime. Like rice farmers, the problem is related to the lack of infrastructure support. Agrisource (2001) conducted a study to determine the potential benefits and losses from liberalizing corn. Results indicated that the gains from liberalizing corn trade far outweigh the losses. The gains mainly are due to the potential livestock and poultry expansion as a result of cheaper corn prices. What is crucial is properly attending to the losses of farmers to avoid any destabilizing effects on the economy.

Impact of trade policies on soybean

At present there are only a few soybean farmers, therefore no adverse impact is foreseen on them. The challenge would be more on how to develop a potential soybean industry. Given that soybean is fairly liberalized and is a major feed input, raising import tariffs to encourage domestic production may have more disadvantages than advantages. It is thus important for the government to thoroughly review first the benefits and costs of trying to develop a local soybean industry.

Demand for and supply of feed crops

Demand of feed crops

Consumption structure and characteristics

This section focuses on the consumption structure of primary feed crops in the Philippines.

Corn. Sixty to 70 per cent of the corn supply (local and imported) in the country, particularly yellow corn, is consumed as feed for the livestock and poultry industries while about 15 to 25 per cent is consumed as food. Corn is also utilized in the manufacturing or processing industry as starch, gluten, alcohol, cooking oil and snack foods.

In recent years, consumption of corn as feeds has been increasing while consumption as food has been decreasing. This is primarily because corn is only a secondary staple in the country (Costales, 1995) and considered as an inferior good (Bouis, 1991). Thus, as long as food demand for corn is limited to being a staple, as in the case of white corn, no other sources of expansion in demand aside from population growth would seem to raise demand for corn as food (Costales, 1995).

The main source of variation in demand for white corn has been the changes in the market for yellow corn (Costales, 1995). In times of surges in demand but where imports were not allowed to systematically respond, local feed millers resorted to white corn to fill their requirements in place of yellow corn, thus driving up the demand and prices of white corn (Costales, 1995).

On the contrary, due to the fact that yellow corn is a major component in livestock and poultry feeds, resources, efforts and policy directives were focused on improving its efficiency in production. And given the increasing demand for poultry, pork, and egg products there would be an increasing demand for yellow corn and the other feed crops.

Palay. Rice is primarily consumed as food and remains to be the staple food of approximately 80 per cent of Filipinos (PCARRD, 2002). It accounts for about 35-65 per cent of

the total calorie intake of households in the country (David and Balisacan, 1995 as cited by PCARRD, 2002).

Although rice production has been increasing by 3.6 per cent annually, it is still unable to keep pace with the growing demand of the increasing population which is increasing by 2.3 per cent per annum. Other factors include trade liberalization, continued conversion of rice lands for industrial and urban use (PCARRD, 2002), and high per capita consumption (103 kg/year). This has made the country dependent on imports to fill the supply deficits.

On the other hand, rice consumed as feed was limited to brown rice and rough rice and its by-products, which include rice bran, rice middling and rice polishing. Rice bran, at 10 per cent of paddy weight (Cruz, 1997), is the most common and abundantly utilized rice by-product in feed formulations of the livestock and poultry industries. However, no data was available on rice bran consumption in the country.

Soybean. Soybean demand is almost entirely derived from the demand for its processed products. The bulk of the demand for soybean comes from the processors, who "crush" the beans into oil and meal. In the Philippines however, imported soybean, which constituted the bulk of the local supply was mainly used as raw materials in manufacturing mixed feed and feed ingredients (BPRE, 2004). As of 2002, soybean meal constituted 83 per cent of the total imported soybean and soybean products. This was equivalent to 1,273 million mt of soybean meal.

The majority of demand for soybean meal comes from the livestock and poultry industries. This feed ingredient satisfies 90 per cent of the basic protein and amino acid requirements of poultry, hog and cattle sub-sectors (Soybean Market Overview, 2004).

Soybean oil is also highly imported and predominantly used as an input to the processed food industry. Margarine, shortening, salad oils and cooking oils usually contain some soybean oil in the form of edible oils (Soybean Market Overview, 2004).

Aside from being processed as oil, demand for soybean as food may be as follows but not limited to, "an ingredient in the preparation of a variety of fresh, fermented and dried food products like milk, tofu, tempeh, miso yuba, soya sauce, ice cream, bean curd and bean sprouts" (BPRE, 2004). Moreover, it is also the main raw material in processing "taho" or soy curd - a popular snack food in the country.

Consumer price behaviour

Trends in wholesale and retail prices of corn, palay and soybean are illustrated in Figures 4 and 5 respectively.

Corn. Wholesale price of corn increased at 10 per cent per annum from 1982 to 2002. In contrast, world prices, quoted at US yellow corn f.o.b. gulf port, declined by 20 per cent for the same period (Table 25). Comparison of the wholesale domestic prices of yellow corn with its economic parity prices (i.e. export f.o.b. prices multiplied by the official exchange rate of the year) revealed that, on average, domestic prices of yellow corn were double that of the export parity prices (Gonzales, 2000). This reflected the high corn price protection in the country and the evident price uncompetitiveness.

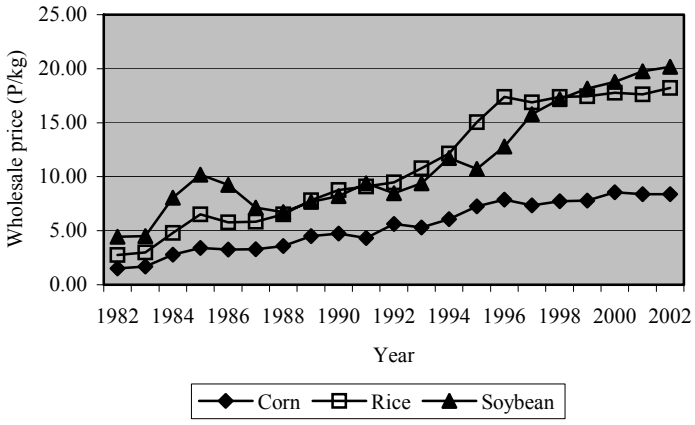
Domestic retail prices of corn exhibited a similar trend as wholesale prices rising at 10 per cent annually. Compared with white corn, yellow corn retail prices were higher by 5 per cent, on average, for the last two decades.

Rice. The domestic wholesale and retail price of rice both increased annually by 11 per cent over the last two decades. It was interesting to observe that the 2002 nominal wholesale price was 560 per cent higher than the 1982 level. This was in contrast to the 31 per cent decrease in export prices (f.o.b.) quoted in Thailand. Thus, a large gap between local and world prices is evident. On average, the price of locally produced rice was 73 per cent higher than world prices. As shown in Table 25 there was a general decline in world prices of cereals.

Soybean. In general, domestic wholesale prices of soybean increased by 9 per cent per year. Trends reveal that prices in 2002 had increased by as much as 354 per cent over the 1982 level. This was contrary to the decline in world prices (f.o.b.) quoted at US Gulf port. Much like corn and rice, the country is uncompetitive in producing soybean as shown in the price ratio of domestic wholesale and world prices of soybean. On average, domestic wholesale prices were higher by 72 per cent than world prices.

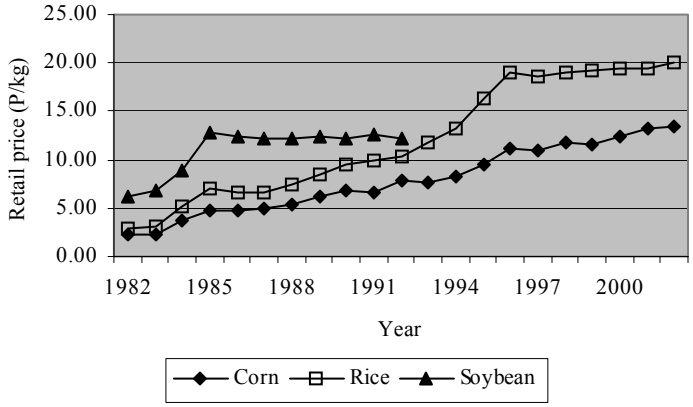
Similarly, the domestic retail price of soybean followed the trend of wholesale price. Although the data available for retail prices was only for the years 1982-1991, it was observed that the retail increased by 8 per cent over the said 10-year period.

Figure 4. Trends in wholesale prices (nominal) of selected feed crops, Philippines, 1982-2002



Source: Author's own calculation.

Figure 5. Trends in retail prices (nominal) of selected feed crops, Philippines, 1982-2002



Source: Author's own calculation.

Table 25. Wholesale domestic and export parity prices of selected feed crops, Philippines, 1982-2002

Year	Wholesale price (P/mt) (A)			Export price ($/mt) (B)			Official exchange rate (P/$) (C)	Economic export parity price (P/mt) (D)			Ratio (A/D)		
	Yellow corn	Rice	Soybean	Yellow corn[a]	Rice[b]	Soybean[c]		Yellow corn	Rice	Soybean	Yellow corn	Rice	Soybean
1982	1,590	2,760	4,450	113	247	265	8.54	965	2,109	265	1.65	1.31	1.97
1983	1,780	2,990	4,510	140	243	264	11.11	1,555	2,700	264	1.14	1.11	1.54
1984	2,920	4,810	8,070	140	233	263	16.70	2,338	3,891	263	1.25	1.24	1.84
1985	3,540	6,510	10,190	116	198	262	18.61	2,159	3,709	262	1.64	1.76	2.09
1986	3,480	5,790	9,240	95	178	261	20.39	1,928	3,613	261	1.80	1.60	1.74
1987	3,660	5,840	7,150	90	203	259	20.57	1,850	4,174	259	1.98	1.40	1.34
1988	3,940	6,520	6,710	108	272	258	21.09	2,278	5,736	258	1.73	1.14	1.23
1989	4,470	7,820	7,660	112	290	257	21.74	2,438	6,313	257	1.83	1.24	1.37
1990	4,800	8,770	8,210	109	249	256	24.31	2,649	6,053	256	1.81	1.45	1.32
1991	4,400	9,100	9,400	107	228	255	27.48	2,940	6,265	255	1.50	1.45	1.34
1992	5,990	9,480	8,460	104	229	254	25.51	2,654	5,842	254	2.26	1.62	1.31
1993	5,600	10,780	9,400	101	191	253	27.12	2,736	5,191	253	2.05	2.08	1.37
1994	6,200	12,130	11,730	108	219	214	26.42	2,847	5,772	214	2.18	2.10	2.07
1995	7,400	15,040	10,720	124	290	219	25.71	3,176	7,462	219	2.33	2.02	1.90
1996	7,710	17,390	12,810	166	276	226	26.22	4,346	7,224	226	1.77	2.41	2.16
1997	7,630	16,880	15,800	117	247	224	29.47	3,451	7,273	224	2.21	2.32	2.39
1998	8,320	17,400	17,191	102	250	223	40.89	4,171	10,211	223	1.99	1.70	1.89
1999	8,470	17,460	18,170	75	252	225	39.09	2,945	9,858	225	2.88	1.77	2.07
2000	9,200	17,770	18,785	70	180	229	44.19	3,094	7,955	229	2.97	2.23	1.86
2001	9,430	17,610	19,754	70	150	234	50.99	3,569	7,649	234	2.64	2.30	1.66
2002	8,910	18,210	20,184	90	170	240	51.60	4,644	8,773	240	1.92	2.08	1.63

Sources: Selected Statistics on Agriculture various issues, BAS.
World Bank.

Note: [a] f.o.b. Gulf prices.
[b] f.o.b. Bangkok prices.
[c] f.o.b. Gulf prices.

Consumption response to market forces

This section discusses the demand responses for food, feed and other uses of corn, palay and soybean to market forces for the years 1982-2002. Table 26 shows the summary of the demand runs for this study. Three separate functions were used to analyze total demand for each crop: demand for food, demand for feed and demand for other uses.

Table 26. Results of the demand analysis of the feed crops, Philippines, 1982-2002

Independent variable	Food			Feed			Other uses		
	Corn[a]	Palay	Soybean	Corn[a]	Palay	Soybean	Corn[a]	Palay	Soybean
Constant	27.73***	-6.06***	-122.82***	7.52***	18.37***	-44.09***	23.67***	-41.88***	1.0***
	(11.472)	(-2.599)	(-7.555)	(5.873)	(6.808)	(-6.517)	(6.628)	(-3.752)	(435.920)
Corn retail price	-0.31*	0.44**							
	(-1.673)	(2.377)							
Palay retail price	-0.81***	-0.09[ns]							
	(-3.737)	(-0.586)							
Soybean wholesale price			-0.34[ns]			0.12[ns]			
			(-0.681)			(0.283)			
Population		1.36***	5.30***						
		(12.299)	(5.432)						
Per capita GDP/income	-0.47**	0.36**	4.83***						
	(-1.993)	(2.453)	(3.398)						
Corn wholesale price				-0.08[ns]					
				(-0.545)					
Palay wholesale price $_{(t-1)}$					-0.31[ns]				
					(-1.353)				
Egg production					-1.57***				
					(-3.309)				
Poultry production				0.22*	1.12***	2.78***			
				(1.862)	(2.895)	(9.409)			
Pork production				0.47***	0.46*				
				(3.904)	(1.828)				
Corn feed and food use							-0.45***		
							(-4.736)		
Palay feed and food use								2.54***	
								(3.342)	
Soy feed and food use									1.00***
									(7304.34)
Corn Area							0.48***		
							(4.353)		
Palay Area								0.26[ns]	
								(0.185)	
R^2 (%)	65.4	95.9	89.2	96.3	82.6	89.3	92.2	71.1	100
Significance of model	***	***	***	***	***	***	***	***	***

Source: Author's own calculation.

Corn

Corn food demand: $lnQ_{food} = 27.73 - 0.31\ lnRP_{corn} - 0.81\ lnRP_{palay} - 0.47\ lnINC$

The explanatory variables included in the corn food demand model were real retail prices of corn and palay, and per capita GDP. These variables explained 65 per cent of the variability in the demand for corn as food. Population was omitted from the model because of its linear relationship with the rest of the explanatory variables.

Based on the results, demand for corn as food was significantly affected by its own price. Results indicated that a 1 per cent increase in corn retail price would lead to a 0.31 per cent

decrease in demand for corn as food. This own price elasticity estimate of corn showed that it was price inelastic. Furthermore, corn was shown to be a complement of palay (e_{CR} = -0.81). It was also observed that corn as food was an inferior good, as manifested by the negative income elasticity of -0.47 per cent.

The result of the own price elasticity estimate of corn was relatively similar to that of the estimates based on other studies. Ferrer-Guldager (1977) as cited by Estrada and Bantilan (1991) estimated corn demand elasticity to be -0.36. Likewise, IAPMP (1981) as cited by Costales (1990) derived an own price elasticity estimate of corn food demand of -0.40. The own price estimates derived in this study and past studies were consistent with a priori economic expectations. Corn, being a staple crop in the Philippines, tends to be less responsive to its own price over time (Estrada and Bantilan, 1991).

Corn feed demand: $lnQ_{feed} = 7.52 - 0.08\ lnWP_{corn} + 0.22\ lnPROD_{poul} + 0.47\ lnPROD_{pork}$

The data used for the quantity of corn as feeds was from the Department of Agriculture-GMA Corn Programme.

The feed demand model with respect to corn wholesale price, poultry and pork production explained 96 per cent of the variations in the corn feed demand. The major demand shifter was pork production which had the highest consumption of total feed produced in the Philippines. Results of the regression show that an increase by 1 per cent of pork production would raise corn feed demand by 0.47 per cent. Likewise, poultry production also positively affected demand for corn as feeds. The negative sign of corn wholesale price, on the other hand, was consistent with a priori expectations but was insignificant.

Corn demand for other uses: $lnQ_{othuses} = 23.67 - 0.45\ ln(Q_{food} + Q_{feed}) + 0.48\ lnAH_{corn}$

Corn demand for other uses (processing and seeds) was greatly influenced by the level of corn used as feed and food and corn area harvested. These explanatory variables determined approximately 92 per cent of the variation in the dependent variable.

As for the effect of combined corn food and feed use, there existed a negative relationship between food and feed use and corn for other uses. This was consistent with the theoretical hypothesis that as corn feed and food use increase, corn for other uses would decrease given a supply constraint.

Corn area harvested and corn for other uses were directly related. This means that an increase in the corn area harvested would likewise raise the demand for other uses of the commodity. The variable was also found to significantly affect the demand for other uses of corn.

Palay

Palay demand as food: $lnQ_{food} = -6.06 - 0.09\ lnRP_{palay} + 0.44\ lnRP_{corn} + 1.36\ ln\text{POP} + 0.36\ lnINC$

The model explained 96 per cent of the variations in palay food demand. Results also showed that the main factor influencing demand for palay was population. A one per cent increase in population would lead to a 1.36 per cent growth in palay demanded as food.

Palay demanded as food was also found to be positively affected by corn retail prices. The coefficient for corn retail price showed that as the corn retail price increased by 1 per cent, the corresponding growth in palay food demand was 0.44 per cent. This highlighted that the two commodities were substitutable. Likewise, a positive relationship was observed between food demand for palay and per capita GDP/income and was statistically significant.

Results of the regression also indicated that palay food consumption declined with an increase in its own retail price. However, this variable was not statistically significant.

Palay demand as feed: $lnQ_{feed} = 18.37 - 0.31\ lnWP_{palay(t-1)} - 1.57\ lnPROD_{egg} + 1.12\ lnPROD_{poul} + 0.46\ lnPROD_{pork}$

Based on the results of the model, egg, poultry and pork production significantly affected demand for palay as feeds. It was observed that a 1 per cent increase in pork and poultry production brought about a 0.46 per cent and 1.12 per cent increase in demand for palay as feed respectively. Hence, palay used as feed was more responsive to poultry production,whereas, demand for palay as feed was inversely related with egg production because of the collinear effect of the explanatory variables with one another specifically, production of egg, poultry and pork.

Palay demand for other uses: $lnQ_{othuses} = -41.88 + 2.54\ ln(Q_{food} + Q_{feed}) + 0.26\ lnAH_{palay}$

Demand for other uses of palay included utilization for processing and seeds. Palay used for feed and food was positively related with palay for other uses because of the strong demand for processed rice products such as rice flour, among others. The dependent variable was also observed to be positively affected by palay area harvested, although the coefficient was not significant.

Soybean

Soybean demand as food: $lnQ_{food} = -122.82 - ln0.34\ WP_{soy} + 5.30\ lnPOP + 4.83\ lnINC$

Population and per capita income were the major factors influencing demand for soybean as food. Elasticities show the positive relationship of population and per capita income to soybean demanded as food.

Soybean wholesale price, on the contrary, was inversely related to demand for palay as food but was found to be insignificant.

Soybean demand as feed: $lnQ_{feed} = -44.09 + 0.12\ lnWP_{soy} + 2.78\ lnPROD_{poul}$

Including livestock and poultry production in the model resulted in incorrect signs of the coefficients. The explanatory variables were likewise insignificant. A likely explanation for this was the existence of multicollinearity between these variables. Thus, only soybean wholesale price and poultry production were included in the regression run.

Results show that poultry production significantly affected demand for soybean as feed. The variable of own wholesale price had a positive coefficient sign but this was not significant.

Soybean demand for other uses: $lnQ_{othuses} = 1.0 + 1.0\ ln(Q_{food} + Q_{feed})$

The demand for other uses of soybean was primarily for processing. As shown in the model, 100 per cent of the variation in soybean demand for other uses was attributed to soybean food and feed consumption. The soybean area harvested variable was omitted from the model because it was linearly related to food and feed consumption and made the other variables insignificant.

The model revealed that a 1 per cent increase in the aggregate demand for food and feed would also lead to a 1 per cent increase in soybean demand for other uses. There was strong

demand for other uses which was primarily processing of imported soybeans to soybean meal used for feeds, and soybean oil, sauces, among others as food.

Consumption projections to 2015

Annual growth rates in the demand for food, feed and other uses were estimated for corn, palay and soybean using elasticity estimates from the demand functions. Consumption projections were then made from 2003 to 2015 using these growth rates. These projections are presented in Table 27. Total demand was estimated to reach 8 million mt for corn, 15 million mt for palay and 3 million mt for soybean by 2015. These were 1.4 and 1.5 times higher than the 2003 level of demand for corn and rice respectively, while for soybean, this was 9 times higher than its 2003 level of total demand.

Projected demand for food. The estimated annual increase in demand for corn, palay and soybean as food were 0.71 per cent, 3 per cent and 14 per cent respectively. For corn, the estimated demand for food in 2003 was close to 0.97 million mt and projected to reach 1.2 million mt by 2015. Demand for palay as food was estimated at 8.7 million mt in 2003 and projected to reach 12.2 million mt by 2015. On the other hand, Soybean food demand was estimated at 78,176 mt in 2003 and projected to increase five-fold by 2015.

Projected demand for feed. Palay and corn demanded as feed was projected to increase by 3 per cent and 4 per cent annually respectively. In 2003, the estimated demand for corn feed was 4 million mt and projected to double by 2015. For palay, the demand for feed was 0.58 million mt in 2003 and estimated to reach 0.86 million mt by 2015. In contrast, soybean demanded as feed was calculated to increase by as much as 14 per cent annually. Demand for soybean feed was projected to reach 7,036 mt, a five-fold increase from its 2003 value of soybean feed demand.

Projected demand for other uses. Based on the regression model of this study, the demand for other uses of corn, palay and soybean are likely to increase by 2 per cent, 8 per cent and 22 per cent respectively. Soybean showed the highest potential growth rate in demand for other uses. This is possible since it has much more diverse uses compared to corn and palay. By 2015, the projected demand for other uses was 0.71 million mt for corn, 1.6 million mt for palay and 2.4 million mt for soybean.

Comparison of projection results with another method. Comparing the projections of demand for the three feed crops with the projections of feed demand from growth rates of the poultry and swine industry, their feed conversion ratios (FCRs), and usage of corn, rice bran and soybean meal in feed rations (Table 28), it was observed that: (1) the generated model for corn feed demand was comparable with the estimated demand for corn based on the FCR generated corn feed demand, such that the feed demand model was only lower by 7 per cent; (2) there exist limitations in projecting rice and soybean feed demand since data on the supply and utilization accounts, provided by BAS, used for the models did not include imports of soybean meal and actual rice bran utilization. Hence, projections on rice and soybean as feeds from the model may be underestimated.

Table 27. Demand projections using demand regression results, 2003-2015

Year	Food (mt)			Feed (mt)			Other uses (mt)			Total demand (mt)		
	Corn	Rice	Soybean	Corn	Rice	Soybean	Corn	Rice	Soybean	Corn	Rice	Soybean
2003	971,803	8,686,279	78,176	4,049,975	582,760	1,470	924,360	610,342	229,102	5,946,138	9,879,381	308,747
2004	978,654	8,938,442	89,363	4,199,257	601,974	1,675	905,129	660,305	278,588	6,083,040	10,200,720	369,625
2005	985,554	9,197,925	102,150	4,354,042	621,821	1,908	886,298	714,357	338,763	6,225,893	10,534,103	442,821
2006	992,502	9,464,940	116,768	4,514,532	642,322	2,174	867,858	772,835	411,935	6,374,892	10,880,097	530,878
2007	999,499	9,739,708	133,478	4,680,937	663,500	2,477	849,802	836,099	500,913	6,530,239	11,239,306	636,869
2008	1,006,546	10,022,451	152,579	4,853,477	685,375	2,822	832,122	904,542	609,111	6,692,145	11,612,369	764,512
2009	1,013,642	10,313,403	174,413	5,032,376	707,972	3,216	814,810	978,588	740,679	6,860,828	11,999,963	918,307
2010	1,020,788	10,612,801	199,372	5,217,869	731,314	3,664	797,858	1,058,695	900,665	7,036,515	12,402,810	1,103,701
2011	1,027,985	10,920,891	227,902	5,410,200	755,426	4,175	781,258	1,145,360	1,095,209	7,219,443	12,821,676	1,327,286
2012	1,035,232	11,237,924	260,515	5,609,620	780,332	4,757	765,004	1,239,119	1,331,774	7,409,856	13,257,375	1,597,046
2013	1,042,530	11,564,161	297,795	5,816,391	806,059	5,420	749,088	1,340,553	1,619,437	7,608,009	13,710,774	1,922,652
2014	1,049,880	11,899,869	340,410	6,030,783	832,635	6,175	733,504	1,450,291	1,969,235	7,814,166	14,182,795	2,315,821
2015	1,057,282	12,245,322	389,123	6,253,077	860,087	7,036	718,243	1,569,011	2,394,590	8,028,602	14,674,421	2,790,750

Source: Author's own calculation.

Table 28. Projected demand for mixed feeds, corn, rice bran and soybean meal, Philippines, 2003-2015

Year	Estimated demand for mixed feed (mt)			Estimated demand for feed crops (mt)		
	Eggs	Poultry	Hogs	Corn	Rice bran	Soybean meal
2003	600,162	2,576,434	6,123,300	3,719,958	1,394,984	1,523,806
2004	619,273	2,702,554	6,441,719	3,905,418	1,464,532	1,599,659
2005	638,993	2,834,847	6,776,695	4,100,214	1,537,580	1,679,323
2006	659,341	2,973,616	7,129,090	4,304,819	1,614,307	1,762,988
2007	680,337	3,119,179	7,499,810	4,519,730	1,694,899	1,850,858
2008	702,001	3,271,866	7,889,808	4,745,470	1,779,551	1,943,145
2009	724,356	3,432,028	8,300,087	4,982,588	1,868,471	2,040,072
2010	747,422	3,600,030	8,731,700	5,231,661	1,961,873	2,141,874
2011	771,222	3,776,256	9,185,758	5,493,295	2,059,985	2,248,798
2012	795,781	3,961,109	9,663,427	5,768,127	2,163,047	2,361,103
2013	821,122	4,155,010	10,165,935	6,056,827	2,271,310	2,479,061
2014	847,269	4,358,403	10,694,574	6,360,099	2,385,037	2,602,957
2015	874,249	4,571,752	11,250,704	6,678,682	2,504,506	2,733,093

*Using FCRs 1:1.85 for eggs, 1:2 for poultry and farm efficiency of hogs at 1:3.49.
Estimations
Corn: 40 per cent of total mixed feed demand (BAI).
Rice Bran: 15 per cent of total mixed feed demand.
Soybean: 15 per cent of egg and hog feed demand.
20 per cent of poultry feed demand.

However, using actual data from BAS versus the derived/projected data from the model, it was revealed that the models generated for food, feed and other uses of corn and rice were conservative (meaning it deviated from actual total demand by only 0.05-4 per cent) which could attest to the robustness of the projections.

Product development

Recent trends in feed product development have been on specialization and segmentation. Likewise, the possibility of opening new markets by catering to the home mix sector which "comprised 44 per cent of the feed industry" (Carlos, 2004) is being eyed by the major industry players. Feeds nowadays are specialized into various types and forms. Feedmillers are also into the development of "niche, high-value products" such as vitamin premixes and high-protein concentrates. This is to give the farmers convenience and freedom of choice to combine their feeds according to their specifications.

Some of the registered nutrition products available in the Philippines as cited by PHILSAN (2003) which enhance and improve the growth performance and serve as nutritional feed additives or for disease control/prevention for livestock and poultry include: 1) acidifiers; 2) amino acids; 3) animal protein concentrates; 4) anthelmintics; 5) antibiotics; 6) anti-oxidants; 7) coccidiostats; 8) enzymes; 9) flavor/sweeteners; 10) mold inhibitors; 11) pigmenters; 12) protein and specialty feed concentrates; 13) mineral premixes; and 14) feed additives (non-antibiotics) among others. These products have been developed to increase livestock and poultry efficiency and productivity.

Supply of feed crops

Production structure and characteristics

Corn

Corn is the second most important cereal in the Philippines. As of 2003, there were 300,000 corn farming families with an average landholding of 2.7 ha (Espino, 2004). Corn farming has been their main source of income, particularly in Mindanao where the bulk of domestic corn is produced.

Corn is usually planted twice a year, during the dry and wet seasons. The peak harvest months for corn are July to September. On the other hand, lean months of production are during February to June (Gonzales, 2000).

Corn production in the country could further be classified as white and yellow corn. The latter made up about 58 per cent of total corn production and occupied about 37 per cent of total corn harvested areas as of 2002 (Table 29). In the past 15 years, farming technologies used in growing yellow corn brought about an average growth rate in yield of 4 per cent annually. From 1988 to 2002, yellow corn yield improved by as much as 80 per cent. This is in stark contrast with the 15 per cent rise in white corn yield for the same period. Annually, white corn yield had been decreasing by approximately 4 per cent.

Table 29. White and yellow corn area harvested, production and yield, Philippines, 1988-2002

Year	Corn								
	Area harvested ('000 ha)			Production ('000 mt)			Yield (mt/ha)		
	White	Yellow	Total	White	Yellow	Total	White	Yellow	Total
1988	2744.9	1000.2	3,745	2,859	1,569	4,428	1.04	1.57	1.18
1989	2702.4	986.9	3,689	2,923	1,599	4,522	1.08	1.62	1.23
1990	2,739	1,081	3,820	2,966	1,888	4,854	1.08	1.75	1.27
1991	2,583	1,006	3,589	2,906	1,749	4,655	1.12	1.74	1.30
1992	2,351	981	3,331	2,700	1,919	4,619	1.15	1.96	1.39
1993	2,098	1,051	3,149	2,670	2,171	4,798	1.27	2.07	1.52
1994	1,866	1,140	3,006	2,090	2,429	4,519	1.12	2.13	1.50
1995	1,670	1,022	2,692	1,862	2,266	4,129	1.12	2.22	1.53
1996	1,696	1,040	2,736	1,883	2,268	4,151	1.11	2.18	1.52
1997	1,699	1,027	2,726	1,879	2,453	4,332	1.11	2.39	1.59
1998	1,451	903	2,354	1,620	2,203	3,823	1.12	2.44	1.62
1999	1,608	1,034	2,642	1,824	2,761	4,585	1.13	2.67	1.74
2000	1,573	937	2,510	1,889	2,622	4,511	1.20	2.80	1.80
2001	1,570	920	2,555	1,920	2,610	4,525	1.23	2.83	1.77
2002	1,500	890	2,395	1,800	2,520	4,319	1.20	2.83	1.80
Average	1,990	1,001	2,996	2,253	2,202	4,451	1.14	2.21	1.52

Source: BAS.

Geographical distribution of production. Of the three major island groups of the Philippines, Mindanao dominated corn production with a 60 per cent share (2,591,580 mt) of the total corn produced in 2002. Luzon, on the other hand, registered a 33 per cent share with Cagayan Valley as its major producing region.

Yellow corn, the major ingredient in livestock and poultry feed formulations in the Philippines, was harvested at an average of 2.83 t/ha. The major producing regions, Cagayan Valley from Luzon and Northern Mindanao and ARMM from Mindanao had average yield levels that were higher by 17 per cent than the national average (Table 30).

Variety of corn planted. Fifty-two per cent of the country's area harvested with white corn was planted with low yielding traditional varieties (DA Corn Roadmap, 2003). In contrast, 83 per cent of the area planted with yellow corn was dominated by hybrid varieties with potential yield of 7 t/ha. However, this potential yield level has never been realized primarily due to production-related limitations such as the infestation of the corn borer, weather (drought), and inefficient production, among others. Table 31 shows the extent of area harvested with yellow and white corn of traditional, OPV and hybrid corn varieties.

Table 30. Corn area, production and yield, by region, Philippines, 2001

Region	Production			Area			Yield		
	White	Yellow	Total	White	Yellow	Total	White	Yellow	Total
Luzon	**141,560**	**1,319,794**	**1,461,354**	**122,519**	**439,494**	**562,013**	**1.16**	**3**	**2.6**
CAR	20,710	72,842	93,552	12,138	20,920	33,058	1.71	3.48	2.83
Ilocos	37,335	145,331	182,666	15266	36,324	51,590	2.45	4	3.54
Cagayan Valley	43,797	863,380	907,177	27,984	265,401	293,385	1.57	3.25	3.09
Central Luzon	8,320	105,745	114,065	7,356	24,485	31,841	1.13	4.32	3.58
CALABARZON	4,714	37,583	42,297	5,396	31,124	36,520	0.87	1.21	1.16
MIMAROPA	3,752	55,003	58,755	3,714	27,376	31,090	1.01	2.01	1.89
Bicol	22,932	39,910	62,842	50,665	33,864	84,529	0.45	1.18	0.74
Visayas	**222,884**	**54,192**	**277,076**	**324,812**	**46,380**	**371,192**	**0.69**	**1.17**	**0.75**
Western Visayas	31,765	43,775	75,540	40,667	34,400	75,067	0.78	1.27	1.01
Central Visayas	145,680	8,331	154,011	228,413	10,025	238,438	0.64	0.83	0.65
Eastern Visayas	45,439	2,086	47,525	55,732	1,955	57,687	0.82	1.07	0.82
Mindanao	**1,553,210**	**1,233,372**	**2,786,582**	**1,117,781**	**435,602**	**1,553,383**	**1.39**	**2.83**	**1.79**
Zamboanga Peninsula	131,256	3,053	134,309	173,002	2,259	175,261	0.76	1.35	0.77
Northern Mindanao	395,886	402,847	798,733	258,650	119,283	377,933	1.53	3.38	2.11
Davao region	136,443	11,963	148,406	170,232	6,985	177,217	0.8	1.71	0.84
SOCCSKSARGEN	385,789	533,253	919,042	224,260	220,888	445,148	1.72	2.41	2.06
ARMM	443,195	275,150	718,345	246,403	83,639	330,042	1.8	3.29	2.18
CARAGA	60,641	7,106	67,747	45,234	2,548	47,782	1.34	2.79	1.42
Philippines	**1,917,654**	**2,607,358**	**4,525,012**	**1,565,112**	**921,476**	**2,486,588**	**1.23**	**2.83**	**1.77**

Source: BAS.

Table 31. Area harvested by type and variety of corn, Philippines, 1999-2001

Type	Traditional		OPV		Hybrid	
	Area (ha)	Share (%)	Area (ha)	Share (%)	Area (ha)	Share (%)
Yellow	119,379	9.03	41,791	15.64	803,118	83.89
White	1,202,344	90.97	225,485	84.36	154,263	16.11
Total	1,321,723	100	267,276	100	957,381	100

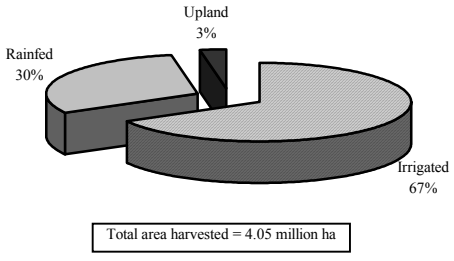
Source: DA Corn Roadmap, 2003.

Palay

Over the last decade and a half, production of rice increased at an average rate of 3.6 per cent annually, partially due to the increasing irrigated area. Irrigated rice fields composed 67 per cent of the total area devoted to rice production while 30 per cent were rainfed (Figure 6). The rest was devoted to upland rice farming.

The yield level of irrigated rice fields was 45 per cent higher than rainfed lands. On average, irrigated rice fields were able to yield 3.68 t/ha. IR64 was the most widely planted rice variety on irrigated rice farms and had a potential yield level of 7.5 t/ha. Currently, yield per hectare of irrigated rice farms falls short by 50 per cent of this potential yield level. In general, this is due to a lack of technical skills to use the technology and a lack of access to necessary inputs such as fertilizers. Table 32 shows the yield levels of palay by type of planting environment.

Figure 6. Palay area harvested by environment, Philippines, 2002



Source: Author's own calculation.

Table 32. Palay yield (mt/ha) by region and by type of environment, Philippines, 2002

Region	Irrigated	Rainfed	Upland	Average
Luzon	**3.77**	**2.73**	**1.65**	**3.49**
CAR	3.32	2.19	2.09	3.16
Ilocos	3.67	3.03	2.58	3.45
Cagayan Valley	3.96	2.15	-	3.70
Central Luzon	4.12	3.61	-	4.04
Southern Tagalog	3.48	2.68	1.41	3.12
Bicol	3.14	2.14	-	2.74
Visayas	**3.41**	**2.29**	**1.54**	**2.83**
Western Visayas	3.37	2.56	1.60	2.96
Central Visayas	3.10	1.62	1.75	2.27
Eastern Visayas	3.67	1.96	1.48	2.73
Mindanao	**3.62**	**2.72**	**1.57**	**3.24**
Zamboanga Peninsula	3.63	3.01	1.15	3.33
Northern Mindanao	3.80	3.14	2.32	3.67
Davao	4.27	3.18	1.48	3.94
SOCCSKSARGEN	3.55	2.93	1.71	3.37
ARMM	3.25	2.46	1.46	2.43
CARAGA	2.99	2.31	1.26	2.77
Philippines	**3.68**	**2.56**	**1.58**	**3.28**

Source: BAS as cited by PIDS.

Geographical distribution of production. Luzon dominated rice production in the Philippines (Table 33), accounting for 56 per cent of total rice output in the country. The two major producing regions located on Luzon Island were Central Luzon, often called the "rice bowl" of the country, and Cagayan Valley.

Table 33. Volume of production of palay by region, Philippines, 2002

Region	Production ('000 mt)	Share (%)
Luzon	**7,458**	**56.20**
CAR	304	2.29
Ilocos	1,200	9.04
Cagayan Valley	1,708	12.87
Central Luzon	2,240	16.88
Southern Tagalog	1,250	9.42
Bicol	757	5.70
Visayas	**2,571**	**19.37**
Western Visayas	1,730	13.04
Central Visayas	219	1.65
Eastern Visayas	622	4.69
Mindanao	**3,288**	**24.78**
Zamboanga Peninsula	505	3.81
Northern Mindanao	533	4.01
Davao	440	3.32
SOCCSKSARGEN	1,061	7.99
ARMM	423	3.18
CARAGA	327	2.46
Philippines	**13,271**	**100**

Source: BAS as cited by PIDS.

Variety of palay planted. As of 2002, area planted to certified and hybrid seeds of rice had a 61 per cent share of total land devoted to rice production (DA Rice Roadmap, 2003).

Soybean

In 2002, the country produced only 985 mt of soybean which was primarily consumed as food. This accounted for just 0.4 per cent of total supply with the rest coming from imports. The low production level caused by an undeveloped soybean industry were the consequences of the following: (1) existence of a limited number of experienced farmers; (2) small amount of available seeds of local varieties; (3) not considered as a high value crop; (4) farmers' unfamiliarity with farm and household utilization; and (5) uncertainty of the soybean market (Draft Roadmap for Soybean, 2003).

In the early 1970s and the 1980s, various government institutions and private firms attempted to intice farmers to propagate soybean but failed in their efforts (Baconawa, 1990 as cited by Cruz, 1997). Although vast tracks of lands are ideal to produce soybean in the Philippines, high production and marketing costs discourage local farmers from planting the crop (Cruz, 1997). However, this crop remained a priority crop in the Key Commercial Crop Development Program of the MTADP.

Geographical distribution of production. Mindanao still remained the major producer of soybean in the country with 80 per cent of total production as of 1997 (Table 34). This was attributed to the CARAGA region, where 46 per cent of the total soybean was produced.

Table 34. Soybean volume, area and yield, Philippines, 1997

Region	Volume (mt)	Share (%)	Area (ha)	Share (%)	Yield (mt/ha)
Luzon	**174**	**10.77**	**129**	**10.36**	**1.35**
Cagayan Valley	174	10.77	129	10.36	1.35
Visayas	**145**	**8.98**	**270**	**21.69**	**0.54**
Western Visayas	6	0.37	8	0.64	0.75
Central Visayas	125	7.74	250	20.08	0.50
Eastern Visayas	14	0.87	12	0.96	1.17
Mindanao	**1,296**	**80.25**	**846**	**67.95**	**1.53**
Zamboanga Peninsula	2	0.12	3	0.24	0.67
Northern Mindanao	62	3.84	53	4.26	1.17
Davao	389	24.09	211	16.95	1.84
Soccsksargen	60	3.72	50	4.02	1.20
ARMM	36	2.23	56	4.50	0.64
CARAGA	747	46.25	473	37.99	1.58
Philippines	**1,615**	**100.00**	**1,245**	**100.00**	**1.30**

Source: CGPRT.

Producer price behaviour

Feed crop prices. Trends in nominal farm gate prices of corn, palay and soybean are shown in Table 35. Domestic nominal farm gate prices for corn have been rising by 10 per cent annually for the last two decades. In the same way, nominal domestic prices of rice and soybean also rose, by 11 per cent and 8 per cent annually.

Product prices. The average selling prices of yellow corn and soybean meal are shown in Table 36. Generally, annual prices of yellow corn and soybean meal increased by 2 per cent and 3 per cent respectively. The decline in price of yellow corn in 1999 could be attributed to the increase in production brought about by expansion of area harvested with yellow corn and the sudden decline in world prices. On the other hand, the decline in price of imported soybean meal may be attributed to the appreciation of the Philippine peso.

Table 35. Nominal farm gate prices of selected feed crops, Philippines, 1982-2002

Year	Corn		Rice		Soybean	
	Price (P/kg)	Growth rate (%)	Price (P/kg)	Growth rate (%)	Price (P/kg)	Growth rate (%)
1982	1.30		1.37		3.51	
1988	2.85	-1.90	3.17	8.56	7.22	44.69
1993	4.63	-3.04	5.40	12.27	9.92	8.06
1997	6.07	-6.18	7.92	-2.58	12.48	7.68
2002	6.73	0.82	8.82	7.96	11.67	-25.62
Average	4.45	10.14	5.34	10.78	9.05	7.71

Source: BAS.

Table 36. Average selling price (P/kg) of selected feed ingredients, Philippines, 1996-2002

Year	Yellow corn	Soybean meal
1996	7.77	11.13
1997	7.93	12.87
1998	7.60	12.08
1999	6.84	8.48
2000	8.02	11.22
2001	8.87	13.04
2002[P]	8.30	12.00
Average	7.90	11.55

Source: MDD, BAI as cited by Molina, 2003.
Note: P= partial as of June 2002.

Production response to market forces

This section deals with the functions and coefficients generated on the yield and supply responses for corn, palay and soybean using data from 1982-2002. Table 37 shows the results of the regression analyses.

Table 37. Results of the supply analysis for corn, palay, and soybean, Philippines, 1982-2002

Independent Variable	Dependent variable					
	Area			Yield		
	Corn	Palay	Soybean	Corn	Palay	Soybean
Constant	13.84***	12.63***	2.24**	4.87***	1.85^{ns}	5.97***
	(24.243)	(3.661)	(2.372)	(4.843)	(1.012)	(4.655)
Corn farm gate price$_{(t-1)}$	0.81***	-0.15^{ns}	0.41^{ns}	-0.25**		
	(2.805)	(-0.823)	(0.703)	(-2.093)		
Palay farm gate price$_{(t-1)}$	-0.45^{ns}	0.09^{ns}	-1.94***		-0.09^{ns}	
	(-1.061)	(0.343)	(-2.725)		(-0.782)	
Soybean farm gate price$_{(t-1)}$	0.23^{ns}	-0.26**	0.35^{ns}			-0.49***
	(1.367)	(-2.128)	(1.067)			(-3.027)
Palay area harvested$_{(t-1)}$		0.21^{ns}				
		(0.955)				
Soybean area harvested$_{(t-1)}$			0.95***			
			(10.728)			
Urea price$_{(t-1)}$				-0.18**	-0.02^{ns}	0.11^{ns}
				(-2.341)	(-0.275)	(0.906)
Wages$_{(t-1)}$				0.69***	0.03^{ns}	0.44*
				(3.835)	(0.272)	(1.929)
Palay yield$_{(t-1)}$					0.77***	
					(3.316)	
R^2 (%)	64.3	60.4	96.9	90.7	77.7	68.4
Significance of model	***	***	***	***	***	***

Source: Author's own calculation.
Notes: *, **, *** = significant at 10 per cent, 5 per cent, and 1 per cent levels respectively.
ns = not significant.
[a] Data used is from the GMA-Corn Program because it approximates feed use in corn. Data was also estimated for feed use (1982-1989).
values in parentheses are t-values.
(t-1) lagged values by 1 year.

Corn

Corn area: $lnAH_{corn} = 13.84 + 0.81\ lnFP_{corn(t-1)} - 0.45\ lnFP_{palay(t-1)} + 0.23\ lnFP_{soy(t-1)}$

Estimates of the coefficients revealed that corn farm gate prices affected corn area harvested positively. Conversely, palay farm gate prices inversely relate to corn harvested area. These two crops presumably competed for the same land use, particularly during the dry season.

Corn yield: $ln\mathrm{YH}_{\mathrm{corn}} = 4.87 - 0.25\ lnFP_{corn(t-1)} - 0.18\ lnPI_{urea(t-1)} + 0.69\ lnPI_{wage(t-1)}$

The explanatory variables in the yield function included real corn producer price, price of urea, and agricultural wages. These explanatory variables explained approximately 91 per cent of the variations in the dependent variable.

Based on the results, corn farm gate price, urea price and wages significantly affected corn yield. For corn producer price, an increase of 1 per cent leads to a 0.25 per cent decline in the yield of corn. Urea price was observed to be negatively related to yield. This implies that corn growers opted to use minimal fertilizer in order to minimize their costs when fertilizer prices were high. Wages, on the other hand, were positively related to yield. A possible reason for this was that farmers may choose to improve on their input or technology usage in order to save on labour costs.

Palay

Palay area: $lnAH_{palay} = 12.63 - 0.15\ lnFP_{corn(t-1)} + 0.09\ lnFP_{palay(t-1)} - 0.26\ lnFP_{soy(t-1} + 0.21\ lnAH_{palay(t-1)}$

The signs for farm gate prices (corn, palay, soybean) were consistent with economic theory. However, corn and palay farm gate prices were insignificant determinants of palay area harvested. The lagged area was included in the supply response function to reflect partial adjustment towards a desired area, the partial adjustment being attributed to the inability to make short-run changes to fixed input levels (Griffiths, *et al*., 1999).

Palay yield: $lnYH_{palay} = 1.85 - 0.09\ lnFP_{palay(t-1)} - 0.02\ lnPI_{urea(t-1)} + 0.03\ lnPI_{wage(t-1)} + 0.77\ lnYH_{(t-1)}$

Regression results showed that 78 per cent of the variations in the palay yield were due to the explanatory variables included in the model. However, only lagged palay yield was found to be significant. This variable was included in the model to represent the hypothesis that after a poor year of harvest, farmers tend to plant more palay thereby increasing productivity in the subsequent year.

Soybean

Soybean area: $lnAH_{soy} = 2.24 + 0.41\ lnFP_{corn(t-1)} - 1.94\ lnFP_{palay(t-1)} + 0.35\ lnFP_{soy(t-1)} + 0.95\ lnAH_{soy(t-1)}$

The major determinants of soybean area harvested were palay producer price and lagged area harvested of soybean. These variables explained 97 per cent of the changes in soybean area.

Table 38. Supply projections using area and yield response model, 2003-2015

Year	Area (ha)			Yield (mt/ha)			Production (mt)				Supply surplus/deficit (mt)		
	Corn	Palay*	Soybean	Corn	Palay*	Soybean	Corn	Palay*	Rice	Soybean	Corn	Rice	Soybean
2003	2,359,994	4,095,627	699	1,828	3,325	1,292	4,315,062	13,615,991	8,850,394	903	(1,631,077)	(1,028,987)	(307,844)
2004	2,325,056	4,145,537	630	1,854	3,370	1,315	4,310,928	13,970,316	9,080,705	828	(1,772,113)	(1,120,015)	(368,797)
2005	2,290,636	4,196,054	567	1,880	3,416	1,338	4,306,798	14,333,861	9,317,009	759	(1,919,096)	(1,217,093)	(442,062)
2006	2,256,726	4,247,188	511	1,907	3,463	1,362	4,302,672	14,706,866	9,559,463	696	(2,072,220)	(1,320,634)	(530,182)
2007	2,223,317	4,298,945	460	1,933	3,510	1,386	4,298,549	15,089,578	9,808,226	638	(2,231,690)	(1,431,080)	(636,230)
2008	2,190,403	4,351,332	415	1,961	3,558	1,411	4,294,431	15,482,250	10,063,462	585	(2,397,714)	(1,548,906)	(763,927)
2009	2,157,976	4,404,358	374	1,988	3,607	1,436	4,290,317	15,885,139	10,325,341	536	(2,570,511)	(1,674,622)	(917,771)
2010	2,126,030	4,458,030	336	2,016	3,656	1,462	4,286,207	16,298,513	10,594,034	492	(2,750,309)	(1,808,776)	(1,103,209)
2011	2,094,556	4,512,356	303	2,044	3,706	1,488	4,282,100	16,722,644	10,869,719	451	(2,937,343)	(1,951,957)	(1,326,835)
2012	2,063,548	4,567,344	273	2,073	3,757	1,514	4,277,998	17,157,813	11,152,578	413	(3,131,859)	(2,104,797)	(1,596,632)
2013	2,032,999	4,623,002	246	2,102	3,808	1,541	4,273,899	17,604,305	11,442,798	379	(3,334,110)	(2,267,975)	(1,922,273)
2014	2,002,903	4,679,338	222	2,132	3,860	1,569	4,269,804	18,062,416	11,740,570	348	(3,544,362)	(2,442,224)	(2,315,473)
2015	1,973,252	4,736,361	200	2,162	3,913	1,597	4,265,714	18,532,449	12,046,092	319	(3,762,889)	(2,628,329)	(2,790,431)

Source: Author's own calculation.
* Palay/paddy refers to unmilled rice.

Lagged soybean area was highly significant. This variable reflected that the area planted with soybean for the current year would be most likely influenced by the area planted to it from the previous year. This could be attributed to the inability of farmers to make short-term changes to a fixed input.

Soybean yield: $lnYH_{soy} = 5.97 - 0.49\ lnFP_{soy(t-1)} + 0.11\ lnPI_{urea(t-1)} + 0.44\ lnPI_{wage(t-1)}$

In the soybean yield function, agricultural wages and soybean farm gate price were variables found to significantly affect soybean yield. Based on the model generated, the explanatory variables explained 68 per cent of the variations in soybean yield.

Production projections to 2015

Using the area and yield response models of this study, projections for production from 2003 to 2015 were calculated for corn, palay and soybean. These production projections are summarized in Table 38.

Projected area harvested. Results of the projections for corn area showed a declining trend. This is partially explained by the projected increasing area for rice. Given that land is a limited natural resource, these projected trends are not far from reality. In fact, these two crops do compete for use on the same pieces of land. From 1993 to 2002, the decline in area harvested for corn was matched by an increase in area harvested for rice (BAS, 2002). An exemption was in 1998, when both crops experienced decline in area harvested due to the El Niño phenomenon. Similarly with corn, the area harvested for soybean is also declining.

It was observed that area harvested for both corn and soybean declined while rice increased. Rice is a staple food in the Philippines and given the high rate of population growth, pressure to increase production by increasing area harvested is likely to occur within the next decade.

Projected yield levels. Using the yield response model, a growth rate in yield of 1.4 per cent for corn and rice, and 1.7 per cent for soybean were estimated. This is quite low in order to meet the high demand for these feed crops. Aside from the low growth rates in yield, the present yield levels for corn, rice and soybean are still quite low.

From 2003, the average yield levels were 1.8 mt/ha for corn, 3.3 mt/ha for rice, and 1.3 mt/ha for soybean. These are projected to reach 2.1, 3.9 and 1.6 mt/ha respectively.

Projected production levels and surplus/deficits. Based on the area and yield projections, the production levels were derived. Results of the projection showed that corn production would decrease from 4.31 million mt to 4.27 million mt. This is largely due to the declining area devoted to corn. Although projected yield per hectare is increasing, this is insufficient to offset the decline in area harvested. A similar trend for soybean was observed. From 903 mt in 2003, soybean production was projected to decline to 319 mt in 2015. Rice was the only crop that showed an increase in production. It was projected to reach 18.5 million mt by 2015.

Using the projected consumption levels discussed in the earlier part of the chapter, results indicate huge production deficits for all three crops. By 2015, deficits of 3.7 million mt for corn, 2.6 million mt for rice, and 2.8 million mt for soybean were projected. Increasing yield levels is one of the most important aspects that the Philippines needs to pursue to reduce this gap.

Comparing projections with actual data. Using actual yearly data in the past (1989-2002), production projections for the feed crops were evaluated. It was revealed that: (1) projections for corn and rice were generally comparable with the actual data such that deviations ranged from -1 per cent to 3 per cent; and (2) local soybean production may be overestimated

primarily due to data inconsistencies (i.e. rapid decline in area harvested to soybean during 1990-2002).

Development of farming technologies and production arrangements

The farming technologies available to farmers cover three aspects. These are improving yield levels, reducing pest infestations (during the growth stage and storage of crops), and farming practices to make the feed crop production more efficient.

The companies providing corn seed technologies are BIOSEED Philippines, Inc., Pioneer Hi-Breed Agricultural Technology, Inc., Syngenta Philippines, Inc. and Asian Hybrid Seed Technnologies, Inc. These companies provide yellow hybrid seeds and transgenic corn, which is the most controversial new seed technology. A major objective of these technologies is directed towards addressing corn borer infestations – a major pest for Philippine corn production. The potential yield levels of the varieties sold by these firms range from 6.56 to 7.84 mt/ha (PCARRD, 2002). Open-pollinated and white corn varieties that would be suitable to specific areas in the Philippines (e.g. Luzon, Visayas, Mindanao) are also provided by government institutions.

For palay, there are many farming practices and seed technologies that are aimed at reducing pest infestations such as the "Golden Kuhol" or snails, rodents and stem borers. The major providers of these technologies are PhilRice, the International Rice Research Institute, and the University of the Philippines at Los Baños. Rice seed technologies are also available for various agro-ecological environments such us upland and lowland areas, rainfed or irrigated areas.

Unlike corn and palay, technologies for soybean are not as abundantly explored. However, the most important development for soybean is the recent arrangement between Quedancor and the San Miguel Corporation. These two intend to establish a ₱ 2 billion soybean plantation in Surigao del Sur and plan to give each participating farmer 1.5 hectares of land and access to a ₱ 50,000 collateral-free minimum loan. This arrangement would not only give the development of a soybean industry a boost but foreign exchange would be saved from the reduction in soybean imports.

Trading of feedstuffs and feed crops

International trading

The Philippines is a net importer of feed crops like corn and soybean. The country is the largest single importer of soybean from the US and is also a net importer of feedstuffs for animals. There are a few exports of feedstuffs for animals from the Philippines including sugarcane tops, corn cobs/stalks/leaves, fruits waste (peels), wheat bran and other residues, copra oil cake and other solid residues. Imported feeding stuff for animals, on the other hand, include soybean oil cake/meal, cereal bran, fodder roots, flours, feed additives, solid food residues, among others.

Before the accession of the country to the GATT-WTO, corn imports were low. This was the time when import restrictions were in place for corn. Imports then dramatically increased in 1995 when the Philippines started to liberalize the corn sector by removing quantitative restrictions as required by the WTO trade agreement. Average imports of corn from 1995 to 2002 were 304,000 mt (Table 39).

Soybean imports were increasing at an average annual rate of 29 per cent from 1988-2002 (Table 39). However, unlike corn imports, soybean imports fell after the Philippines became a member of the GATT-WTO. There were two probable reasons for this. One was the rise in the world soybean price by 2 per cent and the other was the trade liberalization of corn.

The latter reason resulted in livestock and poultry producers increasing their corn usage compared to soybean.

Table 40 presents the total value of exports and imports in 2002 of feeding stuff for animals by regional trading block. It was only with Japan that the Philippines had a positive trade balance. With respect to ASEAN, the USA and European Union trade partners, the Philippines had a negative trade balance. Overall, the Philippines was a net importer of feeding stuff for animals.

Table 39. Corn and soybean imports, 1988-2002

Year	Imports (in '000 metric tons)			
	Corn*	Growth rate (%)	Soybean	Growth rate (%)
1988	25.00		24.00	
1989	173.00	592.00	28.76	19.83
1990	345.50	99.71	24.04	-16.42
1991	0.32	-99.91	63.25	163.13
1992	0.60	87.50	51.89	-17.95
1993	0.65	8.33	61.57	18.64
1994	0.89	36.92	135.52	120.12
1995	208.02	23,273.03	86.88	-35.90
1996	405.44	94.90	137.79	58.60
1997	307.59	-24.13	111.05	-19.40
1998	462.12	50.24	148.24	33.49
1999	149.46	-67.66	262.59	77.14
2000	446.43	198.70	249.19	-5.11
2001	171.77	-61.52	315.17	26.48
2002	278.24	61.98	257.10	-18.42
Average (1988-1994)	77.99	120.76	55.57	47.89
Average (1995-2002)	303.63	2,940.69	196.00	14.61
Average (1988-2002)	198.34	1,732.15	130.47	28.87

Source: BAS.
**unmilled corn.*

Table 40. Total value of exports and imports of feeding stuff for animals, 2002

Regional trading block	Feeding stuff for animals*		Trade Balance (X-M)
	Exports (X)	Imports (M)	
ASEAN	2,365.49	26,045.77	-23,680.28
Japan	4,790.23	173.2	4,617.03
USA	0	125,084.16	-125,084.16
European Union	7,244.71	20,964.75	-13,720.04
Total	14,400.43	172,267.88	-157,867.45

Source: BAS.
** excluding unmilled cereals*.
Note: values are in '000 f.o.b. US$.

Direction of trade

As discussed earlier, the Philippines is a net importer of corn and soybean. The US was the major source of imports for both these feed crops. In 2002, 58 per cent of total imported corn was from the USA (Table 41). The other major sources of Philippine corn imports were China (39 per cent), India (1.77 per cent), and Thailand (1.20 per cent). The value of corn imports in 2002, reached a total of US$ 49 million (f.o.b.).

Soybean imports in 2002 reached a total of 257,000 mt. Similarly with corn, 166,000 mt of these soybean imports (approximately 65 per cent of total soybean imports) were from the US (Table 41). Argentina and Canada were the other major sources of imports, with a share of 21 per cent and 12 per cent of the total import quantity respectively. Over half of the total value of soybean imports was paid to the US. This totaled US$ 50 million (f.o.b.).

Table 42 presents the import and export values from ASEAN and European Union countries, the USA and Japan. Overall, the Philippines has a negative trade balance of US$ 321 million (f.o.b.) with respect to trading of feeding stuff for animals. The country's major contributors to export value of domestic feeding stuff for animals are the Netherlands, Japan, and Singapore. These countries had a share of 18 per cent, 15 per cent and 7 per cent to total export value respectively.

Most of the imported feeding stuff for animals came from the US. In terms of value, the share of the US of total value of imports was 36 per cent. This was followed by Thailand (4 per cent), Singapore (2 per cent), Netherlands (2 per cent), UK (1 per cent) and Belgium (1 per cent). Other European and ASEAN countries shared less than 1 per cent (Table 42).

Table 41. Philippine corn and soybean imports by country of origin, 2002

Country of origin	Imports (in '000 metric tons)							
	Corn*				Soybeans			
	Quantity	Share (%)	Value	Share (%)	Quantity	Share (%)	Value	Share (%)
USA	160.63	57.73	24.29	49.34	166.3	64.68	49.92	57.97
Argentina	0	0	0	0.00	52.9	20.58	23.31	27.07
Brazil	0	0	0	0.00	2.5	0.97	1.4	1.63
Canada	0	0	0	0.00	30.74	11.96	10.3	11.96
China	108.32	38.93	14.04	28.52	2.03	0.79	0.62	0.72
Thailand	3.35	1.20	4.98	10.12	0	0.00	0	0.00
India	4.93	1.77	4.56	9.26	0	0.00	0	0.00
Indonesia	0.87	0.31	1.31	2.66	0	0.00	0	0.00
Others	0.14	0.05	0.05	0.10	2.63	1.02	0.56	0.65
Total	278.24	100	49.23	100	257.1	100	86.11	100

Source: BAS.

** unmilled corn, not including sweet corn*.

Note: Quantity in '000 metric tons; value is f.o.b. value in million US$.

Share in per cent is with respect to total quantity and value by commodity.

Table 42. Trading of feedstuff for animals by country (f.o.b. million US$), 2002

Country	Exports	Share (%)	Imports	Share (%)	Total trade	Share (%)
Belgium	0.003	0.01	3.510	1.00	3.51	-3.51
Brunei	0	0	0	0	0	0
Denmark	0	0	0.821	0.23	0.82	-0.82
France	0	0	2.035	0.58	2.04	-2.04
Germany	0.365	1.18	2.491	0.71	2.86	-2.13
Greece	0.000	0	0.030	0.01	0.03	-0.03
Indonesia	0.007	0.02	3.246	0.92	3.25	-3.24
Ireland	0.000	0	0.053	0.02	0.05	-0.05
Italy	0.591	1.91	0.271	0.08	0.86	0.32
Japan	4.790	15.46	0.173	0.05	4.96	4.62
Luxembourg	0	0	0	0	0	0
Malaysia	0.030	0.10	1.874	0.53	1.90	-1.84
Netherlands	5.628	18.16	6.077	1.73	11.71	-0.45
Portugal	0.000	0	0.005	0.001	0.00	0.00
Singapore	2.285	7.37	7.606	2.16	9.89	-5.32
Spain	0.000	0	1.706	0.48	1.71	-1.71
Thailand	0.044	0.14	13.320	3.78	13.36	-13.28
UK and Northern Ireland	0.657	2.12	3.965	1.13	4.62	-3.31
USA	0.000	0	125.084	35.53	125.08	-125.08
Others	16.59	54	179.770	51.07	196.36	-163.18
Total	30.99	100.00	352.04	100.00	383.03	(321.05)

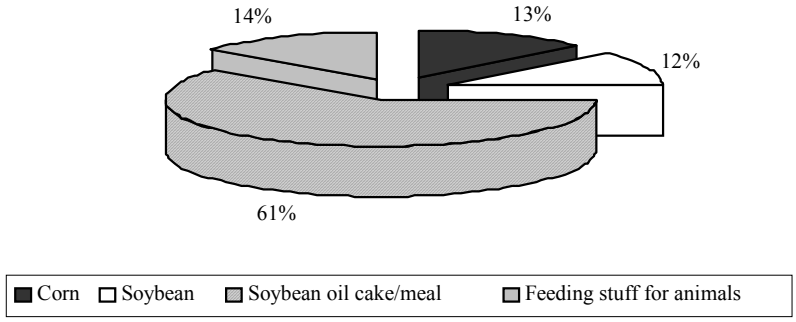
Source: BAS.

Import behaviour and structure

Figure 7 shows the distribution of imported feed crops and feeding stuff for animals in 2002. The most imported feeding stuff for animals is soybean oil cake/meal. Overall, its share of total imports of feed crops and feeding stuffs for animals was 61 per cent. On the other hand, soybean had a share of 12 per cent of total feed crop and feeding stuff imports while corn shared 12 per cent. The remaining 14 per cent were shared by other feeding stuffs for animals (e.g. solid food/fruit residues, bran, feed additives etc.).

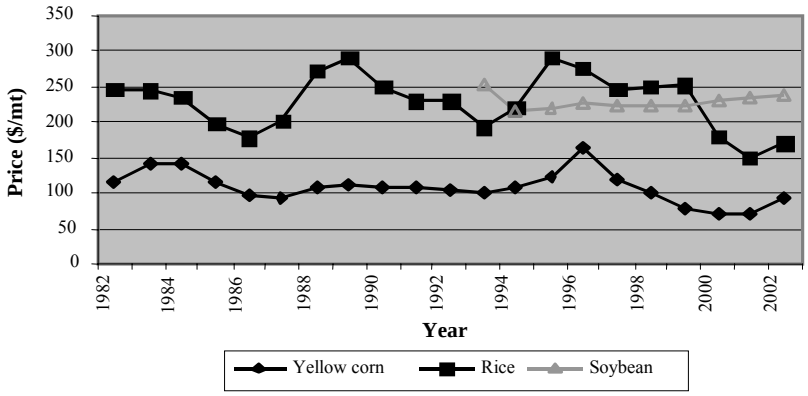
Given that the Philippines is a net importer of feed crops and feeding stuffs for animals, a brief review of world price trends would help explain import behaviour in the country. After the implementation of GATT-WTO in 1995, world prices of yellow corn fell (Figure 8). This was favourable for livestock and poultry producers. Aside from the removal of quantitative restrictions on corn, this also partly explains the rise in imported yellow corn for feed after 1995. On the contrary, soybean prices rose after 1995. As discussed earlier, soybean imports went down in 1995. Although actual figures of soybean imports are increasing, its growth rate, in general has been declining. Most likely, this reflects the rising trend in world soybean prices as seen in Figure 8.

Figure 7. Distribution of imported feed crops and feeding stuff for animals, 2002



Source: Author's own calculation.

Figure 8. World prices (f.o.b.) of yellow corn, rice and soybean, Philippines, 1982-2002



Source: Author's own calculation.

Import projections to 2015

The projection of imports to 2015 was based from the projected demand and supply. These were discussed in the earlier part of this chapter. Export level was not projected due in part to the limited exports the country has made. Exporting corn, rice and soybean was primarily undertaken by the Philippines to comply with trade commitments. Thus, years with export data do not necessarily imply that there were domestic production surpluses of the feed crops and rice. The export level scenario also depicted that exports were minimal and established no trend. This was the primary reason why the export function specified by UNESCAP-CAPSA was not estimated in this report.

Based on Table 43, importation of the identified feed crops and rice are projected to increase until 2015. Corn imports are projected to increase by 7 per cent annually. In terms of imports' share to supply of corn, this will reach 47 per cent by 2015. This scenario implies that the Philippines will import almost half of the domestic corn requirement by 2015. Also, by 2015 the country is estimated to be only 53 per cent self-sufficient in corn. The high dependence of the country on corn imports will be lessened if yield levels per hectare could be improved. This would necessitate more productivity enhancing technologies such as use of Bt corn, as well as adoption of best farm practices.

Table 43. Projected import level (metric tons) of corn, rice and soybean, Philippines, 2003-2015

Year	Corn	Rice	Soybean
2003	1,631,077	1,028,987	307,844
2004	1,772,113	1,120,015	368,797
2005	1,919,096	1,217,093	442,062
2006	2,072,220	1,320,634	530,182
2007	2,231,690	1,431,080	636,230
2008	2,397,714	1,548,906	763,927
2009	2,570,511	1,674,622	917,771
2010	2,750,309	1,808,776	1,103,209
2011	2,937,343	1,951,957	1,326,835
2012	3,131,859	2,104,797	1,596,632
2013	3,334,110	2,267,975	1,922,273
2014	3,544,362	2,442,224	2,315,473
2015	3,762,889	2,628,329	2,790,431

Source: Author's own calculation.

On the other hand, it is projected that the country will import almost 100 per cent of its local soybean requirement by 2015. Projections indicate that soybean imports will annually rise rapidly at a rate of 20 per cent. In contrast, the 18 per cent share of imported rice in the total local supply in 2015 will curtail production of rice bran, being the by-product of palay. Imports of rice will increase by 8 per cent per annum.

Measures to meet excess demand

Government and private sector initiatives

In order to achieve great strides in feed crop development, public and private sector partnership is very important. This is necessary to ease the supply-demand gap for feed crops in the country. The partnership takes the form of credit, production technology, infrastructure development, and R&D.

Credit. Credit provides farmers the means to buy quality seeds, fertilizers and other inputs necessary to raise their level of production. Participation of the private sector in the provision of credit to farmers has been to the advantage of the industry. The private sector

provides credit arrangements similar to those of the government financial institutions (GFIs) such as Land Bank of the Philippines and QUEDANCOR. The provincial LGUs as conduits for farmers and farmer organizations using the Internal Revenue Allocations (IRAs) as collateral are being sought as suggested by the DA road map for feed crops.

Production technology. Technologies used in the production of feed crops determine their level of productivity. For corn, seed multiplication is done mainly by private multinational companies such as Monsanto, Cargill and Pioneer. Private in nature, these companies are perceived to be purely profit-driven and have little or no concern for the environment or farmers' welfare. The government ensures that the supply of seeds is accessible to farmers while encouraging the private sector to balance their profit-driven seed technology generation with the environment and farmer's welfare. The government, fortunately, does not fully rely on private sector R&D. It also continues to invest in seed production technology research. For rice, the Philippine Rice Research Institute (PhilRice) takes the lead in technology generation, distribution and extension. The government has to take full advantage of the presence of the International Rice Research Institute (IRRI), through access of technologies and other services it is offering.

The government also promotes the use of high quality seeds through its extension programmes and field demonstrations. In addition to the extension programmes of PhilRice, DA, and other government SCUs, the local government units are the main unit tasked with extension needs to ensure that farmers have access to high quality seeds and provide the necessary information on the technology.

Infrastructure development. A vital area that needs the government's attention is infrastructure development, such as farm-to-market roads, irrigation, and post-harvest facilities. Improving infrastructure, especially in rural areas, will go a long way in helping local feed crop farmers achieve development and eventually compete under a liberalized economy. The roll-on roll-off (Ro-Ro) system bannered by the Arroyo administration is a step in the right direction to improve transportation from the various islands, especially from Mindanao. Ro-Ro is a transportation system that enables the movement of vehicles across islands. There has been no assessment of this system yet, especially as to its impact on transportation costs, the flow of goods including agricultural goods, and the effect on corn farmers in Mindanao.

Private sector participation is also being tapped by the government to provide infrastructure support. Specifically, it hopes that the private sector can invest in shallow tube wells and mechanical dryers.

Research and development. In the Philippines, agricultural R&D in general receives little budgetary support. For corn and soybean, budgetary support is low even though these are major feed crops necessary to boost the local livestock industry. David (2002) suggested that some of the R&D budget for rice be transferred to corn to correct this. There is still room to increase budgetary support for R&D. The Philippines spends only about 0.4 per cent of GVA in contrast to the World Bank recommended level of 1 per cent for developing countries. There is no doubt that there are high returns in investing in R&D. Private sector R&D only focuses on varietal development (e.g. hybrid and Bt seeds). Other areas of collaboration with the private sector include R&D in irrigation, mechanical dryers and marketing management.

Trade cooperation and liberalization. The Philippines is signatory to three major agreements that aim to liberalize trade, thereby, opening the economy to foreign competition: GATT-WTO, AFTA, and APEC. Benefits obtained by the country from these agreements include access to cheaper inputs like seeds and fertilizers for feed crop production, access to new technologies for feed crop production improvement (e.g. biotechnology, farm mechanization technologies etc.). It is therefore important that the government provide the necessary support to the feed crop sector consistent with the rules of these trade agreements.

Liberalized trade means that the country has to focus on commodities where it has competitive advantage since the Philippines is a net importer of agricultural products. Given that livestock are a labour intensive venture and feed crop production is land intensive, it is possible that in the long run, the Philippines will shift to livestock production since the country has a large labour force. The challenge, however, is determining whether growth in these sectors will offset losses from feed crop farmers, especially corn farmers that are likely to be displaced by trade liberalization. Habito (2002) cites this scenario in a few East Asian countries that concentrated on developing their livestock and poultry sectors rather than producing feed crops.

Farmer participation in feed crop development

Farmer participation in feed crop development is very important. One way of involving farmers is by forming cooperatives. By doing this, farmers are organized into large groups that could pool resources and bargain for access to credit and cheaper prices for inputs like seeds, fertilizers and even farm machinery. However, cooperative development in the country has been relatively slow, although there are also success stories. These stories could be reviewed so that lessons may be drawn and shared with others. Helping farmers form cooperatives will not only help improve farmer participation in feed crop development but it will also help mitigate the negative effects of trade liberalization. Farmers that form a cooperative have the potential to better cope with competition.

Farmer participation in feed crop development is also through extension programmes like field demonstrations, educational trips and the training of farmers at different agricultural research institutions (e.g. IRRI and PhilRice). Contado (2003) enumerated six major players in extension services: 1) Agricultural Research and Development (R&D) institutions; 2) Department of Agriculture attached agencies; 3) Local Government Units (LGUs) of the Department of Interior and Local Government (DILG); 4) the State Colleges and Universities (SCUs); 5) some Non-Governmental Organizations (NGOs); and 6) private agribusiness companies. Cardenas (2003) opined that plurality of extension in the Philippines is best because it is difficult for any single agency to meet all the extension needs of the country and disseminate different information on relevant knowledge and technology to farmers which are generated by private and public institutions.

Feed crop farming. The government aims to improve farmers' technical skills (i.e. proper use of quality seeds, optimal use of fertilizers, and farm management skills) for feed crop farming. For corn, the government hopes to elevate yield levels by improving seed technologies used in production. These include improving OPV yield levels, encouraging use of hybrid seeds, and providing access to Bt corn. On the use of Bt corn, the government needs to properly monitor the use of the technology, address environmental and consumer concerns raised by some sectors in society, train farmers, and present its benefits and costs. Only with substantial training and information can farmers make good farming decisions. At present, only a draft soybean road map is in place. In order to encourage farmers to plant soybean, the government needs to provide information on cultural management and production practices, in addition to ensuring its market.

Response to market development. A market is what drives farmers to produce. Information asymmetry discourages farmers to produce. Lack of infrastructure such as roads and post-harvest facilities leading to waste is also another area that affects marketing. For corn, the demand centres where most feed mills are located are in Luzon, while the bulk of production is in Mindanao. Feedmillers opt not to locate in Mindanao due to the peace and order situation and the high cost of transporting their feeds to Luzon where the majority of livestock producers are located.

In order to address these problems, two key areas need to be pursued. To address the problem of farmer's access to information, market matching can be done. In this way, a guaranteed market is given to farmers at the same time ensuring them premium prices for their produce. The peace and order problem in Mindanao is complex as it involves economic, political and socio-cultural issues. Suffice to say that addressing the economic issues is tantamount to providing economic opportunities for the Filipinos in Mindanao. A genuine peace deal with the Muslim separatists in Mindanao must be brokered to achieve national unity to achieve development.

Response to manufacturing development. Although corn and soybean are primarily used as feed crops, they are also used as raw materials in the food and cosmetic manufacturing sectors. Corn is increasingly being utilized as processed snacks such as chips, as well as used in cosmetic products and adhesives. Soybean is also used as soy milk, tofu and soy sauce, among others. These alternative uses for corn and soybean increase demand and are therefore good for farmers since it increases farm gate prices. Developing these products, however, competes with feed production. The government should therefore work harder to ensure increased production of corn and soybean.

Measures to mobilize farmers' involvement. The measures to mobilize farmers' involvement in feed crop development are spelled out in the Ginintuang Masaganang Ani (GMA) Program. The government aims to organize individual farms into farm clusters. A farm cluster is defined as any contiguous prime corn area of at least 400 hectares situated in municipalities within the Strategic Agriculture and Fisheries Development Zones (SAFDZs). Programmes are then focused on improving productivity in these farm clusters. This strategy is an area-based approach, where the farmers' needs are met depending on the characteristics of their area. In general, the objective of this area-based approach is to improve farmers' access to technology, inputs, credit, post-harvest facilities, marketing infrastructure and support systems, human resources, and institutional development.

Farmers are considered stakeholders in feed crop development. In this case, they are also consulted and encouraged to be involved in the planning, monitoring and evaluation of government programmes. A participatory approach, such as this strategy being advocated in the government programme would produce much more tangible results compared to centralized planning where only a few participate. With this approach, area-specific problems and strategies are more easily formulated. Forming cooperatives is also being advocated to further improve farmers' participation in feed crop development. It also allows farmers to have a chance to cope with trade liberalization, have greater bargaining power to procure cheaper inputs, access to credit, as well as access to marketing and infrastructure support. However, what is important with maintaining the viability of cooperatives is having a system of accountability in place.

Potentials and constraints to feed crop expansion – SWOT analysis

A SWOT analysis for the three feed crops under study better provides an overview of what problems confront the feed crop sector. It also shows the strengths and opportunities that can be used to achieve greater development in the feed crop sector.

Corn

Strengths:

1. ***High demand or consumption of pork and poultry products which translates to high demand for feeds. Corn is considered a derived demand of livestock products.*** Pork and poultry products use feeds that have 65-75 per cent corn as a primary ingredient. As such, higher demand for these two livestock products would lead to higher demand for feeds. Consequently, the high demand for feeds translates to higher demand for

corn. Given the increasing population, pork and poultry demand is also projected to increase in coming years. During the last decade, the pork and poultry sectors have demonstrated that they are indeed bright spots of Philippine agriculture, posting positive growth despite the financial crisis in 1997 and the El Niño phenomenon in 1998.

2. ***Existence of a National Corn Program.*** A National Corn Program is crucial because it puts forth necessary support for the corn sector. Concerns regarding production, post-harvest, and marketing are highlighted and strategies are put in place. An important aspect of the programme is its effective and efficient implementation.

Weaknesses:

1. ***Lack of infrastructure such as farm-to-market roads, irrigation, post-harvest facilities, and trading centres that lead to high transport and marketing costs; hence farmers tend to sell their produce raw and unprocessed at prices dictated by traders (PCARRD, 2002).*** The importance of infrastructure in feed crop expansion cannot be overemphasized. Lack of rural infrastructure works against farmers in two ways: one, farmers don't have access to cheap inputs and two, their produce cannot make it to the market on time or in good condition. Lack of irrigation facilities also inhibits production. In the end, farmers suffer because they are unable to produce quality crops, hence, lower prices for their produce. Lack of infrastructure makes the domestic price of corn uncompetitive.
2. ***Seventy per cent of production as estimated by BAI is contaminated by aflatoxin.*** Aflatoxin contamination significantly reduces the price and the demand for corn.
3. ***The low yield performance of corn compared with other Asian countries has led to supply deficits.*** Low yield performance is the main reason why local corn production is low. While livestock and poultry producers are rapidly expanding their production to meet demand, the corn sub-sector is unable to cope with the demand for corn as feed.
4. ***Inadequate credit and financial assistance to corn farmers due to insufficient allocation of funds to Quedancor.*** Farmers have very few financial resources. They rely on the income they receive from their produce. With no access to credit, they will be unable to purchase the necessary inputs like seeds and fertilizer to produce corn.
5. ***Declining area planted to corn.*** The area planted to corn on average has been declining by 2.9 per cent from 1988-2002. Since total land area is fixed and cannot be expanded, source of growth from corn production can only come form the use of new technologies like Bt corn.
6. ***High price of hybrid seeds and other inputs.*** Farmers need quality seeds such as hybrid seeds to raise production. To achieve their yield potential, hybrid seeds require other inputs. The high cost of the seeds and the inputs hinder farmers from fully realizing the potential of hybrid seeds.

Opportunities

1. ***Mechanization of production, processing and handling (establishment of the Grains Highway Program). Through this, grain quality will be enhanced and the logistical costs will also be lessened (DA Roadmap, 2003).*** Mechanization of production and improving processing and handling (through the establishment of a Grains Highway program) is intended to improve efficiency both in the production and marketing of corn by lowering costs.

2. ***Presence of high yielding varieties of corn. Conversion of lands planted to traditional varieties into OPV areas, and OPV areas to hybrid areas. The conversion of lands planted with OPV to hybrids could double the corn yield of 3 mt/ha (DA Roadmap, 2003).*** As of 2002, 52 per cent of total area harvested was planted with low yielding traditional varieties, 10 per cent was planted with OPVs and 38 per cent with hybrids (DA Corn Roadmap, 2003). Converting traditional seed users to OPV, and OPV to hybrids will greatly increase corn production.
3. ***Commercialization of Bt corn.*** The Asiatic Corn Borer (ACB) is a major pest in the Philippines. It reduces yield by 4-31 per cent (Teng, Fernandez, and Hofer (1992) and Logroño (1998)). Field trials by Monsanto in 1999 demonstrated that Bt corn not only reduced this pest damage but also has higher yields compared with other varieties (James, 2003). Thus, the potential for Bt corn to increase farmers' yield levels would ultimately help increase their income. However, Bt corn is controversial, particularly with respect to environmental and consumer safety concerns. Bt corn however, remains a technological option for farmers. A proper analysis of the benefits and costs should be conducted, including environmental, consumer and ethical concerns of using this new technology.

Threats:

1. ***Feed wheat is increasing in acceptance as a substitute for corn in feed formulations. Corn has a 35-37 per cent tariff compared to feed wheat's 7 per cent, making the former easier to import than the latter***. Inconsistencies in the tariff structure leads to negative effects for corn, such that livestock producers are using wheat instead of corn in their feed formulations. This translates to lost income for local corn farmers.
2. ***Soil degradation from intensive cropping, resulting in declining land productivity.*** Years of intensive cropping have resulted in lower productivity of the land. Replenishment of soil nutrients is not enough for the land to cope with the cropping patterns.
3. ***Peace and order problem in Mindanao where the bulk of corn is produced.*** Mindanao, referred to as the "land of promise, a land of milk and honey" is undoubtedly resource-rich. The potential growth for Mindanao will remain unrealized so long as the peace and order problem persists.
4. ***Unpredictable weather conditions in the country (occurrence of storms – La Niña - and severe drought - El Niño).*** According to the BAS (2003), 85 per cent of corn losses were due to typhoons and floods. The government should provide alternative livelihood programmes, crop insurance systems and other coping mechanisms to mitigate farmer's losses during unpredictable weather.
5. ***Livestock and poultry diseases (e.g. bird flu, FMD, etc.).*** As already stated, corn demand is a derived livestock and poultry demand. Anything that negatively impacts the livestock industry will also negatively impact the corn sector. As such, reduced demand for corn could likewise be expected when livestock and poultry are negatively affected by factors such as bird flu, FMD and others.

Rice

Rice being a staple in the Philippines receives considerable government support. By-products of rice used in the livestock industry include rice straw as roughage, rice bran, rice hulls and broken rice grains. However, rice cannot be categorized under a feed crop policy agenda since it is used primarily as food.

Strengths:

1. ***Widely available because it is the staple food of Filipinos.*** There will always be readily available by-products such as rice bran, rice hulls and broken rice for the livestock sector given that rice is a staple food.
2. ***Extensive R&D programme.*** The rice sector is fortunate to have an extensive rice programme due to the relatively high budget allocation for its R&D. There are two rice R&D institutions in the Philippines, PhilRice and IRRI. In addition, a strong rice R&D network exists. The country has a pool of experts and scientist capable of implementing a rice R&D programme. Like corn, there also exists a rice programme that includes strategies to address the problems and challenges faced by the sector.

Weaknesses:

1. ***Lack of hybrid seeds and certified seeds in some regions (DA Rice Road Map).*** Hybrid and certified seeds have high yields. The availability of these seeds poses a problem for farmers and this forfeits their chance to raise yield levels. The government targets a harvested area of 1 M ha. for certified seeds and 0.8 M ha for hybrid seeds.
2. ***Inadequate transport and post-harvest facilities lead to low palay procurement during the wet season. The lack of post-harvest facilities also results in high post-production losses.*** A moisture content of at least 18 per cent is required for palay to fetch premium prices. This is necessary to have a quality-milled rice. Without proper post-harvest facilities, farmer's produce are either not bought or command low prices.
3. ***High production cost (R&D Status and Directions, PCARRD).*** Domestic rice production costs in the Philippines are generally higher compared to other Asian countries such as Viet Nam, Thailand, Indonesia and China. Consumers are at the losing end of these high costs because it translates to higher prices. Lower production costs for rice must be pursued in order for the sector to be able to compete in a liberalized economy. Some of the factors that contribute to the high production costs are poor access of farmers to technology and inputs and lack of infrastructure support.
4. ***Insufficient irrigation facilities.*** Rice production requires adequate amounts of water, so irrigation becomes essential. Without irrigation facilities, farmers plant only during the rainy season when water is available. They are also unable to diversify to other crops. Availability of irrigation facilities is indeed important to allow farmers to maximize their land use.
5. ***Poor farm to market roads.*** Poor farm-to-market roads negatively affect rice growers since this increases the cost of marketing and the prices of inputs.
6. ***Dependence of farmers on government subsidies such as hybrid rice seed procurement.*** Rice farmers received generous government subsidies during the Marcos regime (late 1970s to 1980s) up to the Aquino regime (late 1980s). At present, they still receive support but not in the form of subsidies because this is no longer allowed in the GATT-WTO. Too many subsidies, which were supposed to be an incentive, resulted in a disincentive for farmers to do their share of improving their farm operations. Ultimately, once these subsidies were removed and liberalization was introduced, rice farmers had great difficulty coping and competing.

Opportunities:

1. ***Increasing domestic demand due to high population growth.*** Population growth in the Philippines (2.3 per cent) is quite high compared to other Asian neighbours and consequently, domestic demand is expected to further increase. It is an opportunity because it serves as a ready market for rice.

2. ***Availability of high yielding varieties with a corresponding technology package (R&D Status and Directions).*** Rice technologies packaged by R&D institutions like PhilRice and IRRI are readily available. How these technologies can reach farmers for their adoption is an important consideration.

Threats:

1. ***Unpredictable weather conditions in the country (La Niña and El Niño).*** This problem confronts all agricultural activities in the Philippines, including rice. In 2003, 53 per cent of palay crop losses were due to the prolonged dry spell and 41 per cent were due to typhoons and floods (BAS, 2003).
2. ***Availability of cheap imported rice from neighboring countries.*** Rice is cheaper in other Asian countries. In fact, some policy experts advocate for the Philippines to just be a rice importer since the country is not in a position to compete due to high production costs.
3. ***Rice Smuggling.*** Smuggling problems confront almost every sector. Rice is not an exemption. Farmers lose their incomes due to smuggling.

Soybean

Strengths:

1. ***High demand for pork, poultry and aquaculture products translates to high demand for soybean and soybean products.*** Pork, poultry and aquaculture also use soybean as feed. Given the high demand for these commodities, soybean will not have difficulty finding a market.
2. ***Known ability of soybean to improve soil productivity.*** Given the soil degradation trends in the Philippines, soybean is a good alternative crop because of its known ability to contribute positively to soil productivity.

Weaknesses:

1. ***The country is a net importer of soybean and soybean products. In fact, it is included in the top ten agricultural imports of the country.*** The dependency of local industries on imported whole soybean, soybean meal and oil for various uses means that they are subject to volatilities in the world market as well as the domestic exchange rate. The competitiveness of the local industry is undermined because of this dependency.
2. ***Low productivity among farms due to insufficient or non-application of fertilizers (Mangabat, 1998).*** Part of the reason for this weakness is the lack of technical expertise on the part of farmers. Soybean cannot be expected to achieve higher yields without the proper use of complementary inputs (i.e. fertilizers).
3. ***Lack of drying and other post-harvest handling facilities especially during the wet season, leading to deterioration in the quality of the produce (BPRE).*** Due to this, farmers are discouraged from planting soybean. Low quality commands low price, thus, net farm incomes from soybean are low.
4. ***Lack of market outlets and good prices (BPRE).*** Lack of sure markets where good prices are guaranteed discourages farmers from planting soybean. A market is available for soybean amongst the livestock, poultry and aquaculture sectors. However, no transactions occur because there is no means of facilitating the exchange.
5. ***Declining area harvested and domestic production of soybean.*** This is due to the lack of incentives for farmers to continue planting soybean. Ensuring a market for their produce could help counteract this threat.

6. ***Few agencies are disseminating technical knowledge on production and utilization of the crop.*** Soybean farmers do not get much support from the public sector. Only a few agencies disseminate technical knowledge on the production and utilization of this crop. Thus, there are also a limited number of soybean farmers. Ultimately, a soybean industry is not able to take off from its present status.
7. ***High cost of inputs used in production (Mangabat, 1998).*** Inputs are the key to efficient production of soybean. If farmers don't have access to cheaper inputs (seeds and fertilizers), the soybean industry will not become viable because other measures (such as raising tariffs on imported soybean) are no longer possible.

Opportunities:

1. ***Presence of a contract growing scheme for an assured market of the commodity.*** A contract growing scheme will assure farmers of a stable source of income. With this scheme, the necessary inputs are provided to farmers because the buyers desire quality produce. A major contract grower of soybean in the country is Nestle in Cagayan rovince.
2. ***Increasing consumption of soybean as feed due to increasing population of livestock, as well as food (milk, sauces, tofu, taho, etc.) due to promotion of the crop as a food supplement.*** Soybean has many uses. It is used as feed and as raw materials in the food manufacturing sector. The potential for an expanded and diverse market is available for farmers.

Threats:

1. ***Availability of cheaper imported soybean and soybean products from other countries.*** In fact, domestic prices on average were above international prices by 53 per cent from 1994 to 1997 (Mangabat, 1998). This makes it difficult for a domestic soybean industry to develop. Raising tariffs on imported soybean is not a viable option. To counteract this problem, the government may resort to training farmers to plant soybean, improving access to cheaper inputs (seeds and fertilizers), and providing of infrastructure support.

Conclusions and recommendations

Demand for corn, palay and soybean is expected to increase in coming years. This is attributed to the increasing demand for feeds due to the rising demand for livestock and poultry products, an increasing population, and increasing demand from the industrial and manufacturing sectors. The growth in corn and palay production in the past 15 years could not keep pace with the high demand. Thus, huge supply deficits are anticipated. Ultimately, import volumes are expected to increase for these feed crops to fill the deficits unless something can be done to increase domestic output.

The feed crop sector is closely linked to the livestock and poultry sectors, where as much as 60 per cent of the sector's production costs are accounted for by feeds. Many commercial livestock and poultry firms that are vertically integrated into the feedmilling enterprise have reduced their feed costs, allowing them to be more price competitive (Habito, 2002). In the Philippines, however, commercial firms produce only a small percentage of total animal inventories since 77 per cent of swine and 99 per cent of cattle and carabao are raised backyard. This implies that improving the competitiveness of the livestock and poultry sectors means providing access to cheap and quality feed crops and livestock production arrangements that would consolidate backyard farmers. By consolidating backyard farmers, they could also follow

commercial firms and vertically integrate with a feedmilling enterprise. Also, being consolidated as a group provides them with bargaining power that would allow them to have access to inputs at lower prices.

Livestock and poultry production trends exhibited positive growth in the last 15 years, from 5-8 per cent. Thus, there is also room for the feed crop sector to expand. What is crucial is to meet the volume and quality demanded of feed crops, especially corn and soybean. Imports of these feed crops, however, is inevitable.

Production trends for corn, palay and soybean were also reviewed. For corn and soybean, a decline in area harvested by 3 per cent and 11 per cent per annum, respectively, was observed from 1988 to 2002. The growth in corn production was mainly due to the growth in yield by 3 per cent. In the case of soybean, production declined 10 per cent annually, while yield growth was only 1 per cent. Local soybean farmers were only able to supply 0.4 per cent of total supply in 2002. Unlike corn and soybean, rice had a positive annual production growth of 4 per cent and yield improvements of 3 per cent per year. These production trends contributed to the supply deficits for these feed crops.

Consumption trends were likewise presented for the three feed crops as well as other foods (e.g. meats and cereals, among others). Based on FNRI surveys, there was a declining trend in per capita consumption of cereals and cereal products by 2.51 per cent from 1978-1993. This was mainly due to the decline in consumption of rice, corn and their products. On the other hand, meat, poultry and their products had increasing consumption trends: 15.6 and 29.5 per cent respectively. These consumption trends highlight that demand for corn, rice and soybean as feed could be expected to increase in the next decade.

Based on FCRs from past studies and feed crop production, consumption and economic data from 1988-2002, supply and demand projections were made. Results indicated that the demand for corn as feed could range from 6.3 to 6.7 million mt by 2015, while demand for rice bran would be 2.5 million mt or rice as feeds at 0.9 million mt by 2015, and approximately 2.7 million mt for soybean meal. However, projections on production, given current area harvested and yield growth rates, indicated that it would not be able to meet this high demand. Assuming that local production will be channeled only to feed utilization, only 65 per cent of corn feed and 75 per cent of rice bran demand could be met by local production. Soybean demand would almost entirely be met by imports.

These sufficiency levels could still be raised. First, most farmers have not achieved the potential yield levels for corn and rice. Soybean farmers are very few in number because of the lack of technical skills in soybean production and the uncertainty of the market. Second, in the short-term, relying solely on imports is not necessarily the best option because of the predicted increase in demand for meat and poultry products from other Southeast Asian countries. This means an increase in demand for these feed crops within these countries. Volatility in world market prices for these feed crops could be expected.

In order to lessen or completely eliminate the supply-demand gap, policy recommendations and other measures were made for corn and soybean. The policies are focused on production, post-harvest, infrastructure, and development linkages with other relevant sectors for the feed crop farmers. Only corn and soybean policy recommendations are discussed since rice is covered by food policies of the government. Given that rice is a political good, it enjoys a considerable amount of government support.

Production policies

The government should improve the access of farmers to new technologies so that yield levels could be raised and further increase domestic production, especially yellow corn. Access

could be improved by providing farmers credit to purchase these quality seeds (e.g. hybrid corn, Bt corn, higher yielding OPVs) as well as the necessary inputs such as fertilizers.

Along with improving access to seed technologies, the government should also improve its extension programmes so that effective farming practices (appropriate use of various seed technologies, integrated pest management, assessing soil quality, choosing appropriate seeds in particular locations) can be shared with farmers.

Production arrangements, like the recent ₱ 2 billion collaborative project of San Miguel Corporation and Quedancor for a soybean plantation in Surigaro del Sur is a model to observe. The project involves developing a 400 ha soybean plantation. If this is successful, similar arrangements for corn can also be made, consolidating farmers' land into one big plantation and providing them with farming support. The advantage of this model is that farmers can access quality seeds, new farming technologies, as well as a sure market. For corn, the possible partners are the livestock and poultry growers. Market tie-ups could be pursued and these livestock and poultry producers could provide credit and quality seeds. This would also help ensure that they receive quality feed crops.

Post-harvest facilities

Storage facilities are important for corn. The lack of proper storage facilities has caused large losses due to aflatoxin contamination and spoilage. Livestock and poultry producers also are disadvantaged because the reduction in supply causes volatility in domestic prices. The government should provide loans to farmer organizations or cooperatives to establish storage facilities. The farm-cluster approach used by the government is a good approach to be used in developing post-harvest facilities for a group of farmers.

Infrastructure development

Lack of good farm-to-market roads has been a persistent constraint to the development of the agricultural sector in general. It has been advocated time and again that there is a need to improve the road infrastructure in rural areas. Competitiveness in feed crop production cannot be achieved under a liberalized trading regime without proper farm-to-market infrastructure.

Aside from farm-to-market roads, the development of irrigation facilities is equally important. Irrigation facilities will allow farmers to increase their number of croppings per year, thereby increasing overall production.

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Comments on the Philippine Country Report

Danilo P. Baldos[*]

Introduction

The Philippines' country report, I believed has comprehensively and adequately covered the major areas of concerns and issues put forward as tasks for this Regional Workshop on Prospects of Feed Crops in Southeast Asian countries. I must commend the efforts and hard work of Dr. Danilo Cardenas of PCARRD and his team for putting together the wealth of information and carrying out the analyses on feed crop demand and supply, trends in trade, history and prospects of domestic production and consumption including the feed crop sector's strengths, weaknesses, opportunities and threats (or constraints).

Our situation in the Philippines is somewhat unique when compared to the rest of the countries in the Asia Pacific region. We continue to have a high rate of growth in population (averaging 2.3 per cent per year during the last 15 years), sluggish economic performance (in GDP and GNP terms), nearly a double-digit inflation rate (8.4 per cent increase in CPI), and a situation where modest economic growth has been only in the area of the services sector. During the period covered by this study, the Philippines' over all balance of trade was consistently negative, except for 2 years in 1999 and 2000. The trade position in agriculture reflects the same features because the aggregate value of exported pineapple, coconut oil, fresh banana, and fisheries produce (tuna, shrimp and prawn) is lower than the value of imports of soybean products, wheat, milk products and grain (rice and corn). Despite the recent data showing a declining trend, the agricultural sector still accounts for a substantial share (38.6 per cent) in providing rural households with employment. When combined as one, the annual growth rate in gross value added (GVA) contribution of the agricultural, fisheries and forestry sector was very modest at 3.3 per cent during the period of study. Analysis of the sector further shows annual growth rates in GVA terms for agriculture (rice and corn) that have essentially been flat, those of livestock and poultry declining, though only very slightly, and the fisheries rising from a negative position to about 6.0 per cent in 2002.

Ranked in their order of importance and contribution to the protein food supply of the country, feed crop dependent industries are, swine (1.332 million tons), poultry (0.952 million tons), fisheries – milkfish, tilapia and prawns (0.390 million tons), and beef, carabeef and chevon (0.316 millions tons). With the fastest growing industries, swine and poultry posting an average rate of 4.65 per cent and 7.90 per cent, respectively, demand for feed grains is projected to increase considerably. At present, the feed supply situation (3.0 million tons per year) is primarily dependent on yellow corn - of which 18 per cent of the total requirement has to be imported, for rice bran most of it is still obtained from domestic production, and soybean of which nearly 100 per cent has to be imported. Importation of feed wheat at times is noted in the report especially when world prices are cheap and even if prices are not under tariff conditions it still makes a good option. Local production of other feed ingredients such as fish meal, feed additives and minerals all show downward trends suggesting that cheaper and better quality imports could have also been imported. The historical picture for commercial feed production shows more or less consistent growth in the poultry, aqua and other sectors, though it is

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somewhat more erratic on swine feeds. Over all, the commercial feed industry is growing at an average rate of 11.4 per cent per year. On the processing industries side, the feed milling sector is reported to have a total rated capacity of 20,500 tons per 8 hour shift composed of 143 small mills, 72 medium size and 72 others rated at 50 ton or more in capacity. Considering the current year's registry of combined output of nearly 3.50 million tons annually, the feed milling sector appears to be only operating at 48 per cent of its rated capacity. There is a cost associated with the idle use of these capital assets and expectedly may also be contributing to the already high cost of commercial feed.

Existing policies in the feed crop sector and their implementation

There are tremendous opportunities for the Philippines to develop its feed crop industry sector in response to the growing demand for meat, egg, poultry, livestock and fishery products according to the report. However, the development pace of feed crops is by and large dictated by both the short- and long-term policies of the government in agriculture, land reform, labour, land use, banking, trade and industry, and the overall investment environment. For the purposes of this workshop, the commentary intends only to focus primarily on 3 key areas, namely, production, market and industry.

Feed crop area development

Government policies dealing with the production of feed crops, primarily corn and rice have all been short-term in nature. In view of this, area development and the focus have all been arbitrary, with the past and current government programmes still unable to sustain expansion or intensification in area commitment efforts. For instance, it is nearly a decade now since the Department of Agriculture launched its delineation of the country's key production areas (KPA) where the major crop development initiatives were targeted to have taken place but till now activities in those delineated areas have been very slow. Specifically, in infrastructure – the most critical factor in production area development. The outcome, feed crop area plantings have been patchy, too spread out and contracted or expanded each year without any direction. This development environment has left the government with much expense, still unable to see a long-term need to build the required infrastructure, and the private sector and local investors at a loss and therefore unwilling to expand their initial activities any further.

Progress in area development of feed crops is at hand. Recently, under the framework of key production areas (now tagged as cluster areas), Cagayan Valley corn area development is now moving in the right direction attracting the seed companies, providers of mechanized planting and harvest operations, private sector credit providers, and booming input suppliers and trader businesses. Much is still to be desired in terms of investment in infrastructure support such as farm-to-market roads, and the private sector establishing additional post-harvest facilities, storage and possibly feed milling. It is in this situation that over the long-term, the government is expected to go a long way in clearly understanding and promoting its position to fully develop the key production areas not only for feed crops but for others as well.

Production technology promotion

In the area of production technology, the present government's "GMA Corn Program" for instance is to be noted as primarily promoting the use of hybrid corn technology in the traditional corn areas. Such a programme traces its origin from the "Maisan Program" of the

70's that focused on the use of improved open pollinated corn varieties to replace the farmers' land varieties but was met with limited success. Over time, and with the private sector assuming the lead and the business interest, hybrid corn technology has vigorously been promoted by 3 multinational seed companies since 1975 and for almost 30 years now the adoption rate has only been 37 per cent (478,000 ha planted twice a year or 957,000 ha harvested area). Truly, big strides have been achieved when this position is expressed as a percentage of the total yellow corn areas, as the hybrid seed technology use translates as 84 per cent. Despite such efforts, national corn yield levels have been only 2.2 tons per ha on average. One may ask - why is this so? It is important to note that the government's programmes are designed for technology promotion initiatives and given the situation of limited farmers' access to credit, often the timing and application of inputs including the adoption of recommended production practices at the farm level have been far from the level desired. The net result, average yields in hybrid yellow corn below the actual yields of 4.2 tons per ha normally obtained by farmers using best practices. A similar situation exists in the promotion by government for hybrid rice technology that is now gaining noticeable acceptance among farmers.

More recently, Bt seed corn has been released for commercial use and while proven most effective during the wet season planting especially in areas with high incidence of corn pest, the adoption rate and use among corn farmers is slow due to a price tag that is almost double the non-Bt seed. Due to its insect protective attributes, the Bt corn technology has also been documented to result in clean harvested corn ears with much lower aflatoxin contamination. Another area where corn production technology will have considerable influence in reducing farm-level cost is mechanization since roughly no less than 30 per cent of farm work is still manual labour. Unfortunately, even with the enactment of the "Agriculture and Fisheries Modernization Act" current government policies are still too restrictive for service providers or even cooperatives to acquire tractors, planters, fertilizer applicators or crop protection equipment. Brand new machines are quite expensive but the use and importation of secondhand machinery has not been accepted or explored. Presently, farm mechanization is in the groundbreaking stage in only one key corn production area.

Credit and financial support

As always, the government is under tight budgetary constraints, and faced with a history of poor credit collection and repayment by borrowing farmers, it has now minimized its exposure in credit support services. Still, there is now an existing government initiated Quedan Credit Corporation or QuedanCor programme in place but this in fact is very small, estimated to have a total credit portfolio of less than ₱ 1 billion to serve several commodities. Due to budget limitations, credit support to corn production in many areas has already been withdrawn and farmers have been left to rely much on informal credit systems to finance their operations. In the Cagayan Valley region alone, private creditors and financiers bank-roll the corn farmers to the tune of no less than ₱ 2 billion in credit each year. As for the banks, farmer credit from banks had been largely untapped because of the high risks and servicing costs associated with dealing with individual farmers. In addition to poor repayment among farmers, the numerous documentation requirements farmers have to comply with is viewed as enough of a deterrent to even the most avid farmer-borrower. Banks have also a bias against agricultural credit and loans, often preferring to lend funds to the industrial and manufacturing sectors. The government must still provide feed crop farmers access to credit, not by direct lending as it has done in the past, but by some other innovative means, and bring the largely untapped financial resources locked in banks to these users. The government also has to understand that lending by the private sector and financiers will continue for sometime in the future, as it is a lucrative

business to operate in the rural areas and must look into ways how it can possibly take part in this existing informal credit system. Perhaps, by giving the private lenders and financiers access to cheaper credit under agreements that borrowed funds will in-turn be lent to farmers at a nominal mark could will be a workable alternative.

Market infrastructure

The market infrastructure for feed crops in the Philippines is developing but only slowly, therefore market channels are still typically multi-layered and expected to take out most of the margins that can be realized from domestic trade in grains. As such, this can be cited as also one of the reasons why domestic prices tend to be higher than the world market. Fully aware of the constraints in the marketing system, the government has initiated more direct involvement, supporting local government unit (LGUs) initiatives to establish so-called buying centres or trading posts under the Department of Agriculture. But the scale has been so minute and minimal that such facilities are often makeshift in operation and eventually left as just empty structures. While the NFA is mandated to be actively involved in alleviating the constraints in domestic grain trade during the peak of harvest, it has neither the budget nor the up-to-date equipment and reach to handle a sizeable fraction of the grain trade in the rural areas.

With highly constrained government activities in the domestic trade of feed grains, the majority of the stocks are consequently held in private hands – a situation that is desired in a free market economy. However, the ability of the private sector to handle the incoming stocks is also currently limited as they have not upgraded their facilities nor expanded their capacities to absorb the increasing production volume delivery of the feed crop farmers. In many rural areas not served by all weather roads, the stocks must remain in farmers' houses delivered to the grain buyers only during the dry season (in Cagayan Valley for instance, no less than 150,000 tons of corn from the wet season crop do not enter the trading system until 4 months later). The high cost of borrowing money, the expense in keeping grain inventory, and the threat of cheaper imports are probably the major reasons why private sector traders have not upgraded facilities and expanded their operations. Hence, market infrastructure remains underdeveloped. Further, the development of a public market, also handling feed grain trade in rural areas, has been delegated to the local municipal and provincial governments, and by law allowed to retain only a fraction of their internal revenue allocation income, these neither have the capacity nor the access to large enough loans to invest in improving their market infrastructures. And unlike in other countries where the feed milling sector is to some extent vertically integrated with the feed crop market structures, this situation is yet to happen in the Philippines.

Post-harvest and storage facilities support

The government's current policy direction on post-harvest facilities is in loan terms, providing equipment to farmers' groups and cooperatives. Lacking the skills, experience and the cohesiveness to keep these facilities in operation, much of that support ends in failure. Moreover, the present grain trading system only pays marginally on properly dried grains and small purchases of well dried and good quality grains are often mixed with the rest of the bulk to facilitate volume handling. Sadly, the government has not learned from this. Although, investing in bulk handling facilities with attendant post-harvest equipment is perhaps the right way to build such infrastructure support to the feed crop industry, who will do it and more importantly, who will pay for it is not exactly clear under current policies.

It is estimated that there are large enough business opportunities for the private sector to be realized in investing in post-harvest handling and storage facilities for feed crops. When given access to credit at reasonable interest rates (or even subsidized rates), existing traders can upgrade to better facilities, if only to expand and grow their business operations further. There is a catch to this option however, what to do with the largely unused capacity of the National Food Authority (NFA) - the government's food and feed trading entity. Traditionally, taking on mostly import transactions, the NFA lacks the operating funds to procure and keep under its control even 5 per cent of the country's domestic production volume. In recent years, a policy has been set to privatize the NFA with loan support from the Asian Development Bank but the government did not ardently pursue its implementation. It is surmised that while the government wanted to privatize the NFA it also still wanted to keep some of its operation under government control - a clear case of a dilemma in policy implementation.

Pricing and price support

Unlike previous feed crop development programmes, the government's setting of the minimum purchase price for feed grains is no longer in operation. Although there are still set directives on the buying price at NFA warehouses to procure feed grains locally, the volume of domestic trade handled by this facility is insignificant. Domestic farm gate price on feed grains is therefore, more or less demand and supply driven. There is substantial price variance in feed grains from Luzon with that from Mindanao, the major determinant being the usually higher cost of grain handling and shipping from Mindanao to Luzon where most of the feed millers are located (farm gate prices on offer in Mindanao are generally lower to offset the higher handling and shipping costs). As shown in the country report, the price of locally produced feed grains in the Philippines is much higher than regional or world prices. This might be viewed as a function more of the yield levels rather than of production costs as input prices are not significantly higher in the Philippines than anywhere else.

In view of the lower yields and consequently higher production costs of domestic feed grains, the government normally regulates the entry of cheaper imports. It does this by keeping import inflows to a minimum (the so called minimum access volume or MAVs) as permitted by trade agreements and then timing the delivery to coincide with the lean months, thereby achieving minimal impact on domestic prices. On the feed milling side, imports of feed grain substitutes such as feed wheat and barley are still permitted especially when world market prices are particularly depressed. In a practical sense, the government does protect the feed crop industry indirectly – a move that it will have to take to safeguard the millions of small farmers growing feed crops until improvements in yield and reductions in production costs are achieved.

Imports and trade

A policy of regulating importation is still the major strategy of government to place the trade of feed crops under its control and the NFA is very much pivotal in this effort. To a great extent, imports are often tied to government access to a credit facility or aid, as is the case of imports under the US PL 480 programme. Occasionally, there are however, cases of smuggled feed grains – primarily milled rice-that are apprehended, confiscated and then auctioned off in favour of the government. Despite such efforts, the retail prices of feed grains in the Philippines are still so attractive that there is enough margin to make and the risks are low enough to bring in smuggled stocks. The Philippines is signatory to several trade liberalizing agreements, and adheres to what other countries are also implementing in terms of policies – to cautiously

implement and comply with such agreements. There is slow implementation of the needed safety nets to permit the Philippines to fully abide by the agreements signed concerning international trade, such as the GATT- WTO, including the trade of feed grains.

Industry Plans and Direction

Government policies that influence the feed milling sector have the most profound affect on feed crop development. For example, where the government has permitted the entry of big players whom have brought with them the resources and technologies, and have successfully integrated the businesses of minor players and transformed them into sizeable operations have offered much needed competition to local players. Positioning and expanding milling operations in Mindanao where a supply of feed corn has been traditionally moved to Luzon, has already spurred growth in poultry and swine contract growing in the south. The threat has also obliged the small feed milling operators south of Luzon to set up feed grain buying stations or to link with the feed grain traders in the north. Interest among the feed millers and government to develop the local soybean and cassava industry as sources of feedstuff is already receiving serious attention.

With the foregoing developments, the Department of Agriculture has again revived interest on previously set key production areas as take off points in its industrial development road maps wherein the intent is to better link the feed crop area development to the feed milling and livestock industry base. Considerable investment on the part of the government to implement its industrial road map plans, however is needed and the government is already investigating funding sources internally and externally. And unlike previous initiatives, private sector participation from the feed milling and the livestock sectors has now become an integral part of the industry plans and in setting the industry direction.

Information support to industry

As a matter of policy, the government has pledged support to better provide industry with up-to-date information. Implementation of programmes under this initiative are now only held back by the government's slow pace in modernizing the agricultural and fisheries sectors as mandated in the Agriculture and Fisheries Modernization Act of 2001. But recognizing that information support systems are crucial to industrial development and promotion, the present government is seriously looking at extending support for the implementation of AFMA law until 2010. This will then definitely accelerate the efforts of putting in place industrial information support systems that the various government agencies are currently struggling to initiate.

Research and development

The Department of Agriculture fully recognizes the potential impacts of R&D not only on the feed crop sector, but on the entirety of the agricultural and fisheries sectors and, much of its policy directions are underpinned by this position. Unfortunately, it does not have the luxury of having to allocate funds to fully support all the research and development initiatives and projects from the public R&D institutions. Over the short-term, limited support for R&D, as a whole, and for feed crops in particular, should be expected. Fortunately, the periods of limited public R&D support have created a situation where trained expertise in public institutions has moved to industry where their knowledge and skills have been put into use solving industry

problems - what the government has lost, the private sector has benefited from. Undoubtedly, this movement has substantially strengthened R&D in the private sector. Meanwhile, limited interaction between the industries and public sector R&D has led the researchers to become alienated from the problems of the industries and consequently worked on projects they thought were industry problems. The current situation, many research projects and results have yet to be re-validated if in fact they are needed by the industries or useable by the industry production base – the farmers.

Public – private partnership in R&D were buzzwords in the Philippines years back, but such partnerships have been the subject of scrutiny, not from the private sector but mostly within government R&D institutions. The private sector finds public research organizations too bureaucratic to work with. In my opinion, the public R&D system must re-invent itself to become more responsive to the problems and needs of the feed crop industry. Having worked with the private sector for years, I am fully aware that R&D is just a small part of the whole business or industry chain that can be easily folded up or put in the dustbin if the business environment becomes increasingly difficult. This must be fully understood and appreciated by the government's R&D institutions for them to be relevant to the industries they are saying they are trying to help and support.

Implications of selected policies in the feed crop sector

Government policies affecting the feed crop sector in particular, and the agricultural and fisheries sectors in general, have all been anchored on issues of economics, politicies, social, and more recently global competitiveness. Therefore, any policy promulgation will have complex implications that are often difficult to simplify. In this commentary, I will attempt to pick only those government policies reported in the country presentation that in my opinion will have significant implications in shaping the feed crop industry sector.

Policies on agro-industrial and feedstuff industries

As discussed in the country report, many of the policies in the area of the feed crop sector are related to regulatory standards, compliance and administrative procedures. The Bureau of Animal Industry (BAI) oversees the manufacture, importation, distribution, advertisement and sale of livestock, poultry, aquaculture and specialty feeds, veterinary drugs and chemical feed additives. Concentrating much on regulatory functions, the BAI has overlooked policies that will guide the rational and more robust development of the feed industries, feed crop area development, and related sub-industries that will sustain it. For example, will consolidation and merger in the feed milling industries enhance feed crop area development to ensure a guaranteed supply and quality of feed grains over the long-term? There are no clear cut answers to this. It is a fact that size and magnitude of business operation is a critical success factor to maintain competitiveness and ensuring growth of industries. As already shown in many places, integrators are generally better able and usually have the financial might to spur and lead robust industrial growth.

Agricultural policies

While the Philippines has enacted its agriculture and fisheries modernization law, implementing guidelines of that law vaguely sets the direction and policies on what, where and how modernization is to take place. Therefore, interpretation of the law has been more

government involvement and intervention, higher stakes and participation, and more public reliance on its programmes despite a generally regarded poor track record of implementation. The government has under its management the Agriculture Competitiveness Enhancement Program (or ACEP) Funds targeted at lending to enterprises and projects that are aligned to promote competitiveness. This fund, unfortunately has low visibility, limited reach, and is yet to imbibe an industry development focus, for example feed crop area development in support of the feed milling and livestock industries.

Rather than setting a long-term path to agricultural and fishery industry development, programme orientation is followed by the government as exemplified by the GMA banner programmes it now implements for rice, corn, livestock and high value cash crops, all of which are currently constrained by budget cuts. By their nature and operation, programmes are perceived as short-term strategies, short of critical mass, weak in continuity and lacking assurance of sustainability. It is in this context and in my opinion that the agricultural policies cited in the country report will not have much impact in any feed crop development initiatives in the Philippines.

Market and trade policies

The managed exchange rate float, tariff and inflation targeted policies of the government are not expected to impact many feed crop industries, even when much of the hybrid seeds, fertilizers, chemicals and machinery are now all imported with minimal tariffs under the AFMA law. So far, tariff impositions on imported feed grains appear to be holding back the entry of cheaper imports expected to negatively impact the feed crop industry. To effectively manage the feed grains' trade position, the government still intends to maintain the state trading activities of NFA. Adhering to its commitments to international trade agreements the Philippines has signed such as; AFTA, APEC and GATT-WTO, the government is expected to comply selectively and advantageously in accordance with its interest in view of its slow pace in implementing the safety nets that the agricultural and fisheries sectors need.

The case of soybean being an important feed ingredient deserves some attention. The report presented the view that industrial development needed critical review. Given the present situation of very limited area planted, the analysis of competitiveness and then taking the view that it is uncompetitive I would say has to be seriously re-examined. The yield levels on local soybean farms are no poorer than in other tropical countries that opt to grow the crop, and I believe the technologies needed to improve yields are at hand, the only thing lacking is the will and persistence to ground a sizeable production area deserving industry status (say a 100,000 ha production base). There are good areas in the Philippines where soybean can be grown profitably and even just to attain a 30 per cent target level of import substitution is already a noble and achievable goal.

Conclusion and recommendations

The country report's analysis of strengths, weaknesses, opportunities and threats of the feed crop industry is commendable. The points brought to a fore, however, are not new and essentially were the same points probably presented and discussed in other workshops or forums years back. The Philippine government is fully aware of this, recognizes the situation and is now addressing these points within the limits of its financial, administrative and physical resources and expectedly the progress has been slow. Fortunately, private sector businesses are now more active in seeing to it that government efforts are complimented by their interest to

further develop the feed crop industry. Their participation and commitment of financial support are now more visible in several industrial development road maps initiated by the Department of Agriculture.

The realization is seen, that as livestock industries among countries in the Asia Pacific region have grown and will continue to grow, competition for sourcing the needed feed grains becomes more acute. Therefore, intensification or expansion of domestic production is now given more serious attention. It is to be noted that even those countries that use to export feed grains, say Thailand, are now opting to use these grains domestically with a view to export the higher value products from poultry, livestock and fisheries. Breakthroughs in technology from elsewhere and easy access to inputs will be expected to make it easier to intensify the development of feed crops in countries that grow these crops on a small scale but are moving towards commercial production operations. And as time and experience have proven, success is achieved, not in putting an entirely new system where everybody will have to learn, but building on, and making improvements to existing production systems, and then growing these to the fullest extent possible. On this note, I am still optimistic the Philippines will be able to see and actually implement what needs to be done, and achieve significant advancement in its feed crop industries.

Prospects of Feed Crops in Southeast Asian Countries: Thailand (FEEDSEA)

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Executive summary

The major objectives of this study are: 1) to review and analyze the current production situation, consumption, marketing and price of foodstuffs and projected trends of demand and supply for feed crop production in Thailand; and 2) to evaluate potentials, weaknesses, opportunities and constraints for expanding feed crop farming in Thailand. This evaluation will be used for formulating policy options to promote the sustainable development of feed crop farming in Thailand and to propose possible cooperation for trade and development of feed crops among Southeast Asian countries.

The Thai study is facilitated by the availability of data at the Department of Agriculture and it's various agencies, the Department of Customs, the Fiscal Policy Office under the Ministry of Finance and the Department of Trade Negotiations under the Ministry of Commerce.

Overview of feed crops in Thailand

Thailand has been producing a variety of coarse cereals, roots and tubers (soybean, maize, sorghum, cassava and sweet potato) that can be processed into feed. The most used of these farm commodities is soybean in the form of meal, broken rice and maize. Currently the use of cassava for monogastric animals is on a gradual rise.

Since 1992, demand for feedstuffs in Thailand has increased dramatically due to Thailand's expansion of its animal meat exports. Prior to that, Thailand had enough feed ingredients for domestic use and some surplus to export. However, the increase in demand for feed ingredients due to the expansion of livestock production has led to the importing of some feed ingredients. And now, the import of these ingredients is greater than domestic production. (Table 1).

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Table 1. Production and consumption of feed crops in Thailand, 2002 (Unit: million tons)

	Production	Exports	Imports	Consumption
Soybean	0.261	-	1.529	1.790
Soy meal	0.799	-	1.752	2.251
Maize	4.230	0.163	0.005	4.072
Broken rice	1.967	-	-	1.573
Cassava [1/]	16.868	3.802	-	4.295

Note: [1/] Cassava: production: fresh cassava root.
Export: cassava products.
Consumption: fresh cassava root.

Feed crops in this research comprise of broken rice, maize, soybean and cassava that are mainly utilized in the feed industries in Thailand.

Potentials and constraints to feed crop expansion

Rice

Milled rice by-products are annually in abundant supply as the major feed ingredients. Rice is produced in all regions of Thailand. The share ratio of non-glutinous rice to glutinous rice is 3:1. This is true for many varieties of rice that have been improved by the responsible State Agencies. Major production comes from the Central Plains, which is largely irrigated thus enabling two rice crops annually providing plenty of rice. SWOT analysis reveals that:

Strengths

i. The farmers' skill and experience is in producing rice.
ii. Regions are conducive to rice growing.
iii. Some varieties have distinctive characteristics.

Weaknesses

i. Most of the paddy fields are rainfed.
ii. Many of them lack good farm management skills.

Opportunities

i. More rice markets have low tariffs due to FTA agreements.
ii. Thailand has seen prosperity in involving itself in market access of the organic farm products' market.

Threats

i. Farmers lack sufficient post-harvest management skills. The harvesting period of the second rice coincides with the monsoon season leading to high moisture content with insufficient grain dryers.
ii. High local marketing costs reduce competitiveness due to inefficient management.

Maize

Maize is mostly grown in the north and northeast by approximately 350,000 households. Being entirely rainfed, water requirement is crucial in time of blossoming and earing. The seeds used are available from both state agencies and private businesses producing hybrid maize seeds. With higher yields, the private seeds are much more expensive.

Strengths
i. A non-GMO crop.
ii. The improved seeds with good nutrients are well distributed to the farmers.

Weaknesses
i. Shortage of local maize supply in some years because maize is switched to cassava due to the more attractive price.
ii. Harvesting the first crop coincides with the monsoon period and high moisture content causes aflatoxin problems.

Opportunities
i. Thailand can utilize neighbouring countries as potential maize supply sources under trade cooperation.
ii. Thailand would gain more market access from bilateral and multilateral trade agreements.

Threats
i. Most of the maize-planted areas are rainfed, causing supply to often fluctuate.
ii. There are several competitive crops, so the expansion of planted area is not simple.

Soybean

Suitable areas for growing soybean are located in the north with approximately 120,000 farming families. The crop needs more care in terms of irrigation, fertilizers and weeding. Soybean is grown twice annually; one monsoon crop and one dry season crop.

Strengths
i. A non-GMO crop.
ii. There are adequate domestic food and feed businesses to absorb production.

Weaknesses
i. It is a minor crop.
ii. It needs much care and tending.

Opportunities
i. It can be processed into a variety of food products.
ii. A favourite health food.

Threats
i. Insufficient research and development activities on the variety.
ii. Soybean import prices are low.

Cassava

Cassava grows quite well in arid, sandy loam areas. Most is planted in the northeast and the east by about 500,000 farming households. It is common for the farmers to weed only a little when necessary and apply little fertilizer resulting in low yields. At times, they leave their cassava plants to grow a competitive crop and then come back to pick the roots when they reach harvesting time. Some farmers do not take care when harvesting. They have foreign materials, such as dirt, sand and pieces of the cassava stem mixed up, thus affecting the farm prices received.

Strengths

i. Cassava can be grown in any soil; infertile soil or rainfed and harvesting can be deferred.
ii. A non-GM crop with little pest and disease attack.
iii. It is a low price carbohydrate source in animal feed.
iv. Improved cassava, with high starch percentage varieties are distributed nationwide.

Weaknesses

i. Farm prices fluctuate according to product price cutting by exporters.
ii. Farmers/producers are smallholders with low financial status.

Opportunities

i. Abundant annual supplies for local linkage industries.
ii. More markets are potentially accessible following bilateral free trade agreements.

Threats

i. Cassava is forced to rely on foreign markets. In Thailand it is used as feed only in fattening cattle and dairy cows in shredded form.
ii. Almost all planted areas are currently rainfed and therefore enhancing productivity cannot be realistically carried out.

The econometric modeling for these crops includes predictions of production. Regarding the demand for feedstuffs, the estimation is based on increases in the livestock population.

Supply model and supply projection

Supply model

The econometric model is used as the quantitative analysis method for the impact of various factors upon feed crop production.

Rice

The major factors affecting Thai rice production include the farm price received in the previous year, the price of imported fertilizer the previous year, the availability of irrigation water, the dummy variable representing a year of abnormally serious drought and the time trend representing technological advancement with elasticities of 0.15, -0.16, 0.1, -0.1 and 0.01 respectively. This explains that farm price and fertilizer price are the factors most affecting rice production in Thailand.

Maize

Maize production is determined by the wholesale price of maize in the previous year, the price of sugar-cane in the past three years (competitor), price of cassava roots, price of fertilizers and the dummy variable representing a year of abnormally serious drought with elasticities of 0.55, -0.42, -0.08, -0.35 and -0.14 respectively.

Soybean

There are two equations involving production analysis; these are the planted area equation and yield equation.

Production of soybean = area x yield

The acreage estimation model for soybean points to the factors affecting the area under production of soybean and these are the farm produce price of soybean received in the previous year, the farm produce price of competitive maize received in the previous year as well as the area under production of soybean with elasticities of 0.86, -0.85 and 0.84 respectively.

The yield estimation equation describes the fertilizer price and the amount of rainfall in the previous year as the factors affecting soybean yield per unit area with elasticities of -2.22 and 0.0002 respectively.

Cassava

The cassava supply equation describes the affecting factors to be the price received in the previous year for the fresh cassava roots with a coefficient of 53, the planted area with a coefficient of 2.14 and the dummy variable representing the planted area reduction programme in 1984-1987 with a coefficient of -361.20

Supply projections to 2015

On the basis of the models built and illustrated, projections for the production of paddy, broken rice, maize, soybean and fresh cassava roots for the coming 13 years (2003-2015) are made and shown in Table 2. Assuming no variation in the variables from the existing trends to the coming periods, the estimation finds that the production of paddy as well as broken rice, its milling by-product, will see consistent increases. Similar to maize production, almost all broken rice would be directed to feed utilization. On the contrary, no expansion of soybean cultivated area will be observed because only one state agency is responsible for the limited production of non-GMO soybean seeds. The productivity of the crop could only be increased with the enhancement of production efficiency. With heavy reliance on exports, cassava production will face decline. Provided that cassava utilization is in part diverted to other uses, such as the production of ethanol, there could be an opportunity and potential to produce more. As a matter of fact, Thailand is now conducting research on the impacts of using ethanol made from cassava and molasses on engines.

Table 2. Production projections to 2015 (Unit: million tons)

Year	Paddy	Maize	Broken rice [1/]	Soybean [2/]	Fresh cassava roots
2003	26.110	4.736	2.032	0.295	16.659
2004	26.476	4.766	2.060	0.299	16.479
2005	26.731	4.827	2.080	0.302	16.609
2006	26.984	4.806	2.100	0.305	16.582
2007	27.292	4.876	2.124	0.309	16.557
2008	27.540	4.951	2.143	0.313	16.583
2009	27.797	5.030	2.163	0.317	16.574
2010	28.053	5.121	2.183	0.320	16.571
2011	28.314	5.215	2.203	0.324	16.576
2012	28.581	5.332	2.224	0.328	16.583
2013	28.589	5.385	2.225	0.332	16.507
2014	28.596	5.439	2.225	0.336	16.431
2015	28.803	5.493	2.226	0.340	16.355

Note: [1/] Broken rice is assumed 7.9 per cent available in the paddy milling.
[2/] Constant area * projected yield.

Demand model and demand projection

Demand model

Rice

The demand for rice comprises of demand for domestic consumption and demand for export.

On the basis of the domestic demand equation for rice, major factors that affect the demand are retail price of the milled rice, retail price of the wheat flour; a rice substitute, and per capita income with elasticities of -0.06, 0.11 and -0.26 respectively. The response of demand to changes in price is slightly elastic. Meanwhile, income affects rice consumption most.

With reference to the equation on rice exports, the factors most affecting rice exports are; the f.o.b. price, the rice supply of Thailand's trading partners or major competitors, the average income per capita of the main trading partners, and the dummy variable representing the abnormal phenomena in 1989 when droughts affecting rice production in almost all rice producing countries boosted Thai rice exports with elasticities of -0.24, -1.49, 0.67 and 0.20 respectively. The rice export quantities respond with little elasticity to the f.o.b. prices and population's income, while the supply of Thailand's trading partners and major competitors affect the demand for Thai rice exports most significantly.

Maize

The equation for domestic demand for maize indicates that the major factors affecting this demand include the wholesale price of maize, the price of broken rice which is a maize substitute, price of the eggs, price of the broilers and number of hogs with elasticities of -0.42, 0.19, 0.21, 0.31 and 1.09 respectively. The estimation of the response of maize demand to changes in prices shows that maize prices affect maize demand the most, having an elasticity of -0.42.

Soybean and soybean meal

Demand for soybean

The equation for the domestic demand for soybean shows that the c.i.f. price of soybean and population are factors influencing the demand for soybean with elasticities of -0.05 and 6.33 respectively. The analysis of the response of soybean demand to changes in prices and population disclosed that the population affects soybean demand most, having an elasticity of 6.33.

Demand for soybean meal

Factors affecting demand for soybean meal are the c.i.f. price of soybean meal and the broiler population with elasticities of –0.08 and 2.27 respectively. The response of demand for soybean meal to the c.i.f. price shows of smallest elasticity. A greater broiler population affects demand for soybean meal the most.

Cassava

Demand for cassava comprises of domestic demand for cassava chips and pellets, and demand for pellet exports.

Domestic demand for cassava chips and pellets

Since segregation of data on cassava slices and pellets cannot be made, an aggregate demand equation is employed. As domestic consumption is mostly shredded cassava, the major factor affecting consumption demand is therefore the wholesale price of cassava chips. The

estimation of the domestic demand response on the chips and pellets to changes in the price of the cassava slices is slightly elastic at -0.0004.

Pellet export equation

Since the Netherlands is the importing nation for countries in the EU; Thailand's major market of the pellets, the main influence on pellet export quantities are the c.i.f. price at Rotterdam port and the competitive barley price in Germany, the major destination of the Thai pellets. However, the estimation indicates little impact of the two factors with elasticities of -0.001 and 0.001 respectively.

Demand projections to 2015

As Thai's staple food, rice is traditionally cultivated and consumed no matter how prices fluctuate. Table 3 shows that the demand for rice in the form of paddy continues to grow following population increases. The demand for soybean is little for direct consumption purpose but for crushing for oil and meal is very great, making the total demand for soybean greater. Not for direct consumption, real demand for maize is minimal. Some other farm products can be substituted for it.

The demand for cassava, which is not for direct consumption and its local use as feed is not great, would be ordinary. The trend for cassava chip exports will rise gradually whereas pellet exports will decline.

Table 3. Demand projections for feed crops and feedstuff (Unit: million tons)

Year	Feed crop		Feedstuff			
	Paddy rice	Soybean	Broken rice [1/]	Maize	Soybean meal	Shredded cassava
2003	14.470	1.796	2.032	4.373	3.433	0.403
2004	14.512	1.904	2.060	4.464	3.638	0.404
2005	14.567	2.018	2.080	4.587	3.849	0.401
2006	14.623	2.137	2.100	4.627	4.067	0.403
2007	14.687	2.263	2.124	4.732	4.291	0.403
2008	14.746	2.395	2.143	4.838	4.521	0.402
2009	14.804	2.533	2.163	4.946	4.757	0.403
2010	14.863	2.679	2.183	5.060	5.000	0.403
2011	14.921	2.832	2.203	5.176	5.249	0.402
2012	14.981	2.993	2.224	5.326	5.504	0.402
2013	15.039	3.162	2.225	5.346	5.765	0.402
2014	15.097	3.338	2.225	5.382	6.032	0.403
2015	15.155	3.524	2.226	5.419	6.306	0.403

Note: [1/] Author's estimate: the broken rice is 7.9 per cent of the paddy rice.

The feedstuffs in this study are maize, soybean meal, broken rice and shredded cassava. With the exception of cassava, the other feedstuffs are used in large quantities in the feed industries.

To conclude, the demand for all types of feedstuffs relies heavily on increases in the livestock population that requires specifically increasing the volume of broken rice, despite the substitutability of maize. In the event of a feedstuff becoming expensive, feed mill operators opt for another type that is cheaper. An increase in the demand for feedstuffs, i.e. maize, soybean meal, broken rice and cassava chips follows increases in the livestock population. Therefore, demand will rise to 11.302 thousand tons in 2015 from 7,890 thousand tons in 2003 while the total requirement for compound feeds will increase to 73,367 thousand tons in 2015 from 12,067 thousand tons in 2003.

Most maize and soybean meal goes to broiler production; 3,540 and 1,909 thousand tons in 2015 from 1,953 and 1,052 thousand tons in 2003 respectively. Broken rice will be most used in the swine industry; 1,788 thousand tons in 2015 from 1,455 thousand tons in 2003.

Table 4 shows a breakdown, by livestock type, of demand for feedstuffs in Thailand.

Conclusions and recommendations

Greater demand for feed continues to follow increases in livestock production, while an increases in the population's income tends to raise consumption of livestock products. The expansion of livestock industries causes shortages of domestically produced feed crops, most commonly being soybean meal, a by-product of soybean crushing. As a result, imports of soybean have been several times more than the quantities locally produced.

Almost all domestically produced maize is destined for feed as the Thai population is not in favour of eating corn as food. Thailand produces rice in huge quantities which is its top farm tradable. Consequently, rice by-products are in large supply too; above and beyond the need for feed. The same is true for cassava, which is over produced and used in much smaller amounts each year for feed.

To solve some feedstuff shortage problems, public policy has been implemented for one way free trade to Combodia, Myanmar and Lao People's Democratic Republic on eight agricultural commodities which include the three feed crops; soybean, maize and rice. This reduced the tariffs to zero. Consequently, the three neighbouring countries have become potential sources of feed crop supply for Thailand in times of internal shortages. In addition, Thailand grants technical assistance on feed crop production to these neighbours too.

For the sustainability of production of each feed crop that satisfies the demand at a favourable farm price, suggestions are made that the maize production target should be set at 5 million tons. This will ensure that there will not be over production since maize is replaceable with broken rice and this would maintain a favourable maize farm price.

The increasing production of rice encouraged by the good price received that provides an incentive to produce more horizontally with more use of farm inputs but there has been little more technological adoption, e.g., use of improved high yielding varieties. So, the government will have to promote this further.

The national area planted to rice is 68 million rai, 7 million rai of which are irrigated and the rest is mostly rainfed. The government should seek to develop water sources in the areas prone to droughts.

Farmers often pay less attention to their cassava planting. In times of shortages, it is harvested earlier. In other times, it is picked too late when the growers turn to attend a more profitable crop. Thus, the farm price received for the fresh roots is frequently low due to the low starch content. Therefore, an extension programme may be needed to have the farmers pay attention to the appropriate harvesting period when the starch content is highest and a better price is paid.

The government should arrange for grading and standardization of soybean for fairness to the growers who grow quality soybean. In addition, farmer training programmes should be organized to raise awareness of the moisture content in soybean post-harvest handling. Interestingly, the government is conducting R&D and multiplication programmes of domestic soybean varieties as they are suitable for human food being a non-GMO farm product.

Table 4. Demand for feedstuffs and feed projected on the basis of the demand by livestock type, 2003-2015 (Unit: million tons)

Year	Broiler		Hen Layer		Swine	Feedstuff					Total[2/]
	Maize	Soybean meal	Maize	Soybean meal	Broken rice	Maize	Soybean meal	Broken rice	Shredded cassava	Total[1/]	Animal feed
2003	1.953	1.052	0.838	0.137	1.455	3.912	1.758	1.938	0.282	7.890	12.607
2004	2.053	1.105	0.839	0.137	1.480	4.206	1.818	1.971	0.293	8.108	12.905
2005	2.158	1.162	0.841	0.137	1.506	4.169	1.884	2.005	0.303	8.361	13.219
2006	2.267	1.221	0.843	0.137	1.532	4.276	1.953	2.041	0.314	8.584	13.574
2007	2.383	1.283	0.845	0.138	1.559	4.409	2.028	2.076	0.326	8.839	14.186
2008	2.504	1.348	0.846	0.138	1.586	4.551	2.100	2.112	0.337	9.100	14.287
2009	2.632	1.417	0.848	0.138	1.613	4.698	2.181	2.148	0.350	9.377	14.680
2010	2.766	1.489	0.850	0.139	1.641	4.857	2.203	2.185	0.362	9.607	15.086
2011	2.907	1.565	0.852	0.139	1.669	5.020	2.354	2.221	0.378	9.973	15.509
2012	3.055	1.645	0.853	0.139	1.698	5.194	2.443	2.262	0.392	10.291	15.864
2013	3.211	1.729	0.855	0.140	1.728	5.386	2.540	2.301	0.406	10.633	16.395
2014	3.375	1.817	0.857	0.140	1.758	5.565	2.640	2.341	0.421	10.967	16.862
2015	3.546	1.909	0.860	0.140	1.788	5.744	2.741	2.381	0.436	11.302	17.367

Note: [1/] Total feedstuffs include maize, soybean meal, broken rice and shredded cassava that are expected to be required by all livestock types.
[2/] Total animal feed estimated based on the demand of each major livestock type.

Comments on the Country Report of Thailand

Chan Chiumkanokchai[*]

Based on the information from the report and further elaboration, the commentator summarized his view into three headings namely: prospects of each crop as a feed crop; policy recommendations; and suggestions for further study.

Prospects of each crop as a feed crop

Rice

Rice is a cereal but not one of the target crops under the responsibility of UNESCAP-CAPSA. However, it's by-products, which are broken rice and bran are mainly used as feed in livestock production. Thailand is one of the world's major exporters of rice. Therefore, there are plenty of by-products for feedstuffs, probably more than domestic demand. The report shows that the price of rice by-products has negative correlation with the rice price itself. Supported by the fact that rice is the staple food of Thai people, rice farmers grow their crops for their own consumption regardless how the price fluctuates. This finding shows the little influence livestock production has on rice production.

Rice is grown mainly in rainfed areas. The native varieties such as the well-known Hom-mali rice are often used for planting. Modern high-yielding varieties are planted where water is more regulated and in irrigated areas in both the rainy season and dry season. However, dry season rice, although having high yield tends to be of low quality due to the high moisture content during harvest.

Average yield per unit area of rice is low when compare to the international standard. To increase the competitiveness of Thai rice, production efficiency must be improved, and there seems to be a lot of room for improvement.

Cassava

Thailand ranks number one in the world for exports of cassava products. Cassava chips and pellets are used as cereal substitutes for animal feed in developed countries.

Production of cassava and price strongly depends on the world market which correlates to the world price of cereals. Domestic use of cassava products for feed is still very low. Only 5 per cent of the total fresh root equivalent is used in dairy production. Therefore, similarly to rice, domestic livestock production has little influence on cassava production. For the sustainable production of cassava, it is necessary to improve the quality standard and soil conditions, increase domestic use for livestock production, and to develop new products such as decomposable plastic, flour and alternative fuels, etc.

Yield of cassava is low. The reason Thailand can still produce cassava at a very competitive price is because of the low cost of production and transportation. However, the income of cassava growers is marginal and yield improvement is the most effective way to raise their income.

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Maize

Maize is cultivated mainly for domestic use as animal feed although some varieties are planted for human consumption in both fresh and processed forms. In this case, corn stalks and leaves can be used as fodder. At present, maize production is quite regulated, using hybrid varieties and prescribed cultivation practices. Maize production for feed is confined to rainfed areas. In high rainfall areas, two crops of maize may be planted. In areas with less rainfall, a cropping system of maize-sorghum may be used because sorghum is more drought tolerant than maize. Quality problems may be faced with the first crop because it has to be harvested mid-rainy season.

The average yield of maize is more or less up to the world standard. Local maize barley production generally meets domestic demand with some years witnessing a surplus for export but some years imports are required. Therefore, maize production is very dependent upon demand for animal feed. When demand is high, expansion of the area under maize can replace area under soybean or cassava. It can be said that of all the four crops, maize creates the least trouble for policy makers and practitioners.

Soybean

Domestic production is insufficient to meet the country's demand. Around half of its production is for human consumption and the other half is for oil extraction which in turn produces soy cake for animal feed. Each year, imports of both beans and cake are many times higher than domestic production in terms of quantity. In 2002, Thailand imported seven times more soybean volume than domestic production. In the same year, the import volume of soy cake was twice as much as domestic production. Further investigation would find that the yield of soybean production is very low when compared with the world average. This leads to higher costs of production per unit quantity which make domestic soybean uncompetitive. In order to protect domestic production, the government has to support the industry. Therefore, production efficiency is seen as a very important factor that needs to be improved so that the level of production will be maintained if not increased. There are good reasons for protecting soybean production. One is the nitrogen fixing property of soybean being from the legume family. Growing soybean uses less fertilizers and increases soil fertility.

One of the important obstacles in growing soybean is the availability of soybean seeds which makes expansion of soybean production difficult. Because of the high oil content in soybean, its seeds can be kept for a short period of time under normal conditions (about 6 months). In practice, this problem can be solved by exchanging seeds between crops. Soybean grown in the rainy season (lower-northern and upper central regions) can provide seeds for planting in dry season (irrigated area of the upper-northern region) and vice versa. At present, government services for soybean seed production are not sufficient.

The prospect of soybean production as a feed crop is bleak.

Policy recommendations

Thailand has commitments with WTO on domestic support. At present, government support on agriculture is small, less than *de minimis*. The government should increase its support on the production of feed crops which have low competitiveness. The support should include research and development, technology transfer, market infrastructure, and other services enabling farmers to stand on their own two feet and receive enough income from their profession.

Economic Cooperation Strategy (ECS) with neighbouring countries. The government has committed to assist neighbouring countries (Myanmar, Lao People's Democratic Republic and Cambodia) in economic development. One of the measures is reductions of import tariffs for many agricultural commodities. This measure may have some impact on domestic production. The government should set its strategy with the aim to balance economic cooperation with the welfare of the farmers.

The government currently prohibits commercial production of GM crops. As a result, Thailand is a GMO free country. However, there are some concerns over imported products for processing purposes, especially maize and soybean. The government should clearly state its policy to prevent unfair competition with domestic products because GM products have lower costs of production. Food safety is another reason to prevent GM products from entering the country.

Further study

In order to get the whole picture of feed crops in Thailand, the report should also cover the following points:

1. Cost of production and yield of each crop;
2. Cropping systems/patterns; and
3. Review of long-term policies and trends of livestock production.

Furthermore, with the booming dairy industry in Thailand and the government's policy to boost good quality beef production, fodder crops will become more significant in the near future. UNESCAP-CAPSA may consider assisting Thailand in studying the roles of fodder crops in poverty reduction.

Discussion

Comments from the Floor

On the question of whether safety considerations are taken into account for Indonesian maize for food and feed, it was explained by the National Expert (NE) of Indonesia that toxin can be a problem for expired maize for feed but no investigations were made for the food model analysis in this study. Maize quality is inconsistent within the country and the production areas are scattered making collection more difficult. Aflatoxins are a problem when the maize can not be dried properly or is stored for too long.

On the question of maize imports in Indonesia, it is found the majority is for the feed industry. The discussion went on to the "puzzling" fact that if import prices of grain maize are so competitive domestically, why farmers cannot gain benefit by planting it? On the sweet corn variety for food, it is found beneficial for farmers to plant. Therefore, the research should concentrate more on the improvement of local varieties to benefit the poor farmers.

On the discussion of policy implication of the study, it is concluded that it should be targeted and moved forward to strengthen the policy implications towards poverty alleviation. For example, the possibility to consider alternative ways of feeding poultry substituting maize with locally produced feeds reducing the reliance on markets.

It is found that cassava and palm kernel cake can be used as alternates for feed ingredients, however maize can not be replaced completely due to its protein content, e.g. cassa-pro can increase the content of protein in cassava by more than 15 per cent, but its single-cell protein can only match fish feed requirement, not poultry feed.

On the question of where are the destinations of maize export from Indonesia, the answer is Singapore. On the question of whether there is demand for feed from milk industries in Indonesia, no clear explanation was available from the studies. The major demand projected for feed is from fish culture.

The idea of collaborative research among scientists of Southeast Asia was discussed.

There are three choices of action that can be taken by the countries participating in the studies to fill the gap between supply and demand of feed crops: (a) to increase domestic production by deploying resource available to meet demand; (b) to import feed crops from other countries/regions; and (c) to combine (a) and (b).

In view of trade liberalization, Southeast Asian countries need to optimally utilize the AFTA (ASEAN Free Trade Agreement) framework.

In the Philippines, from the demand and supply equation, the elasticities continue to decline. It was informed that the policy regarding feed crops is not comprehensive enough to answer the supply and demand of domestic feed crops. It is also acknowledged that the policy lacked continuity and integration.

Invited Paper

Feed Crops in South Asian Countries: Problems and Prospects (an outline)

S.S.E. Ranawana[*]

The livestock revolution

- The last few decades have seen a rapid increase in the demand for meat, milk and eggs throughout the world attributable not only to increases in population but to large increases in *per capita* consumption, due, in turn, to changes in lifestyles and to economic growth.
- This increase in the intake of animal products compares with only marginal increases in the consumption of foods of plant origin such as cereals, vegetables and pulses. By the year 2020, it is predicted that in value terms, products from livestock will equal or exceed those from crops worldwide.
- The growth of demand for animal products is much higher in the developing world who are playing "catch up". Presently being far behind the developed countries in *per capita* consumption of milk and meat.
- This has been termed "the Livestock Revolution"; some of the other characteristics of this phenomenon are shown below:
    - A shift in animal production from temperate to tropical areas.
    - A greater demand for meat from poultry and pigs compared to ruminants.
    - A shift in the production base from local, mixed farms to market-oriented agribusinesses.

Demand for feed ingredients

- Since animal products are expensive to import, most countries have planned to meet this increased demand by increasing production within their countries.
- Whilst the breeding materials (animals) for this purpose are available at a relatively low cost and disease control methods are known, the primary limitation, and the main cost, to increasing production is the availability of feedstuffs.
- Although most developing countries are technically capable of increasing production, they face shortages of key feed ingredients (particularly maize and soybean meal) within their countries.
- As a result, although the volume of trade in meat, milk and eggs is relatively low, there is a large and burgeoning trade in feed ingredients in the world.
- Projections show that by 2020, developing countries could be importing huge amounts of cereals to feed their animals.

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South and Southeast Asia

- Many of the changes described above for the developing world are true for Asia and in particular South and Southeast Asia.
- There are, however, some significant qualitative differences in the demand for livestock products between these two regions that must be recognized:
  - Unlike in Southeast Asia, the demand in South Asia has been (and will be) primarily for milk rather than for meat.
  - With regard to the choice in meats, the demand in Southeast Asia is mainly for pork and chicken whereas in South Asia ruminant meats such as beef and mutton are preferred. Of late, however, due to the increasing scarcity and high cost of ruminant meat, there has been a very significant increase in the demand for poultry meat in South Asia; the demand for pigmeat remains low.
  - These differences are reflected in somewhat different demands for feedstuffs and feed crops in the two regions.

South Asian countries

- Agro-ecological zones in South Asia are predominantly the semi-arid and sub-humid zones. Unlike in Southeast Asia, the humid areas are very limited.
- Agriculture is a major economic activity in these countries and contributes between 20 and 40 per cent of the GDP depending on the country. The majority of the population is engaged in farming with livestock being an essential component.
- Cropping patterns: Emphasis is on rice and wheat based systems under irrigation with high inputs and there is a general neglect of rainfed systems. In many countries, however, a significant proportion of the population is still dependant on rainfed systems although they are low in productivity; most feed crops are grown in such areas.
- Demand for animal products: As in other countries, there has been a rapid increase in the demand for milk, meat and eggs, in particular for chicken meat, when compared to crop-based foodstuffs, in all the South Asian countries.
- Ruminant meat originates from extensively raised cattle, sheep and goats and the supply is not expected to increase. The demand for pig meat is small and is not expected to increase to any great extent. The demand for concentrate feeds from these sectors is not significant.
- The consumption of chicken meat in South Asia has increased dramatically and much of the increasing meat demands of South Asians in the future will be satisfied by broiler chickens. The demand for specific feed ingredients (crops) such as maize and soybean meal as a result can be expected to increase dramatically.
- The demand for milk will continue to increase and since buffaloes and cattle are fed on natural forages, crop residues and agro-industrial by-products, the demand for feed crops will be less. In order to increase milk production, however, high energy/high protein feeds will need to be fed to the genetically superior animals that are being bred. This will increase the demand for some coarse grains and oilseed cakes but – unlike for poultry - not specifically for soybean meal or maize.
- In terms of volume, the greatest demand is for ingredients to feed cattle and buffalo but the fastest rate of growth in feed demand is for poultry (5.7 per cent per annum).

Feed industry and the supply of feed ingredients

- Broiler chickens need balanced commercial rations whilst layers can survive on home mixes to some extent. In South Asia, dairy cattle are fed straight feeds or loose mixes and only around 20 per cent are fed with commercial feed mixes.
- The established commercial feed manufacturers operate below capacity in all the South Asian countries. They are primarily concerned with poultry feeds and many of them are fully or partly integrated into poultry "agribusinesses".
- The smaller feed manufacturers, including co-operatives, produce mainly layer and dairy feeds. In addition, many layer feeds and most dairy feeds are mixed at home.
- The main constraint to feed manufacture is the timely supply of ingredients of the required quality to feed millers; this is due to the lack of infrastructure, inefficient marketing chains and the absence of quality control. The linkage between the farmer and the feed miller has to be properly established to ensure timely supply and quality of produce.
- Growing deficits of feed ingredients have been predicted over the next decade in all South Asian countries. In India, for example, the growth in demand for concentrates is 2.7 per cent per annum whereas production is only expected to grow at two thirds this rate.

Feed crops

- Feed crops in the region include the following:
  - *Coarse cereals*: maize, sorghum and a variety of millets.
  - *Oilcakes*: soybean, groundnut, sesame, coconut and other lower protein sources.
  - *Roots and tubers*: Cassava.

    - *Coarse cereals*
      - In South Asia coarse cereals are grown mostly for human consumption.
      - Cultivated by resource-poor smallholder farmers under rainfed conditions.
      - The current price support systems are not effective.
      - Apart from maize, the area under others has declined.
      - Maize is used for poultry, sorghum for both poultry and dairy and millets for dairy.
      - Constraints are the low priority accorded to them, low yields due to poor cropping conditions and primitive practices, poorly developed markets and great variations in prices.
    - Maize is the cereal of choice for poultry and huge demand throughout the world threatens to outstrip the supply; in South Asia, apart from India and Pakistan all others presently import maize and these two are expected to do so by 2020. In India, there is already a special programme for maize designed to increase yields and overall production. Yields are stagnant in Sri Lanka, Bangladesh and Nepal whilst Pakistan shows a small increase.
    - Sorghum is the most important crop for rural farmers in the semi-arid regions where it is used for food, feed and processing. It can be used in poultry and dairy rations. The extent under cultivation has declined in India, the main

producer in the region and a number of proposals have been made to reverse this trend:
  - Introduce summer dual-purpose varieties.
  - Use hybrid seed technology.
  - Intercrop with high value crops or cultivate in fallow paddy fields.
  - Try winter cropping under irrigation.
- *Soybean*
  Soya as a feed crop will only be viable if there is a market for the oil. India currently produces larges surpluses of the meal and other SA countries import from India; still, the region as a whole is a net exporter. Others will only grow Soya as a food crop.
- *Cassava*
  Grown in all countries of the region as a smallholder food crop that is marketed locally and even the demands of the processors are not fully met. Not used as a feed crop due to the lack of processing facilities (as in Thailand), the demand for direct consumption and the seasonality and length of the crop.

Recommendations to increase the production of feed crops

- Active promotion of feed crops and diversification from (only) rice and wheat by giving them similar growing conditions and price support.
- Farming in blocks under contract with feed millers to ensure a ready market for the produce and a fair price as well as quality standards.
- Expansion of feed crops to agricultural systems other than traditional systems; for example irrigated land.
- Development of high yielding varieties with pest resistance; collaborative research between South Asian countries with sharing of technologies and breeding materials.
- Trade negotiations and co-operation between countries in the region to ensure that their products are complementary so that the region as a whole is able to meet the demand for feed crops.
- Effective farmer information and education systems to increase productivity and incomes.
- Private sector involvement in providing inputs, marketing and even production.

Rural poverty and the livestock revolution

- South Asia has around 22 per cent of the world's population which will increase to 1.7 billion by 2010. More than half of these (57 per cent) are dependant on agriculture as their main livelihood.
- Livestock are an essential component of the systems and not only ensure security and survival but also provide vital dietary components and a ready cash income. Most livestock farming in South Asia is carried out on mixed crop-livestock smallholdings which are rainfed.
- More than half the one billion poor people in the world live in this region. The percentage of the poor overall in India is 49 per cent and in rural areas is even larger (79 per cent). These include mainly small farmers, the landless, the transhumant and nomadic pastoralists, women, tribal groups and displaced persons.

- A very large proportion of these people are associated with livestock and the increase in demand for livestock products, therefore provides some opportunities to improve their lot by:
  - Better prices for their livestock products.
  - Cultivation of animal feed crops and supply of ingredients.
- All governments in the region have policies to alleviate poverty and the increasing demand for livestock and feed ingredients could be used as an opportunity in this respect by formulating and implementing suitable strategies.

Consolidated Discussion

Upsurging Livestock Feed Demand in Southeast Asia: A Consolidated Discussion

Budiman Hutabarat[*]

Introduction

Like in most developing countries around the world the demand for livestock products in the developing countries of the Southeast Asian region have shown a dramatic increase since the early 1970s, with the exception of during the economic and financial crisis that swept across the region in 1998 with its effects still being felt today.

Delgado *et al.* (1999) estimated that world consumption of meat rose by 2.9 per cent per annum, from 1982 to 1994. The developed countries' consumption grew at a lower rate of 1.0 per cent per annum, whereas the developing countries experienced a much faster growth rate at 5.4 per cent per annum in that period, and in the region of Southeast Asia it reached at 5.6 per cent per annum (Table 1).

Table 1. Historical trends in meat and milk consumption and cereal feed use, 1982-1994[a]

	Meat	Milk	Cereal feed use
	(Annual percentage)		
World	2.9 (1.8)	n.a. (1.7)	0.7 (1.4)
Developed	1.0 (0.6)	n.a. (0.2)	-0.5 (0.6)
Developing	5.4 (2.8)	n.a. (3.3)	4.2 (2.8)
Southeast Asia	5.6 (3.0)	n.a. (2.7)	7.2 (2.7)

Source: Delgado *et al*., 1999.

[a] Figures in parentheses are the projected trends from 1993-2020.

The authors also found that the increase in meat, milk, fish and major cereal consumption in developing countries from its level in 1971 to the 1995 level were significantly larger than in developed countries both in terms of volume and value (Table 2).

Table 2. Increases in meat, milk, fish and major cereal consumption, 1971-1995

Commodity	Consumption increase		Value of consumption increase	
	Developed	Developing	Developed	Developing
	(Million metric tons)		(Billion 1990 US$)	
Meat	26	70	37	124
Milk	50	105	14	29
Fish	5	34	27	68
Major cereals	25	335	3	65

Source: Delgado *et al*., 1999.

Delgado *et al.* (1999) further went on to make predictions that world consumption of meat and milk will rise by 1.8 and 1.7 per cent per annum respectively, from 1993 to 2020. Developed countries' consumption will grow at lower rates of 0.6 and 0.2 per cent per annum

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respectively, whereas the developing countries will experience much faster growth (2.8 and 2.8 per cent per annum). The region of Southeast Asia is expected to reach a higher growth rate in meat consumption and lower growth rate in milk consumption relative to those in developing countries. The increasing trend of meat consumption was also confirmed by Sugiyama *et al*. (2004) in Asia although there is a difference in the types of meat consumed by the countries (Table 3).

The positive trend in meat and milk consumption is accompanied by a positive trend in the use of cereals as feed for the 1982-1994 period, with the exception of developed countries. Again, developing countries, as well as the Southeast Asia region, were found to have the highest growth rates in the same period, between 4.2 to 7.2 per cent per annum. Projections made by Delgado *et al.* (1999) show that the use of cereals as feed will continue to rise worldwide with developed countries remaining at a lower rate than what will be achieved by developing countries in the Asian region (Table 1).

Table 3. Meat consumption in Asia (kg per capita)

Country	1970				2000			
	Beef	Pork	Chicken	Total meat	Beef	Pork	Chicken	Total meat
Malaysia	1.70	6.60	6.90	15.80	2.00	11.70	36.70	51.10
Philippines	2.30	10.10	2.60	n.a	4.90	13.60	7.60	n.a
Thailand	6.70	5.80	5.80	n.a	3.50	7.30	13.50	n.a
Japan	2.90	7.10	4.70	17.50	10.10	17.90	15.40	43.80
India	2.30	0.30	0.10	3.60	2.60	0.60	0.60	4.50
Pakistan	4.70	n.a	0.20	7.50	6.30	NA	2.30	12.40
Sri Lanka	3.00	0.10	1.20	4.50	1.70	0.10	3.40	5.30

Source: Sugiyama, 2004.

Many researchers have identified that the causes of meat consumption increases are due to improvements in standards of living due to per capita income increases, changes in taste and ways of life, urbanization, and population increases. It is true because when people spend 70 per cent of their income on food, a modest rise in income generates a significant increase in food consumption. It would also generate a shift in the dietary schedule away from basic starches and towards more nutritionally dense foods, such as high-protein livestock products. These changes translate quickly into increased demand for is a factor of production. As feed is the major input in livestock production it is conceivable that the demand for feeds, feed crops, oilseeds and other ingredients must increase too.

For developing countries of Southeast Asia, this trend poses some challenges because: (i) among the many livestock production activities in the region, the poultry and pig meat sectors are more responsive to meet the development in the market; (ii) on the input side, although this region is endowed with an abundance of materials to support livestock production development, there is a trend that livestock feed will become predominated with maize and soybean as sources of raw material for feed industry development; and (iii) many crop production technologies adopted to support livestock development originate from a temperate environment at the expense of potential local counterparts. The paper is aimed to explore and investigate various factors that may impede feed and livestock sectors in this region to take advantage of the growing demand trends. The paper is divided in five sections. Section 1 briefly explains the economic and development characteristics of the region, followed by the availability of agricultural endowment in Section 2. Section 3 discusses the condition of the feed and feed industry and Section 4 touches on the consumption of animal products in the region, which then is followed by discussion of government policies adopted by countries in Section 5. Section 6 summarizes several challenging issues facing feed crop development. Section 7 outlines various attempts to resolve the challenges to take advantage of the growing demand for

animal products and inputs of animal production, particularly feed crops. Finally there is as a concluding summary of the paper.

Development of regional economy

Economic diversity

The population of Southeast Asia in 2000 was estimated at 530 million with a growth rate of 1.0 to 2.0 per cent per annum. Prior to 1997/1998, Southeast Asia economies were growing, and incomes expanded 8 to10 per cent per annum across the region. The Asian economic and financial crisis caused these positive growth rates to plummet, becoming negative, although rates have now slowly regained positive values and are increasing at 0.5 per cent to 5.5 per cent annually across the region. A sustained period of strong economic growth in most of the Southeast Asian countries, rapid structural change, increasing affluence, probable continued strong economic performance in the region, and a projected population of over 615 million by the year 2010, are all factors causing rising Southeast Asian demand for food and agricultural products.

Each country under consideration follows a different course to its economic development. Malaysia has devoted much of its resources to manufacturing and industrial development to respond to the demand of external markets. To some extent, Thailand has followed Malaysia's path in exploiting the international market but puts its emphasis on agroindustry and agricultural products. Indonesia and the Philippines seem to be stuck in developing their agricultural sectors. The contribution of the agriculture sector to the GDP in these countries may be declining but the sector continues to be the major source of employment and foreign exchanges.

Indonesia, with 213 million people in 2000 and a population growth rate estimated at 1.35 per cent per annum, is the fourth most populous country in the world. The Indonesian economy underwent rapid growth between 1970 and 1997, averaging about 7 per cent annual GDP growth. During the period, the agricultural sector grew 3 to 4 per cent annually, less than the economy as a whole but still impressive given the size of the agricultural sector in the economy. Because of the more rapid growth of other sectors, agriculture's share of GDP fell from 45 per cent in 1970 to 17 per cent in 1995. Nevertheless, over 60 per cent of the population resided in rural areas in 1998. Agriculture continues to provide the main source of employment for 44 per cent of the labour force. Its economy grew at 0.2 per cent in 1999, 3.5 per cent in 2000, and 3.4 per cent in 2001.

The Malaysian economy has taken a significant structural change towards an outward looking development strategy in the last two decades, graining experience with the production and exports of industrial goods, a drastic change from an agricultural based economy in the 1970s. The development process, which emphasizes the industrial sector reduces the contribution of agriculture to the national economy. The Malaysian economy grew at 9.3 per cent, and agricultural value added increased by 4.0 per cent in 1995. Agriculture accounted for 14 per cent of GDP in 1995, down from 38 per cent in 1960 (Fuglie, 2001) and it is no longer a major employment source and, in fact following its development course, Malaysia has been experiencing steadily rising wages and incomes due to labour shortages. But the agricultural sector, especially its food sub-sector, still have important roles in the national economy. Now the agricultural sector is dominated by the plantation sector, in particular oil palm and rubber which currently account for 70 per cent of all agricultural land use. As a consequence, Malaysia is relatively highly dependent on food imports. The Malaysian government has a worry because of the growing trend in the value of imported food, in view of the vast amount of natural resources that Malaysia has to produce food for its population. In addition there is a question of

food security and stability, which is directly linked with the volatility and resultant changes in the exchange rate of *ringgit* with respect to major currencies.

The agricultural, fishery and forestry industry groups continue to be the dominant sector in the Philippines economy, accounting for 22 per cent of the GDP, 46 per cent of the total employment, and around 13 per cent of the total export revenues (Cruz, 1997). The sector also generated many of the vital raw materials and domestic demand on which the industrial and services sectors depend but it is no longer the key source of foreign exchange earnings for the Philippines. Total agricultural exports declined from US$ 4.6 billion in 1979 to US$ 1.5 billion in 1994 in nominal dollars. In percentage terms, in 1979 agriculture and forestry accounted for 49 per cent of total Philippine exports but in 1994 it accounted for only 11 per cent of exports (Pray, 2001). Agricultural export revenues are obtained from coconut oil, fresh banana, frozen tuna, sugar, canned pineapple, fertilizer, desiccated coconut, copra oil cake/meal, copra, shrimp and coffee.

Economic growth in Thailand has been remarkable over the past several decades leading the country to quickly join the rank of new industrialized countries. The contribution of the agricultural sector to the Thai economy has been declining from around 12 or 13 per cent in the early 1990s to 10.9 per cent in 1995 and at the same time the relative contribution to agricultural output of cropping and livestock industries has also been falling. (TDRI, 1997 quoted by Riethmuller and Chalermpao, 2002). But agriculture continues to be the principal source of employment for the majority of the labour force. Through the government's planning and programme the agricultural sector has undergone a significant transformation, away from rice, cassava and maize towards high valued products and non-traditional crops such as frozen chicken, sugar and canned pineapples destined for export markets (Riethmuller and Chalermpao, 2002). In international markets, Thailand continues to possess strong comparative advantage in producing many agricultural commodities.

Agricultural transformation

The agricultural profile of many Southeast Asian economies is changing. While most types of agricultural production have continued to grow overall, various sub sector shares have changed. In ASEAN countries, the share of rice in agricultural production (in both volume and value terms) has fallen from 75 per cent or more in the 1950s and 1960s to around 40-50 per cent today, while production of fruit and vegetables has grown noticeably. Some cash crops have remained important (rubber, palm oil), whereas others have shrunk considerably (cotton, jute). Livestock industries comprise the fastest growing sub sector in Southeast Asian agriculture, now occupying at least a 10 per cent share of agricultural GDP in most countries. Fisheries, once mainly a subsistence activity, has become increasingly commercialized, and a valuable export industry. The share of forestry and forestry products, where in past decades a major export industry for all countries except Singapore, has declined to become the smallest sub sector of most regional economies' agricultural GDP.

Industrialization, government policies and changing patterns of demand in ASEAN economies have led to an expansion of the scale and range of agricultural processing industries. In the 1980s, these countries diversified from simple processing for export (such as tropical fruit canning and seafood canning) into a wide range of sophisticated activities (such as beer, soft drinks, dairy products, wheat-based processed foods and processed vegetables, textile and garment manufacture, and timber processing like plywood). A significant proportion of output now serves domestic markets, as well as a growing amount for export markets.

It is interesting to note, however, that Southeast Asia's food and agricultural import growth has been increasingly concentrated towards unprocessed and semi-processed food and agricultural products, in order to carry out further processing and value-adding within countries'

own borders prior to retail sale or export. This occurs due to conducive various trade regimes. These economic strategies are necessary to deal with the massive growth in demand and imports. Most Southeast Asian countries adopt this approach.

Agricultural resources

Crop resources

Developing countries were actually the major supplier of world total crop production, that is cereals, starchy pulses, pulses, oil crops, vegetable oils and vegetables in 2000 because their shares were fifty per cent higher than those of developed countries (Table 4), but total production of crops, in particular, cereals, pulses, and crops of the developed world in 2000 were far above their total supplies because they sell to export markets an amount larger than they purchase as imports. For starchy roots, vegetable oils and vegetables the reverse is true, developing countries' production is above their total supply, again because they export more than they import.

Among the five countries of the Southeast Asia region listed in the table, three countries, that is Indonesia, Malaysia and the Philippines, show domestic production levels of crop groups that are below their supply, meaning that these countries are still importing these crops, except for vegetable oils. For Thailand and Viet Nam, the situation is far better because their domestic crop production is more than supply, with the exception of oil crops in Thailand, and vegetable oils in Viet Nam.

Most of the feed produced comes from cereals, pulses and starchy roots in both developed and developing countries but the developing countries' level of utilization is far below that of the developed world (Table 4). In Southeast Asia the utilization of cereals as feed is still quite low compared to that in developed economies, but for Malaysia, the Philippines and Thailand it exceeds the level reached in the developing countries. Starchy roots are used in a minor quantity but surprisingly pulses are not shown to be utilized at all in the region. This is interesting because this region, with its vast agricultural endowment and suitability for growing starchy roots, should have been able to develop its available crop resources.

Total supply of all crop groups shows a positive trend worldwide during the period of 1996 to 2000, except for starchy roots and pulses in the developed world (Table 5). The supply of pulses also declines in Malaysia, as do vegetables in Indonesia, Malaysia and the Philippines. The supply of starchy roots drops in the Philippines and Viet Nam. Total production also has an increasing trend, excluding cereals in developed and developing countries and starchy roots in developed countries.

With regard to the region of Southeast Asia, each country has different trends for a particular crop. Domestic production of cereals in all listed countries of Southeast Asia is growing, excluding Malaysia which has probably reached its area limit and starchy root production shows a negative trend, except in Thailand. The growth in the production of pulses is also positive, except in the Philippines which also shows negative growth of vegetable production. Oil crop production is increasing in Malaysia and the Philippines, but declining in Indonesia, Thailand and Viet Nam. All countries experience an increasing trend of vegetable oil production.

Table 4. Total supply and percentages of production, imports and exports in 2000

Country/group	Product	Total supply ('000 metric tons)	Production	Imports	Exports	Feed
			(%)			
World total	Cereals - Ex.Beer	1,869,612.8	99.6	15.3	15.6	35.3
	Starchy roots	696,559.9	100.1	5.8	4.7	21.2
	Pulses	53,842.5	101.8	13.5	17.8	23.0
	Oil crops	371,488.1	99.7	19.4	19.3	5.0
	Vegetable oils	90,605.7	103.5	42.8	46.7	0.1
	Vegetables	691,711.3	100.3	5.5	5.8	2.0
Developed countries	Cereals - Ex.Beer	739,373.8	115.4	15.0	31.1	59.7
	Starchy roots	201,506.9	95.0	14.7	8.3	23.0
	Pulses	128,79.09	119.8	27.7	55.8	58.1
	Oil crops	137,235.9	103.6	27.7	34.6	6.7
	Vegetable oils	361,32.79	87.8	49.1	37.8	0.3
	Vegetables	168,145.7	96.7	18.6	15.1	3.7
Developing countries	Cereals - Ex.Beer	1,130,239	89.3	15.5	5.5	19.3
	Starchy roots	495,053	102.2	2.1	3.3	20.4
	Pulses	40,963.43	96.1	9.0	5.8	11.9
	Oil crops	234,252.2	97.4	14.6	10.3	4.0
	Vegetable oils	54,472.91	113.9	38.6	52.6	
	Vegetables	523,565.6	101.5	1.3	2.8	1.5
Indonesia	Cereals - Ex.Beer	5,1498.8	86.0	13.6	0.2	3.6
	Starchy roots	19,627.77	98.0	5.6	3.6	2.0
	Pulses	933.54	96.5	4.1	0.7	
	Oil crops	19,108.86	92.4	7.4	2.0	2.6
	Vegetable oils	3,379.22	257.2	1.6	180.7	
	Vegetables	6,365.06	96.9	4.8	1.7	
Malaysia	Cereals - Ex.Beer	6,079.68	25.2	75.7	3.3	40.8
	Starchy roots	1,113.01	41.9	59.0	0.9	3.7
	Pulses	37.67		102.7	2.7	
	Oil crops	4,493.27	89.2	12.3	1.5	0.1
	Vegetable oils	712.64	1745.1	84.0	1663.9	
	Vegetables	642.81	71.7	45.9	17.7	
Philippines	Cereals - Ex.Beer	15,642.14	81.7	26.6	0.1	27.7
	Starchy roots	2,872.27	94.0	6.2	0.2	3.6
	Pulses	126.09	43.2	56.8	0.0	
	Oil crops	13,960.56	93.4	3.1	3.6	0.3
	Vegetable oils	548.55	271.7	22.2	193.9	
	Vegetables	4,894.03	98.2	2.4	0.6	
Thailand	Cereals - Ex.Beer	15,122.48	143.3	8.8	42.8	34.2
	Starchy roots	2,675.4	722.4	7.3	484.6	0.0
	Pulses	244.62	118.1	2.2	20.4	
	Oil crops	3,051.63	73.0	44.5	1.3	0.0
	Vegetable oils	674.64	135.8	9.3	30.3	
	Vegetables	2,581.8	112.4	1.4	13.8	0.0
Viet Nam	Cereals - Ex.Beer	19,026.93	124.6	5.4	18.6	9.8
	Starchy roots	3,537.1	110.6	0.3	10.9	10.2
	Pulses	244.81	99.9	0.4	0.3	
	Oil crops	1,258.84	104.6	4.7	9.3	
	Vegetable oils	353.3	50.5	64.2	14.7	
	Vegetables	6,488.75	100.0	0.3	0.2	

Source: FAO (various years). Food Balance sheets. http://www.fao.org. (September 2002).

Table 5. Rates of growth of total supply, production, imports and exports, 1996 to 2000

Country/group	Product	Total supply	Production	Imports	Exports	Feed
			(%)			
World total	Cereals - Ex.Beer	0.4	-0.3	2.6	3.4	0.2
	Starchy roots	1.7	1.5	6.2	1.7	-1.1
	Pulses	0.2	0.4	1.0	6.5	-1.4
	Oil crops	3.1	3.7	9.9	8.1	5.5
	Vegetable oils	4.1	3.9	6.2	8.3	-3.1
	Vegetables	4.2	4.3	3.5	3.8	7.1
Developed countries	Cereals - Ex.Beer	0.3	-0.2	0.4	1.2	0.6
	Starchy roots	-0.7	-1.3	5.0	5.3	-3.3
	Pulses	-1.5	0.4	0.0	11.3	-2.9
	Oil crops	2.3	4.2	1.9	4.3	-0.4
	Vegetable oils	4.4	3.2	6.5	5.1	-3.1
	Vegetables	1.5	1.3	3.8	2.9	7.8
Developing countries	Cereals - Ex.Beer	0.4	-0.3	4.3	17.1	-0.8
	Starchy roots	2.9	2.7	9.9	-1.2	0.1
	Pulses	0.8	0.3	2.1	-2.4	1.5
	Oil crops	3.6	3.4	27.0	19.4	14.7
	Vegetable oils	3.9	4.4	5.9	10.0	
	Vegetables	5.3	5.3	2.4	5.6	6.6
Indonesia	Cereals - Ex.Beer	2.2	0.5	-0.3	18.9	5.3
	Starchy roots	1.3	-1.5	513.3	-15.4	-3.3
	Pulses	0.3	1.1	-9.9	14.4	
	Oil crops	0.8	-0.1	12.0	44.4	
	Vegetable oils	2.8	9.9	-18.3	27.2	
	Vegetables	-1.0	-1.6	23.7	-2.8	
Malaysia	Cereals - Ex.Beer	3.2	0.0	1.2	-11.5	1.6
	Starchy roots	2.8	-1.1	1.5	-22.7	0.1
	Pulses	-14.1		-14.1	-13.7	
	Oil crops	4.7	3.2	4.5	-18.0	58.7
	Vegetable oils	-5.4	7.1	69.1	7.0	
	Vegetables	-5.1	0.1	-13.5	-15.2	
Philippines	Cereals - Ex.Beer	2.0	1.9	4.5	0.9	1.1
	Starchy roots	-1.7	-2.1	3.8	20.5	-2.2
	Pulses	2.2	-3.0	8.3	-12.5	
	Oil crops	9.1	2.2	27.7	1.8	4.1
	Vegetable oils	2.4	4.6	17.0	7.1	
	Vegetables	-0.5	-0.6	5.9	-7.5	
Thailand	Cereals - Ex.Beer	1.2	2.5	1.5	3.1	-0.3
	Starchy roots	2.9	2.4	17.5	0.8	-10.9
	Pulses	1.6	2.5	1.4	7.8	
	Oil crops	1.9	-0.5	52.2	16.5	23.3
	Vegetable oils	0.9	9.1	-7.8	170.4	
	Vegetables	0.5	0.3	8.6	-0.3	725.0
Viet Nam	Cereals - Ex.Beer	3.3	6.0	19.4	2.8	14.5
	Starchy roots	-2.2	-1.0	6.4	20.4	-1.1
	Pulses	5.8	2.8	-18.9	-24.2	
	Oil crops	-4.8	-5.9	117.5	-8.6	
	Vegetable oils	8.8	1.5	21.8	45.3	
	Vegetables	9.4	9.3	152.4	-0.5	

Source: FAO (various years). Food Balance sheets. http://www.fao.org. (September 2002).

Raw materials

The raw materials for feed in the region are mainly composed of maize, soybean meal, rice bran or pollard. These materials are mixed with other ingredients or by-products that are commonly available in each country such as copra meal, palm kernel meal, oil palm frond, sago, tapioca and broken rice. The common concerns in the region is that the region does not seem to be able to escape from maize and soybean import dependency to support its growing livestock sector. In Indonesia, the ingredients used in animal feeds are: maize, soybean meal, vegetable proteins (soybean oil cake, nut oil cake, canola, corn gluten meal, rape seed meal), animal protein (fish meal, meat bone meal), general (coconut oil cake, sesbania leaf flour, sesame seed and flour, skim milk powder, fish oil, palm oil, sugar cane, salt, premix aliments, chlorine chloride). Industrial residues also play an important role in the animal industry as well as crop and agricultural residues or by-products such as rice straw and rice bran for smallholders. About 60 per cent of maize and 100 per cent of soybean meal is imported. Despite the country's vast natural fishery resources as an island country, 90 per cent of fish meal is still imported. In Malaysia, common feed ingredients are: maize, soybean meal, fish meal, rice bran, cassava, palm kernel cake (PKC), grass meal, peanut meal, sesame meal, maize gluten meal, lucerne pellet. PKC has been fed for ruminant livestock with success rather than for non-ruminant animals. Raw ingredients for animal feeds such as maize and soybean and others are not produced in Malaysia but imported from overseas. The share of imported feed materials to total Malaysian food bill could reach as high as 30 per cent (Loh 2004) and about 52.4 per cent of all food material imported is maize.

In the Philippines, rice bran, yellow maize and maize bran, wheat and by-products (pollard and bran), copra meal, soybean oil meal, fish meal, and meat and bone meal are the main feedstuffs available for livestock. Rice bran and copra meal are available from local sources and yellow maize is produced domestically in large quantities. Due to occasional shortfalls in local production in recent years, however, some quantities must be imported. Maize imports are predicted to continue in coming years since local maize production has not been able to catch up with the growing demand from poultry and livestock farms.

As is in the case of Indonesia, fish meal for livestock, poultry and fish feeds are heavily imported although the Philippines, like Indonesia, has extensive fishery resources. The use of cassava (*Manihot esculenta*) and ipil-ipil leaf (*Leucaena leucocephala*) meal for animal feeds has gained in popularity in recent years. Cruz (1997) observed that many of the fats and oils used for livestock in the Philippines comes from soybean oil, tallow, and fish oil even though the Philippines produces coconut oil in enormous quantities.

In Thailand, maize, broken rice, a by-product of the rice milling process and soybean are the most popular base ingredients for the poultry and pig industries. Rice bran makes up no more than 30 per cent of finishing rations to avoid it from being bulky. Thailand seems to be producing more than it needs to meet domestic feed demand and is able to export any surplus production to the rest of the region. But Rosegrant *et al*. (1995) showed that this surplus will not be sustained because there is an indication of a shift in demand and production patterns in Thailand. The authors projected that its pig and poultry sectors would be growing rapidly through 2020 and by this time Thailand will shift from a historical net exporter of maize to an importer of 2.1 million metric tons of maize.

For soybean meal, the Thai commercial feed industry imported an estimated 1.4 million metric tons of it in 2003 to close the gap with total soybean meal demand estimated at 2.8 million tons in that year. Sorghum and cassava have gained acceptance as substitutes for maize in pig and poultry rations but soybean meal and fish meal remain the main protein supplements used in the pig and poultry industries. Peanut meal, sunflower meal and sesame seed are generally used as substitutes.

Swastika *et al*. (2004) report that until 2015 domestic maize production is projected to increase from about 9.54 million tons in 2002 to about 12.92 tons in 2015, or grow at about 2.36 per cent annually. However, the growth of domestic demand in the same period is estimated at 5.39 per cent annually, implying Indonesia will have maize deficits for many years to come. The projected rates of growth of demand for maize, rice, and soybean from 2003 to 2015 in the Philippines according to the estimation done by Cardenas and de Villa (2004) are 3.0, 4.0, and 14.0 per cent respectively. Demand for maize could range from 6.3 to 6.7 million tons, while demand for rice bran would be 2.5 million tons, converted to rice as feed at 0.9 million tons, and approximately 2.7 million tons for soybean meal by 2015. The demand for maize, soybean meal, broken rice, and shredded cassava as feed in Thailand are expected to increase at 3.9, 4.7, 1.9, and 4.6 per cent annually from their levels in 2003 to reach levels of 5,744,000, 2,741,000, 2,381,000 and 436,000 tons in 2015 respectively. The production of paddy, maize, soybean, and cassava are expected to grow at 0.9, 1.3, 1.3, and -0.2 per cent annually from their levels in 2003 to amount 28,803,000, 5,493,000, 340,000, and 16,355,000 tons in 2015 respectively. From these results it appears that Thailand should be able to solve its feed crop deficit in rice, maize and cassava but not in soybean meal (Rojanasaroj *et al*., 2004). For Malaysia, Tunku Yahya and Sukir (2004) estimate that demand for maize as feed in 2010 and 2015 will be projected at 2.69 and 2.78 million tons respectively, while domestic supply in those years are 15,453 and 17,880 tons respectively, leading Malaysia to become a net importer of maize. In Malaysia, the potential of feed crops being grown by smallholders and plantations is not bright because they have many attractive alternative crops such as oil palm, rice, vegetables and fruits to choose from and these crops have ready marketing outlets and output prices are better than feed crop prices (Tunku Yahya and Sukir, 2004). While Indonesia, the Philippines and Thailand all have agricultural resources they need to increase their domestic feed crop production, Malaysia does not seem to be interested for various reasons, namely its opportunity costs are very high as there are many high-value products to choose from, and it is labour intensive in nature and labour is very costly in Malaysia.

Animal resources

In Southeast Asia, the animal industry characterizes a dual economy. On the one hand is the small farm economy, the traditional and dominant component, who raise animals for multiple purposes, including a source of cash income, home consumption for protein, draft power, manure, and as a means of household savings during the lean periods. On the other hand there are medium and large commercial companies, which include local and multinational business units, often with close relation to foreign corporations delivering advanced breeding stocks, veterinary services, and management methods to their partners. Their products such as meat and other animal products are primarily aimed at urban populations and foreign markets. Most of these large commercial operations also control their own feed factories and processing plants in fully integrated systems. The two-sided animal industry has implication on how each side procure its own feeds and feed ingredients.

The small farms, usually rearing indigenous poultry or ruminants do not depend on processed and imported materials, rather on local available feedstuffs such as crop residues and other agro-industrial by-products such as rice-bran, copra meal, palm kernel meal, oil palm frond, sago, tapioca and broken rice. The large and integrated companies, mostly growing non-ruminant normally, rely on processed or concentrated feeds. The feed materials are obtained from contract growers or imports depending on local supply conditions and world prices. In most cases these companies receive special treatment when it comes to external trade, through lower import duties, price discounts and bargaining position.

The region has also shown that there is a close link between non-ruminants, particularly the poultry industry, and the feed industry. Any change in government policy on the poultry industry will be transmitted directly to the feed industry and vice versa. It is to no one's surprise that the development of the livestock industry in the region, in particular the rapid growth in the poultry and swine population has been possible because the authorities have not imposed too many restrictions on the scale and types of business. With this facility the companies are allowed to exercise the adoption of full integration systems of livestock. But the consequence is also true that this system is more vulnerable to temporary shocks as was noted during the financial crisis which resulted in bankruptcy for many livestock firms.

A range of livestock are common in all Southeast Asian countries, namely cattle, pigs, buffalo, goats, and poultry which are grown in backyard and commercialized intensive systems. Backyard raisers tend to focus on small animals for meat and for sale and commercial enterprises are interested in large-scale integrated systems, stretching from breeding farms, feed milling to livestock product processing and marketing. Across the region, non-ruminant animal (poultry and pig) industries seem to be the most developed sectors among the different types of animal which many experts conclude as a result of livestock revolution through intensive and integration production system. There is no doubt that the major and the cheapest source of protein in most of the diets of the region's populations today is poultry meat and eggs.

Based on absolute numbers, the average populations of cattle, sheep and goat, and equines in Indonesia in 1996-1998 outnumbered those in Malaysia, the Philippines and Thailand, while the average population of buffalo and camel was higher in Thailand (Table 6). The percentage change in cattle average population from 1986-1988 to 1996-1998 in Thailand is the highest among the countries, while that of sheep and goat is the largest in the Philippines.

Indonesia's beef and veal, and sheep and goat meat also outnumber those of other countries but the Philippines has the highest rates of growth in this type of meat production. For chicken meat, Thailand gained about 30 per cent of ASEAN meat production, followed by Malaysia with 21 per cent and Indonesia with 20 per cent (Table 7). In the export business of chicken meat, Thailand is the leading exporter in the region. Other countries do not seem to export their meat. As a consequence, Thailand and Indonesia do not import chicken at all, while Singapore imports nearly 60 per cent of total ASEAN imports, Malaysia and the Philippines import a smaller percentage (Table 7).

Table 6. Livestock population, grain consumed as feed and meat production in selected countries of Southeast Asia, 1996-1998

Livestock			Country			
			Indonesia	Malaysia	Philippines	Thailand
Cattle		Annual average ('000) 1996-1998	12,029	723	2,263	6,959
		Per cent change since 1986-1988	23.8	13.7	29.1	39.9
Sheep and goat		Annual average ('000) 1996-1998	22,307	575	6,440	173
		Per cent change since 1986-1988	38.8	31.1	44.4	-3.2
Equines		Annual average ('000) 1996-1998	634	4	210	14
		Per cent change since 1986-1988	-7.2	-27	6.8	-25.3
Buffaloes and camel		Annual average ('000) 1996-1998	3,143	150	2,938	3,470
		Per cent change since 1986-1988	-5.6	-30.1	0.8	-42
Grains fed to livestock as per cent of total grain		Consumption 1988	5	37	19	25
		Consumption 1998	8	41	23	31
Meat production ('000 mt)	Beef and veal	Annual average ('000) 1996-1998	350	18	131	213
		Per cent change since 1986-1988	78	59	90	34
	Sheep and goat	Annual average ('000) 1996-1998	101	1	78	1
		Per cent change since 1986-1988	30	0	262	2

Source: World Resources, 2001.

Table 7. ASEAN chicken meat production, 1997-2000

Country	Production (mt)				
	Year				Share
	1997	1998	1999	2000	(%)
Thailand	900,000	930,000	980,000	1,070,000	29.29
Malaysia	717,000	730,000	759,000	770,000	21.08
Indonesia	878,243	604,707	604,514	714,107	19.55
Philippines	496,686	491,230	496,420	533,118	14.59
Singapore	68,400	68,400	68,400	68,400	1.87
Others	385,170	444,350	518,840	565,985	15.49
Total	3,377,099	3,200,287	3,358,774	3,653,210	100
	3,060,329	2,824,337	2,908,334	3,155,625	86.38

Country	Exports (mt)				
	Year				Share
	1997	1998	1999	2000	(%)
Thailand	192,234	260,000	298,000	332,794	96.84
Malaysia	6,100	7,862	6,731	6,731	1.96
Indonesia	2	2,996	2,859	744	0.22
Philippines	0	0	0	7	0
Singapore	6,100	3,504	3,759	3,284	0.94
Others	643	183	107	90	0.04
Total	205,079	274,545	311,456	343,650	100
	204,436	274,362	311,349	343,560	99.96

Country	Imports (mt)				
	Year				Share
	1997	1998	1999	2000	(%)
Thailand	0	68	127	22	0.02
Malaysia	7,709	13,453	26,263	26,263	18.25
Indonesia	449	346	8,141	14,017	0.79
Philippines	969	2,549	29,387	17,519	12.18
Singapore	68,311	61,833	83,818	83,997	58.31
Others	3,084	2,456	2,164	2,054	10.45
Total	80,522	80,705	149,900	143,872	100
	77,438	78,249	147,736	141,818	89.55

Source: van der Sluis, 2003.

Feeds and feed industry

In 2001 total feed grain imports in Southeast Asia were estimated to be 4.5 million metric tons and total feed grain utilization was estimated at 21.90 million metric tons, consumed mainly by the swine and poultry sectors (Rameker, 2004). But a large amount of maize is used for direct human consumption in Indonesia (3.5 to 4.0 million metric tons), Viet Nam (0.5 million metric tons) and the Philippines (1.5 to 2.0 million metric tons). The volume of human maize consumption varies from year to year depending on the rice to corn price ratio within these respective countries (Rameker, 2004). She noticed, however, that feed demand in Southeast Asia continues to grow annually. Feed growth in 2003 was 15 per cent in Viet Nam, 8 per cent in Indonesia, 5 per cent in Thailand, 5 per cent in the Philippines, and 1 per cent in Malaysia. This year feed demand might fall slightly in the region because the region has suffered from avian influenza since last year.

Typical forms of livestock feed in the region are generally forages, agricultural by-products and concentrate feeds. Beef cattle, sheep and goats, buffalo, and dairy cattle rely on forages as their feed although fattening operations involving beef, cattle and sheep, and dairy cattle also use concentrated feeds. In Indonesia, poultry and pig farm industries use concentrated feed, processed from basic ingredients such as maize, soybean, rice bran, cassava, wheat

pollard, fish meal, meat meal and crude palm oil in a proportion of about 50 per cent of maize, 10 to 15 per cent rice bran, and the rest from other ingredients (Setioko and Sani, 1999). In Malaysia, more than 80 per cent of the 4 million tons of commercial feed produced in Malaysia in 2003 is for poultry feed and 40 per cent of total poultry feed is produced for the layer market. This was produced by about 42 large commercial feed factories, contributing about 70 per cent to domestic feed demand and 500 self-feed producers supplying the remaining 30 per cent.

In the Philippines, using 1992 data as base, poultry and livestock operations consume about 96 per cent of the total commercial feeds produced (including aquaculture feeds). Of this, pig, poultry and duck constituted 46.9 per cent, 41.9 per cent and 8.5 per cent respectively. Cattle and goats, though with large populations, are raised primarily on roughages. In Thailand, the livestock industry consumed about 10 million metric tons of compound livestock feed in 1996 (Fuglie, 2001). About 65 per cent of this demand was provided by commercial feed factories, and the remaining 35 per cent was from the other producers. The commercial feed millers produce a uniform quality of pellet sized feeds and protein supplements, while traditional on-farm feed producers manufacture feeds of very varied quality. About half of the demand for compound feed went to poultry (broilers and layers) operations, 37 per cent to pig production, 6 per cent to aquaculture farming, 4 per cent to duck raising, and the balance of 4 per cent was used for cattle, dairy and small ruminant farming. In poultry operations, the share of purchased feed can reach to more than 60 per cent of variable production costs. But more than 70 per cent of pig farmers have adopted on-farm feed production (Kanto, 1991 quoted by Riethmuller and Chalermpao, 2002).

Consumption of animal products

The pattern of animal product consumption varies according to the taste and preference of consumers in the region. In Malaysia, per capita consumption of poultry meat in 2001 was 27.68 kg, eggs 17.05 kg, beef 4.86 kg, mutton 9.67 kg, pork 7.03 kg and milk 46.54 kg per annum (Nor *et al*., 2003) and according to Fuglie (2001) per capita consumption of chicken and chicken eggs in Malaysia is among the highest in the world. For the Philippines, Cruz (1997) noted that from the third national nutrition survey, per capita consumption of pork is 7.5 kg per annum and poultry is 3.3 kg per annum, and of fish and fishery products is 40 kg per annum.

In 1999, domestic consumption of meat in Thailand was estimated at 0.3 kg per capita per annum and specifically for pork, the second most significant meat in terms of local consumption, it was about 4.7 kg per capita per annum in the 1990s.

Another important study on demand for livestock products in the region was conducted by Kobayashi (2004). In his study Kobayashi (2004) was able to present the demand for livestock products for Indonesia, Malaysia, the Philippines, and Thailand after estimating income elasticities of demand on each product in the respective country. The actual and projections of demand for livestock products are summarized in Table 8.

The absolute levels of the consumption may be arguable but some interesting observations can be made from the table. As observed by Fuglie (2001), Malaysia had the highest levels of per capita consumption of meat, eggs and dairy products in 1994. and it still remains to be so in 2004. On the contrary, Indonesian per capita consumption has always been the lowest among the four countries and it remains the same in 2004. It indicates that there is still a room for expanding livestock consumption level in Indonesia.

Table 8 also shows that all respective countries are expected to experience an increase in consumption per capita of livestock products, with the exception of Indonesia for dairy products. The Philippines will have higher growth in meat and dairy product consumption per capita than the rest of the group and Malaysia will have higher growth in egg consumption. If

the demand for animal products continues, animal production will be induced to grow and this will then lead to increases in demand for production inputs.

Table 8. Projections of demand for livestock products in selected countries of Southeast Asia

Countries	Per capita consumption (kg)		
	Actual 1994	Projection 2004[a]	Change (% per annum)
	(Meat)		
Indonesia	9.7	11.2	1.5
Malaysia	49.1	58.5	1.9
Philippines	24.8	35.1	4.2
Thailand	21.2	23.0	0.8
	(Eggs)		
Indonesia	3.1	3.6	1.6
Malaysia	17.6	21.9	2.4
Philippines	5.3	5.9	1.1
Thailand	8.8	10.5	1.9
	(Dairy Products)		
Indonesia	6.6	4.0	-3.9
Malaysia	59.1	68.2	1.5
Philippines	20.7	28.9	4.0
Thailand	21.6	21.5	0.0

Source: Kobayashi, 2004.

[a] This is the result of Scenario III which assumes that economic growth rates are half of those of the 1983/1984-1993/1994 period with a 0 rate for the Philippines and exchange rates are fixed at the March 1998 level.

Government policies

Each country in the region employs various policies to support its agricultural sector. But the government also maintains economy-wide policies to improve general economic performance which may defeat the impact of sectoral policies. The benefits of the sectoral policies are not fully realized partly because measures to enforce them are not in place or the costs of implementation and enforcement are too high. As of today, the government of Indonesia has not yet officially recognized and accepted the commercial vertical integration system of livestock. Many government regulations have been issued to limit this practice and they are still in tact. But in reality few companies have adopted the system and they are still operating today. On the trade side, the import duty on major feed ingredients such as maize, soybean meal, fish meal, groundnut meal and bone meal has been abolished, but presently there is a proposal to impose the import duty again for maize and soybean to about 25-30 per cent as a means to protect local farmers.

In dealing with the development of the livestock industry, the Malaysian government has embedded development into the agricultural sector by launching a programme to enhance the economic contribution and growth of the sector under the Third National Agricultural Policy (NAP3) with an overriding objective to maximize income through the optimal utilization of resources in the agricultural sector. Positive results of the earlier policies in Malaysia have been observed.

The government in its efforts to achieve greater self-sufficiency levels in animal products has embarked on various plans to promote livestock production in specific zones. In an effort to develop the animal industry the NAP3 would try: (1) to supply poultry meat and eggs for the domestic market in sufficient quantities and if possible explore export opportunities; (2) to increase the production of beef, mutton and milk for the domestic market; (3) to supply raw materials required by the processing industry; (4) to continue developing Malaysia as the

"international halal food hub" of the region; and (5) to apply production technology in a sustainable manner. Under the production programme, the NAP3 has identified and would concentrate on six major livestock commodities, namely: poultry meat, eggs, beef, mutton pork and fresh milk. On grains, especially maize, the government has not opted to develop the ambitious local maize production, so its production is projected to be stagnant.

In attempts to improve agriculture competitiveness, the Philippines government has made a large number policy adjustments, both economy-wide or sector-specific, to help improve the agricultural sector's performance, starting in 1986. But some policies adversarily affected the sector such as the overvaluation of the peso. The overvaluation of the peso has led to export increased prices and as a result, a decline in the volume of agricultural exports. It is generally accepted that public infrastructure investment is impartial to any particular sector, but unfortunately public investment policies in agriculture are not as attractive as other policies such as environmental management, rice price stabilization, and agrarian reform. Export taxes on copra were abolished, government monopoly control on agricultural trade on almost all commodities except rice was eliminated. Quotas and tariffs on agricultural inputs were lowered considerably (Pray, 2001). Land reform implementation has been able to redistribute large plantation land in 1995 to small farmers who had less access to credit, used lower levels of manufactured inputs, and grew many other crops compared with larger operations.

Despite all these attempts, the Philippines was protecting agriculture and driving up prices in the 1990s when the 1991 law called "Magna Carta of the Small Farmers" was enacted (Pray, 2001). Under the law, the import quantity of products produced by Philippine farmers and the imports of seeds and planting materials were regulated. The list of products that were subject to import restrictions are sugar, maize, or other grains for livestock feed, and poultry and pork products. In relation to the livestock sector, this commitment can be seen in the importation mechanism of maize to the Philippines that is delegated by the National Food Authority (NFA). NFA has been given the monopoly to import yellow maize to fulfil the demand from the feed millers and poultry and livestock growers and sell it at a fixed price (Villacorte, 1991). If the import price is high, NFA will bear the difference via subsidy fund and when the import price is low NFA reaps profits. The imports, however, are subject to a 50 per cent applied tariff rate. Under a WTO arrangement, the government agreed to allow a tariff rate quota (TRQ) on maize, subject to a 35 per cent duty. Imports beyond the quota level are charged with 80 per cent duty.

The Thai government laid the general foundation of its development programme in the Fourth Economic and Social Development Plan, which argued that the government should encourage industrialization concurrently with agricultural development and give support to basic industries, supporting industries and agro-industries (Riethmuller and Chalermpao, 2002). To encourage industry to locate in rural areas outside of the Central Plains that is already congested with population, the authorities provide incentives packages. But development of new agricultural industries, particularly smallholders has been stagnant due to a lack of investment and working capital. Farmers are inhibited to obtain this capital from financial institutions because they do not wish to use their lands as collateral.

On trade, the Thai government reduced the import duty on soybean meal from 10 per cent to 5 per cent in May 1997 to reduce production costs for meat producers, with a hope that the competitiveness of Thailand's meat in the world markets would be improved. On the other side, the government has set the purchase price to assist Thailand's soybean producers.

Challenge for feed crop development

A major challenge for Southeast Asian food and agricultural production is the transformation in the volume and pattern of demand. Large population growth, it is projected to rise from 450 million in 1991 to over 615 million by 2010, is continuing to primarily drive growth in demand for food and agricultural products, spurring governments to pursue annually rising agricultural production targets.

However, the major economic growth of the ASEAN economies in particular, excluding the Asian crisis period of 1998, has meant considerable growth in per capita GDP, resulting not only in increased consumption of traditional foods, but also, at per capita income levels of between about US$ 800 and US$ 2,200, increasing diversification in the pattern of food consumption into higher value and higher quality foods. As per capita incomes rise in Southeast Asia, people are tending first of all to eat more of the traditional primary staple (rice), and less of traditional secondary staples (cassava, sweet potatoes, maize); then to shift towards an alternative staple (wheat), more fruit and vegetables, and more animal products (meat, fish and dairy products); and finally, to reduce consumption of both traditional and alternative staples, and consume far more animal products, and higher value foods, both fresh and highly processed. This should raise the hopes of governments that many people, particularly feed crop farmers and livestock farmers could be stimulated to participate and take advantage in the process. However, the course also provokes some reservations among the authorities in the region.

Many governments until now are seemingly ill prepared because of the complexity of the problems they are facing to improve their agricultural performance, namely: (i) increasing reliance on imports; (ii) policy-biased against small operations; (iii) environmental impacts; (iv) changes in the structure of agricultural development and regional cooperation; (v) role of multinational companies; (vi) trend to total vertical integration system; (vii) food safety issues; (viii) grain supply and price volatility; (ix) global drive toward transparency and good governance; and (x) globalization and liberalization of trade.

Reliance on imports

With increasing per capita income and diversification in food consumption towards wheat, beef, dairy products, temperate vegetables and fruit, which Southeast Asia is either a non-traditional or minor producer, Southeast Asia has emerged as a significant importer of a diverse range of food and agricultural products in the world. Even for some traditional products, such as pulses and seafood, domestic production has failed to keep pace with demand, likewise resulting in growing imports. The growing trend in imports for animal products and raw materials alike has already been discussed above and would probably be mentioned by the distinguished country experts. But one thing that is clear is the existence of a livestock industry and its supporting components in the Southeast Asian region has become more exposed to an influx of either input materials or livestock final products, which many analysts maintain is only a simple matter of trade phenomena falling under comparative advantage. We will argue, however, that the pseudo-comparative advantage in grain and livestock product exports from the exporting countries is likely because these countries grant a substantial amount of support to their own grain and livestock farmers in various forms such as classified by the WTO as domestic support, export competition or subsidies and high tariffs.

Biased policies against small- scale operations

Many policies implemented by countries in the region to develop their livestock sectors on internal matters and to respond to the external pressures that have resulted in inequitable

impacts favouring large-scale feed manufacturers and large-scale livestock firms and leaving smallholders to face an unfair market environment. This can be seen on two grounds:

Firstly, the administration of tariff quotas on material inputs such as maize and soybean in most of these importing countries is in favour of the large producers. As there are high fixed costs of obtaining the quota and high transaction costs of import, the quota system is biased against the small holders. Secondly, the contract farming system is also in favour of the vertically-integrated contractors who have predominant market power. When there are fluctuations in both the output and the input market, the contractors are always in a better position to shift the costs of adjustment to their smallholder partners.

In the supply of feed, the large-scale integrators not only produce their own feeds for their farms, but they also sell their products on the market, competing with small-scale feed mills. In many instances, the materials used to produce the feed by the large feed millers are imported under special arrangements characterized by low import duty as opposed to prevailing higher import tariffs. With this advantage, the large integrators gain competitive advantage domestically. With further integration horizontally for human food, they can acquire economies of scale in feed grain milling.

In the output market, large-scale manufacturers can decide the types of products supplied by their contract growers by controlling the quality and price of inputs. They can also influence the price and quality of their products and guarantee quality for distribution to specific formal or institutional markets through controlling over the processing and packaging of outputs.

Environmental impacts of agricultural development

The rapid development of agriculture over the last four decades has caused unfavourable consequences on many countries' natural resources in the region, and it has reached an unsustainable degree in some cases. Deforestation, overgrazing, the expansion of agriculture to marginal land, salinization and pollution have resulted in significant land degradation. Fresh water supplies have shrunk due to the demands of rapidly growing populations and contaminated by industrial and residential waste. In developing their agricultural strategies, including the livestock sector, governments cannot afford to ignore the pressing resource and environmental constraints which, if not managed responsibly, could imperil future agricultural growth and development.

The environmental impact of industrial livestock production has raised some social concerns too. In many places in the region, there has been social conflicts emerging over the location of large-scale livestock production close to residential areas. Environmental regulations against pollution are not only meant for heavy and light industries anymore, but is applied on industrial livestock production as well. In Thailand, the livestock industry has grown in close proximity to Bangkok, and heavy concentrations of animals have caused environmental concerns. For some countries in the region like Malaysia and Indonesia, many hog farms have had to close down because the general public does not accept the farm in their vicinity due to its waste and pollution. Recently in Malaysia, the Department of Environment's requirement on pollution and hog waste management became a major concern to farmers. Under the Pig Farming Area (PFA) ordinance, the government enforces the farmers to relocate their farms to designated production areas and meet the guidelines on pollution abatement. Otherwise they will be forced to close down the operation. Farmers are reluctant to invest in waste management systems and infrastructure because of the costs entailed and nobody is confident about the fate of the industry as the government is so committed to enforce the rules. In the Philippines, Catelo *et al*. (2001) observed that government authorities have begun contemplating the regulation of livestock waste, even for smallholder farms (Laguna Lake Development Authority, 2001 quoted by Costales *et al*. 2003). If more and more environmental regulations have to be enforced, it is

necessary to determine how such enforcement would differentially affect the viability of small- and large-scale farms.

With the government ordinance some farms could still be relocated to indicated areas to abate pollution and preserve an integrated farm. But this area is often remote, lacking in facilities like utilities and infrastructure and far from raw materials and farm product markets and consumers, making the costs of transportation unbearable to the hog farm company. The relocation of farms not only applies to hog farming but also to poultry farming in most of these countries.

Restructuring of agriculture and regional cooperation

The higher income and higher cost economies of the region - particularly Singapore, Malaysia and Thailand - are in effect moving towards a regional approach to food and agricultural self-sufficiency by relocating some of their lower value agricultural production to the lower cost economies of the region, including Indo-China and Myanmar. ASEAN agribusinesses are playing a leading role in forging this regional division of labour. For example, Malaysian rubber growers, hard pressed by rising costs and competition from Thai and Indonesian producers, are helping to revive rubber production in Indo-China. Malaysian investment in Indo-Chinese palm oil facilities has started in earnest. Thai agribusinesses are the main participants in the development of aquaculture and forestry industries in Indo-China and Myanmar.

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 trade of manufactured products. However, with the emergence of a Southeast Asian pattern of food and agricultural trade and investment, the potential advantages 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 - parts of two or more countries. For example, the Singapore-Johore-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 of the undertakings is that a central government should delegate the local governments to assume some responsibility to make strategic decisions regarding its vision on how it is going to pursue its agricultural development. This question has been sorted out by regional autonomy law, giving local governments more authority to make decisions that sooth their population best. However, some local governments in certain states often move to fast by adopting some policies that are only meant to please their own population interest and not in line with the national guidelines. As a consequence, central and local governments end up in a contradictory situation. If such disagreements continue to exist, the economic growth zone will not give results as expected.

Multinational companies

Some multinational breeding farms and feed companies have been operating in the region for some time and it appears they could grow persistently in line with the growth of animal sector in countries across Southeast Asia. Of these companies, some have even been able

to diversify their business to other areas. For instance, Cargill in Indonesia operates four feed mills and breeding farms and at the same time it also runs palm plantation and actively trades in feed grains, copra and cacao. It produces over 70 different feeds to more than 300 customers across the poultry, swine and aquaculture value chain and in Malaysia it produces over 130 different feeds to more than 400 customers (Cargill, 2004).

In Indonesia Charoen Pokphand (CP), Cargill and Pioneer Hi-Bred engaged in maize seed production (Fuglie, 2001). CP also operates its own poultry farms in Indonesia and in Malaysia. In Thailand CP and Betagro Agro are the two largest feed millers. In the seed business, CP, Pioneer Hi-Bred, Cargill, Novarties, Pacific Seeds are involved. These corporations also run poultry and pig production business in an integrated manner (Fuglie, 2001). In the Philippines some multinational companies involve themselves in various elements of agribusiness. Pioneer, Cargill, Ayala and Cornworld are involved in maize seed production; Cargill and Cornworld also produce hybrid rice (Pray, 2001). In livestock and poultry production, a few large integrators dominate the business such as San Miguel Corporation, Purefoods, 1995 Vitarich, Swift and General Milling.

The participation of multinational corporations is probably needed to provide impetus not only for the development of local initiatives and improvements in livestock industry performance but also improving the well-being of people involved in agribusiness in such a way that the share of each party in the agribusiness is preserved and not eroded. In practice, however, this share is difficult to define and even if we could, controlling its mechanism is arduous. As a consequence, the income and presence of multinational integrated companies in some countries in the region has put a significant numbers of small livestock farmers out of business and made small feed crop farmers lose their incomes. This problem cannot be judged simply by the adherence to market forces, because this is not the best solution. In theory the market force would tend to be in favour of profit-maximizing objectives of the involved companies. Besides, based on experience in the region recently when the avian flu attacked poultry farms, many large intensive farms were affected. To cater for health conscious consumers and to curb the spread of diseases and restrict the use of antibiotics, the production of poultry may have to change to a less intensive form, free-range natural systems. Thus, some regulations are still required to monitor them and some preferable arrangements should be sought as the second best solution.

Issues on full integration

Based on experience in many countries that demonstrates the strong relationship between the trend towards fully integrated operations and the growth in the livestock industry as broiler and feed millers have seen, many researchers have contended that for the industry to gain growth momentum, total vertical integration between livestock production and feed milling, supplying breeding stocks, feed, medication and, most importantly, capital and individual farmers should be more promoted. Under this scheme farmers would be able to obtain the inputs they need with no constraints. But, others are still skeptical about this conclusion and hold that a fully integrated livestock industry might eventually remove the rural poor farmers and local crop producers and make the country become heavily dependent on inputs such as breeding stocks and feed crop imports. It is argued that the traditional and backyard system should be given a right to live and besides food sovereignty of a country should not be given fully to the distorted world market. As a result of this resistance towards true integration and a desire to remain self-sufficient in food, existing government policies in some countries do not recognize full integration systems.

In order to resolve this disagreement, a comprehensive study on the impact of poultry integration on socioeconomic development is needed. This study will help to uncover the actual

benefits or costs to the country and its people. It also should investigate its impact on jobs, in terms of feed costs and the overall costs of production for animal protein, meat consumption per capita, wages and income, investment, exports of food and other value-added products, processed products' production and distribution, infrastructure development and other facets of the economy.

Internationalization of food safety

As the food industry has become responsive to market forces which require food to be safely consumed by humans, the industry must be able to guarantee that the end product is produced under good production and processing practices in the product chain, from primary breeding, to production, marketing and transportation, to feed, and feed crop production. To set a food safety standard, the international community seems to have taken Hazard Analysis Critical Control Point (HACCP) as an indicator and WTO has also accepted this criteria despite its adoption being only voluntary. But the trend to impose this in domestic and international trade among business firms is most likely. On the other side, WTO also allows its members to construct sanitary and phytosanitary measures to protect its domestic consumers from hazardous material and diseases. On both sides the economies in Southeast Asia are very week at all stages of the production chain and in undertaking the analysis itself. The adoption of Good Production Practices in animal and feed crop production currently is a luxury to most of the smallholder farmers in the region. Facilities and capable human resources to implement a comprehensive analysis in most of the countries are also limited.

With a common preferential trade agreement among countries in the region some feed crops, feed or feed crop products may gain privilege, but when the quality is at stake the 'special treatment' would undoubtedly be left behind, even among the members. To maintain growth in the livestock industry, the importing countries in Southeast Asia or in other regions would need to seek alternative sources of feed in the world market, which is unsurprising from the countries that have implemented the HACCP criteria.

Instability of world grains

Some studies have shown that world grain supply and demand have become tighter and the market has become unstable. At the same time, Asia is persistently relying on imports. The continued reliance on the world grain market is a consequence of population growth and increasing demand for grain that accompanies economic development, with which increases in grain production within the region cannot keep pace. Not long ago, when grain production in China and its exports to the world market dropped, the grain price rose unprecedently causing many grain importing countries unease. The instability in the supply could happen at any moment due to political, economic, agronomical and environmental reasons.

Transparency and governance

The establishment of the WTO and regional free trade areas has given new perspective to many countries around the world for reviewing their domestic policies. The implementation of the agreements under the WTO and the Common Effective Preferential Tariff (CEPT) Scheme of the ASEAN Free Trade Area (AFTA) has created another dimension of competition for Southeast Asian agriculture. Now they have recognition that the global trading environment necessitates the development of a resilient agricultural sector and the enhancement of its global competitiveness. Two important issues that need to be addressed in the countries under study are the issues of high-cost economy and transparency which entails excessive unrelated outlays for conducting business in the region. These issues are interlinked.

It may be true that despite considerable progress raising incomes and boosting food demand by the government in many developing countries, more than half the population in these countries remain poor, because of poor governance. It is difficult for an economy to grow when corruption is rife, when laws to protect investments and enforce contracts do not exist or are not properly enforced, when infrastructure is inadequate and when people are poorly educated. Quite a few investors have raised concerns about the rampant unofficial and unpredictable fees that have to be paid before and even after the business has been in operation. This results in many potential investmentors, needed by many countries in the region, backing off from their plans and shifting to other attractive regions. The region's competitiveness continues to worsen.

A high-cost economy is partly contributed by transportation and handling costs. The location of feed mills is usually in the area where port facilities are available for importing feed ingredients and not so much determined by the location of local material sources. And it is undisputable that raw material supply is very crucial to the operation of feed millers. In either case, the costs of transport and handling in some countries are unpredictable. Many illegal or unauthorized fees must be paid by the importing as well as transportation companies in their operation that cause transport and handling costs of feed to increase. Moreover, uncertainty and the scattered location of raw material supply from local sources and contract purchase arrangements not being widespread cause prices to highly fluctuate and the cost of storage is very high.

Globalization and liberalization

Globalization is more than commodity imports and exports, but rather it involves broad economic integration involving capital flows, foreign direct investment, trade in products and services, immigration rules, and non-trade related issues such as property rights and sanitary and phytosanitary. There are four drivers of globalization: (1) information technology - advances in information technology have improved firms' ability to evaluate and monitor consumer demand and created an expanded geographic market for firms. Livestock feed producers are now able to map sources of their raw materials and buyers of their products, and livestock farm enterprises are now more well informed about prices and qualities of feed coming from various sources; (2) improvements in transportation – firms can now supply markets in previously unattainable regions of the world due to improvements in transportation, logistics, scheduling and delivery. Feed millers in Indonesia, Thailand or any other ASEAN countries have access to any other market in the region; (3) capital mobility – financial and speculative capital, previously available in developed countries is more mobile and available worldwide. Financial and stock markets have been growing in the ASEAN region and many feed producers and livestock farm enterprises have integrated into the system in various stages; and (4) technology transfer – as firms operate globally, the nature of worldwide technology transfer and research and development activity changes to within firms through foreign direct investment and subsidiaries. This has occurred from some time in the development of feed rations and of stock of livestock as a few animal feed millers or livestock farm growers in the region are cross-border investment undertakings.

World markets have now become less trade protected and subject to increasing international competition and opportunities. Many markets embark on various reforms to respond to changes in business environments and political conditions change. Some have undergone these changes very quickly and successfully but others may need some time to adjust and are experiencing painful consequences. The globalization drive has also been felt in the region ever since the region agreed to establish common trade area under AFTA where overall tariffs would be reduced to 0 to 5 per cent and all non-tariff barriers would removed. Through

AFTA, it is envisaged that ASEAN would be an integrated domestic market, an efficient and competitive base to attract foreign investment, an enlargement economy where complementary trading among members and industrial linkages among members are accelerated. This applies increasingly to the ordinary or compound feed industry and the respective ingredient markets. The international markets too are changing their demand for raw materials as well as premix ingredients. Specific to the livestock industry, AFTA has directed that the full implementation of AFTA was supposed to be started in 2003, which would affect livestock products and by the year 2010 whole chicken, whole eggs, day-old-chicks and pig would be included.

The other side of globalization is the trade procedure of meat products which includes certification, inspection of plants, freedom from antibiotic, and Salmonella contamination. In addition, suppliers must go beyond producing a quality product and be prepared to answer questions about food safety as discussed in the previous section, animal welfare, animal health, and the environment. The producers of food have to adhere to responsible production techniques to create desirable, economically viable and, above all, safe food products. But some authors have argued that all these procedures are not a trade issue but new forms of non-trade barrier used by importing countries to stifle the incoming products from foreign sources. Moreover, learning from the outcomes of negotiations that have taken place in various places, the aspirations and interests of developing countries have not been correctly addressed.

In the Doha Round there was expectation that after its implementation developing countries would have a stronger voice in the process of negotiation, hoping also for access of their agricultural products to the developed countries' market. As this did not occur, the developing world expressed its frustration in the Cancun Round through the disagreement in the agricultural negotiation. The deadlock in the agreement on agriculture was brought again into agricultural negotiation in July 2004 in Geneva. The meeting produced a document called the July Package, which surprisingly is more to the advantage of developed countries than to developing countries.

It appears that WTO negotiations have been more concerned with the issues of protection and competition in market access, usually employed by developing economies to equally give consideration to other pillars stipulated in the WTO like domestic support and export subsidies which are typically implemented by developed countries and not by developing countries. Under the July Package 2004, the developed countries would be allowed to shift between 'boxes' and probably granted new 'boxes' under the domestic support pillar. More concessions from developing countries are also requested. The United States put most of its domestic support under the Green Box, and the European Union is in the process of transferring much of its domestic support to the Green Box as well (Khor, 2004). It is known that subsidies under the Green Box do not have to be reduced and is said to be not trade distorting. They also get sensitive products right in the market access pillar. In contrast, developing countries will only get special products, special safeguard mechanisms, and special and differential treatments, and maybe sensitive products in market access pillar. All these benefits will not help much the agricultural sector of developing countries and the stern competition will inevitably be a threat to agricultural sectors in the developing countries.

How to capitalize on the challenges?

A major challenge for Southeast Asian food and agricultural production is the transformation in the volume and pattern of demand. Large population growth, projected to rise from 450 million in 1991 to over 615 million by 2010, is continuing to primarily drive growth in demand for food and agricultural products, spurring governments to pursue annually rising agricultural production targets.

However, the major economic growth of the ASEAN economies in particular has meant a considerable growth in per capita GDP, resulting not only in increased consumption of traditional foods, but also, at per capita income levels between about US$ 800 and US$ 2,200, increasing diversification of the pattern of food consumption into higher value and higher quality foods. As per capita incomes rise in Southeast Asia, people are tending first of all to eat more of the traditional primary staple (rice), and less of traditional secondary staples (cassava, sweet potatoes, maize); then to shift towards an alternative staple (wheat), more fruit and vegetables, and more animal products (meat, fish and dairy products); and finally, to reduce consumption of both traditional and alternative staples, and consume far more animal products, and higher value foods, both fresh and highly processed.

Many of the goods are subject to increasing demand such as wheat, beef, dairy products, temperate vegetables and fruit. These goods are ones in which Southeast Asia is either a non-traditional or minor producer. As a result, Southeast Asia has emerged as a significant importer of a diverse range of foods and agricultural products. Even for some traditional products, such as feed grains and ingredients, pulses, poultry products and seafood, domestic production has failed to keep pace with demand, likewise resulting in growing imports. With widening opportunities in feed and livestock production in Southeast Asia, and considering the bulk population of the region is still engaged in agriculture, except maybe for Malaysia, countries in the region should reconsider their attempt to revitalize their agricultural sector.

Some efforts should be made to increase regional as well as country specific domestic production, again excluding Malaysia. The strong and resilient agricultural sector is still necessary for the livelihood of the population and to respond to the challenges their facing today. Among numerous business undertakings in agriculture, feed, feed crops and livestock business are promising candidates to pursue the objective if it is handled properly. To deal with the challenges on feed, feed crops and livestock development in Southeast Asia some attempts should be made as per the following: (i) promotion and expansion of indigenous feed resources; (ii) promotion of farm-made feed; (iii) curtailing the level of pollution; (iv) active participation in the world trade negotiations; (v) providing assistance to feed crop farmers; (vi) empowering feed crop farmers; (vii) sanitary and phytosanitary application; (viii) improving competitiveness and efficiency; and (ix) expansion of investment in research and extension.

Enhancement in indigenous feed resources

Since feed costs are normally the main component of production costs in Southeast Asia, which amounts to 60 per cent or more of total production costs, an increase in the utilization of indigenous feed resources in undoubtedly an important way of helping livestock producers reduce their costs. Some government initiatives and more importantly those of private sectors are required to stimulate the livestock stakeholders' interest for feed and feed ingredient alternatives. This has been done in Malaysia and Taiwan. In Malaysia, the exploration of abundant agro-industrial wastes and new sources of forage such as chopped oil palm fronds are in progress. The potential for 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 good and their use should be aggressively promoted for acceptance as ruminant feeds (Tunku Yahya and Sukir, 2004). Indonesia should probably follow the Malaysian step. Thailand has had a long history in conducting research on cassava (*Manihot esculenta*) utilization when the EU cuts its cassava pellet imports. In the Philippines the use of cassava and ipil-ipil leaf (*Leucaena leucocephala*) meal for animal feeds gained in its popularity in recent years because they have been widely available due to various government programmes. For commercial livestock enterprises with high-performance animals, which are accustomed to using concentrate feeds and raising breeds much the same with those used in

developed countries, there is a new opportunity and interest to improve indigenous breeds better adapted to regional conditions. This implies that there will be a growing use of locally produced feed resources.

For backyard or traditional smallholder livestock farmers, the improvement in and search for the indigenous feed resources would ease the pressure of feed shortages at the dry season. Moreover, the development of indigenous resources would be able to attract local participation, including small-scale and peasant feed crop farmers to grow these crops. However, any use of indigenous feeds must meet the same requirements as livestock feeds from other sources. Such feeds must not only be palatable and digestible to livestock, without any harmful physiological effects, but they must be available where and when they are needed, and their cost must be low enough to make their use economical. Transfer to farmers of information on indigenous feed resources is another weak point. Low-income farmers would be helped by small inexpensive machines for chopping feed materials etc., while more exploitation of leaf meals, possibly in palletized form, might also benefit this group. Cooperatives can be another way in which small-scale farmers can increase the efficiency and scale of their use of local feed resources.

Two examples of materials that can substitute energy from grains are cassava and sweet potatoes. From their composition, the roots, tubers and fruits plants would be potential substitutes for cereals in providing nutrients (Machin, 1991). The use of dried cassava for the animal feed industry had substantially increased in several Latin America countries (Henry and Correa, 1991). In the region, Thailand has also increased the utilization of its cassava production for animal feed. For sweet potatoes, Scott (1991) wrote that both for agro-biological and socio-economic reasons, potential expansion of sweet potato use on animal feed is possible. As a substitute for protein the region can develop its fishery resources, stretching from west to east, namely western to eastern part of Indonesian waters, and from north to south, Philippine to Indonesian waters. For fats substitutes, Indonesian and Malaysian palm oil and also Filipino coconut oil are available. There might be a problem related to the quality of copra meal and other coconut by-products, but the government and the feed industry has to work together to increase its nutritional value and use in animal feeds. Through appropriate processing methods nutritious animal feed can be made out of coconut meat, but it needs some testing. If its use is to be favourable, the product may substantially reduce dependence upon fish meal and other imported protein-rich feedstuffs.

Promotion of farm-made feed

This effort has been made by various government institutions and its prospects to reduce feed costs are attractive not only for large-scale farming operations but also for farms that are located in distant rural areas, where hauling costs are high, the supply of commercial feed is irregular, and the freshness of feed is generally lower. But on-farm feed milling operations are disadvantaged by higher costs of raw materials compared to large feed manufacturers who purchase in bulk at a lower price. Other factors are also influential. In the open market, large buyers can obtain their feedstuffs through credit, whereas small purchases usually have to be paid in cash and during lean months or shortages in raw materials, the large feed millers almost always receive priority from the trader. The situation could be even worse for small buyers when the trader is also an importer and large feed miller. Some policy measures are required to prevent market control by the large operations and equally important credits to small operations should also be offered.

Pollution abatement

As the animal industry is undergoing a process of restructuring all over the world to respond to a new economic and eco-physical environment, it must be able to meet the demand

for its products while at the same time preserving the environment by modernizing farming methods to improve waste management, which will help to prevent pollution. It is being encouraged to adopt better production technologies to improve productivity, bio-security and create an eco-friendly environment.

Agro industrial waste is a frequent cause of pollution. Possibly the cost of processing into livestock feed and other uses should be shared by the processors. In general, economics rather than technology seems to be the major constraint to making increased use of indigenous feed resources. Even crop residues which have no other economic use may not be a very cheap source of livestock feed if the costs of collection, transportation and storage are taken into account. But technology could give some help in improving economic efficiency to deal with pollution. There has been growing evidence that with simple and inexpensive technology, agro industrial pollution could be coped with and even revenues and positive externalities could be generated. Public research institutions should intervene to introduce these cheap and appropriate technologies.

Active involvement in trade negotiation

Unimpressive improvements in incomes of the poor in developing countries are partly a consequence of inappropriate domestic government policies. The governments of developed countries, however, should also share the blame because in preserving employment in their countries, they have imposed import restrictions on developing country exports like textiles, poultry, shoes, tropical fruits, sugar and high tariff escalations for primary and processed agricultural products. If developing countries cannot trade their products with other countries how can their people earn money to enable them to purchase more food and other goods produced by the developed countries? Thus, the developing countries, especially members of ASEAN should work hand in hand internally or externally to struggle for equitable share of influence with developed economies in decision-making in multilateral trade and non-trade negotiations. As the WTO has been accepted as the avenue where members can convey their trade and non-trade issues and aspirations for negotiation, Southeast Asian countries should use this forum to their fullest benefits. They have to strive together in every way to persuade the developed countries to abandon their protective policies. Economic pie from trade should be extended and expanded to make trading partners better off because economic development is not a zero-sum game. The developing world should also have a share of the pie.

Helping feed crop farmers

The fluctuating price of feed crops is a factor affecting farmer's interest to grow them or converting area to other crops and most frequently the middlemen and collectors reap any gains from price fluctuations. With the limited storage facilities owned by most farmers, they only have two options: to sell their harvest outright at a low price or store the harvest at home awaiting better prices later. The latter alternative is actually uncertain and most likely the grain quality will deteriorate. As a result, the farmer will probably only break-even, which does not offer incentives to improve his farm management. In such a situation, it is expected that the government should intervene and establish a framework of joint-partnerships to be negotiated by farmers and feed milling factories with the objective that farmers will receive reasonable profits from supplying their harvest to the factories and factories will obtain materials they need and remain in business. This type of arrangement has shown good results in some locations of several countries in the region but needs to be replicated.

Empowering feed crop farmers

To improve competitiveness in agriculture, its productivity has to be elevated, its markets developed and strengthened, trade distorting policies phased out not only in individual domestic countries but also in trading-partner countries. This should be sought through all fora, unilaterally, bilaterally and multilaterally.

In an effort to meet the globalization challenge, feed crop farmers should be empowered to take part in agribusiness entrepreneurship through production restructuring in farm clustering to gain economies of scale, pursuit of productivity enhancing measures, such as variety, credit delivery systems, appropriate technologies in fertilizer and soil management, plant pest and disease management, post-harvest, production intensification through irrigation, diversification of production areas through feed crop based-high value crops farming systems, and production mechanization. This requires supporting infrastructure such as contract growing and other market-matching schemes, post harvest infrastructure, farm-to-market roads, and timely market information. Human resource and institutional development activities will be required to strengthen farmer organization and entrepreneurship.

Sanitary and phytosanitary application

For countries in the region to stay in the business, they should now plan to improve the quality of feed and feed crop production. They may not be able to adopt exactly HACCP criteria, but they should be ready to set minimum criteria that preserve the safety of food to consumers.

Increasing competitiveness and efficiency

Cooperation among members of the ASEAN/AFTA should be strengthened to develop and develop the regional livestock industry to protect the industry from increasing competition from external markets. Promoting technical and technological exchange among the ASEAN/AFTA member countries would indeed lead to improvements in the region's production efficiency, value-added and downstream processing to improve competitiveness. This could be extended to areas of breeding, feed, raw material production and processing given the fact that there is similarity in the agroclimatological environments within the region. It is unfortunate that in the case of the avian flu outbreak that eliminated millions of the poultry population in the region recently, such initiatives would have materialized. At a country and a business level, competitiveness and efficiency should also be improved through appropriate technology and policy reforms in investment, trade, and agriculture to curb the high-cost economy, lead to good governance and transparency, and offer open and equal opportunities. Upgrading competitiveness and efficiency could partially be achieved if governments continue to engage in more public investment in infrastructure and supporting and facilitating agencies.

Investment in research and extension

Among the countries being studied, each has already established public research institutions. Some even have institutes that are specifically assigned to deal with crops other than rice such as maize and sorghum, roots and tuber crops. Indonesia and Thailand are examples. But these research centres have not yet lived up to users' expectations. Rather than meddle with problems and real conditions in their own economies, many research programmes seem to emulate the topics and areas being investigated by research centres in the developed world. This results in only limited technological packages being produced that can be adopted by their own farmers. Lack of adoption is also caused by weak extension programmes. If a research programme is designed only as an attachment or local trial of international research

institutes or multinational breeding companies, dependency on technology is inevitable and national research centres will not make any significant contribution to agricultural development. Therefore, national research centres have to internalize their (technical, economical, natural) constraints first in order to plan for technologies that should be invented to solve *its* country problems. In most cases, technological packages produced in developed countries are under ideal conditions with negligible constraints through various economy-wide and sectoral or commodity supports from government, whereas in developing Southeast Asia countries such support is lacking. Therefore, research and extension should be invigorated in agriculture, in particular to utilize local feed resources and local animal breeds, deal with sanitary and phytosanitary issues and improve competitiveness. Research and extension programmes to upgrade and promote local animal resources also demand serious consideration. The involvement of local private companies in research and extension should be encouraged.

Concluding remarks

Many studies have indicated that the demand for livestock products has grown in developing countries, including in the region of Southeast Asia, with exception during the 1998 economic crisis. The countries under study are also projected to show an increasing trend in demand for feed in the next decade leading all countries to be net importers, except Thailand. These growing demands follow patterns of economic development. Each country under consideration follows a different course to economic development. Malaysia has devoted much of its resources to manufacturing and industrial development to respond to the demand from the external market. To some extent, Thailand has followed Malaysia's step to exploit the international market but puts its emphasis on agroindustry and agricultural products. Indonesia and the Philippines seem to be stuck in terms of developing their agricultural sector.

Most of the feed produced in the world comes from cereals, pulses and starchy roots but the developing countries' level of utilization is far below that of the developed world. The levels of utilization in Southeast Asian countries are also still very low. The raw materials for feed in the region are mainly composed of maize, soybean meal, rice bran or pollard. These materials are mixed with other ingredients or by-products that are commonly available in each country such as copra meal, palm kernel meal, oil palm frond, sago, tapioca and broken rice. While Indonesia, the Philippines and Thailand all have agricultural resources they need to increase their domestic feed crop production, Malaysia does not seems to be interested to do so.

In Southeast Asia, the animal industry characterizes small-scale extensive and large-scale intensive system dichotomy. On one hand there is the small farm economy, the traditional and dominant component, who raise animals such as cattle, buffalo, sheep and goat, equines for multiple purposes, including a source of cash income, home consumption for protein, draft power, manure, and as a means of household savings during the lean periods. On the other hand, there are medium and large commercial companies, rearing poultry and pig.

In Indonesia poultry and pig farm industries use concentrated feed, processed from basic ingredients such as maize, soybean, rice bran, cassava, wheat pollard, fish meal, meat meal and crude palm oil in a proportion about 50 per cent maize, 10 to 15 per cent rice bran, and the rest from other ingredients. In Malaysia more than 80 per cent of the 4 million tons of commercial feed produced in 2003 was for poultry feed and 40 per cent of total poultry feed is produced for the layer market. That production was produced by about 42 large commercial feed factories, contributing about 70 per cent domestic feed demand and 500 self-feed producers, supplying the remaining 30 per cent.

In the Philippines, poultry and livestock operations consumed about 96 per cent of the total commercial feeds produced (including aquaculture feeds), based on 1992 data. Of this, pig,

poultry and duck constituted 46.9 per cent, 41.9 per cent and 8.5 per cent respectively. Cattle and goat though with large populations are raised primarily on roughages. Using 1996 data, the Thai livestock industry consumed about 10 million metric tons of compound livestock feed (Fuglie, 2001). About 65 per cent of this demand was provided by commercial feed factories, and the remaining 35 per cent was from the other producers.

Malaysia had the highest levels of per capita consumption of meat, eggs and dairy products in 1994 and this remains true in 2004. In the contrary, Indonesian per capita consumptions have always been the lowest among the four countries and it is still the same in 2004. It indicates that there is still room for expanding livestock consumption levels in Indonesia.

As of today, the government of Indonesia has not yet officially recognized and accepted the commercial vertical integration system of livestock, not like in Thailand, Malaysia and the Philippines. The Philippine and Thai governments exercise quotas, tariffs, and general government policies that affect the ability of importers to have consistent access to feed grains at world prices. In other countries, policies on limiting livestock product prices, as in Malaysia's case determine short-term profitability of the feed, poultry and livestock industries and may affect long-term investment decisions. But in Indonesia import tariffs on maize and soybean are still zero today, although there have been some proposals to raise tariffs to about 25-30 per cent.

Some attempts to deal with the challenges to feed crops and livestock development in Southeast Asia are as follows: (i) promotion and expansion of indigenous feed resources; (ii) promotion of farm-made feed; (iii) curtailing the level of pollution; (iv) active participation in world trade negotiations; (v) providing assistance to feed crop farmers; (vi) empowering feed crop farmers; (vii) sanitary and phytosanitary application; (viii) Improving competitiveness and efficiency; and (ix) expansion of investment in research and extension.

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Closing Address

Closing Remarks

Yap Kioe Sheng[*]

The workshop was found fruitful and my sincere appreciation goes to all participants. The discussion and comments made by respected person/institutions contributed to add further value to the studies. Even though poverty alleviation was not part of the original project title, the work of the Centre (CAPSA) is contributed to poverty alleviation through the use of CGPRT crops.

Four important points have come to the fore during this regional workshop, which could be the basis on how to move forward from here. Firstly, CAPSA and participating countries can use the accumulated knowledge of feed crops in Asia that have been gathered in this study. We already knew and made alert from the studies that feed demand is growing and will continue to grow rapidly. It is the majority of the rural poor farmers that produce this feed crops. The problem is how to link these two in order to better the situation of the rural poor farmer. Secondly, the network of experts that have been working on this study: What and how can we use the knowledge and network of experts? There is an added value of collaborations and the fact that learning from one another is very important. Thirdly, on how can we use the accumulated knowledge and network of experts above in a "programmatic" manner for future activity. Fourthly, the focus should be on the poverty alleviation effort as one of the MDG's (Millenium Development Goals). ESCAP realized that poverty has many dimensions: economically, lack of access in public services, and lack of power and participation. Therefore, the rural poor who deal with the feed crops are an excellent point to depart for follow up studies.

Finally, I wish to thank the resource persons and all participants for attending this regional workshop. I wish you all the best and safe return journey and hope this collaboration work will continue flourish in the future.

[*] Chief, Poverty Reduction Section, Poverty and Development Division, UNESCAP, Bangkok, Thailand. Currently served as Officer-in-charge, UNESCAP-CAPSA, Bogor, Indonesia.

Appendices

Appendix 1 Programme

Regional Workshop
"Prospects of Feed Crops in Southeast Asia: Alternatives to Alleviate Poverty through Secondary Crops' Development"
14-15 September 2004
Bogor, Indonesia

Tuesday, 14 September 2004

Time	Session	Moderator
08:30-09:00	Registration	
09:00-09:15	Opening address by: Mr. Yap Kioe Sheng, Officer-in Charge, UNESCAP-CAPSA	
09:15-09:30	Framework of the project by: Dr. Erna M. Lokollo, Programme Leader, Research and Development / Project Leader of FEEDSEA, UNESCAP-CAPSA	
09:30-10:00	*Coffee Break*	
10:00-11:00	Country report of Indonesia by: Dr. Dewa K.S. Swastika, National Expert Comment by Dr. Kusuma Diwyanto	Dr. Budiman Hutabarat
11:00-12:00	Country report of Malaysia by: Mr. Tunku Mahmud bin Tunku Yahya, National Expert Comment by Dr. Ibrahim Che' Embong	
14:00-15:00	Country report of the Philippines by: Dr. Danilo C. Cardenas, National Expert Comment by Dr. Danilo Baldos	Dr. Erna M. Lokollo

15:00-16:00	Country report of Thailand by: Ms. Chamras Rojanasaroj, National Expert Comment by Mr. Pinit Karsieporn
19:00	*Dinner at the Canary Restaurant, New Mirah Hotel, Bogor*

Wednesday, 15 September 2004

Time	**Session**	**Moderator**
09:00-09:30	Invited paper: "Feed crops in South Asian Countries: Problems and prospects" by: Dr. S.S.E. Ranawana Professor, Livestock and Avian Sciences Wayamba University, Sri Lanka	Dr. Robin Bourgeois
09:30-09:45	Discussion	
09:45 -10:00	*Coffee Break*	
10:00-11:00	Consolidated discussion: "Upsurging livestock feed demand in Southeast Asia: A discussion" by: Dr. Budiman Hutabarat Regional Advisor of FEEDSEA Senior Researcher Indonesian Center for Agro Socio Economics Research and Development (ICASERD)	
11:00 -12:00	Plenary discussion	
12:00-13:00	*Lunch*	
13:00-14:00	Discussion on the possibility of setting up a collaborative agenda to advance the development of secondary crops in participating countries	
14:00-14:15	Closing address by: Mr. Yap Kioe Sheng, Chief, Poverty Reduction Section, Poverty and Development Division, UNESCAP	

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