Economic and Social Commission for Asia and the Pacific

CAPSA WORKING PAPER No. 90

Enhancing Sustainable Development of Diverse Agriculture in Thailand

Nareenat Roonnaphai

United Nations
ESCAP

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E S C A P

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2. Networking and partnership with other international organizations and key stakeholders.
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Enhancing Sustainable Development of Diverse Agriculture in Thailand

"UNESCAP-CAPSA: Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific"

WORKING PAPER 90

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

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List of Abbreviations

AFTA	: ASEAN Free Trade Area
BIMST – EC	: Bhutan, India, Myanmar, Sri Lanka and Thailand – Economic Co-operation
BOI	: Board of Investment
CAP REFORM	: Common Agriculture Policy Reform
CAPSA	: Centre for Alleviation of Poverty Through Secondary Crops' Development in Asia and the Pacific
CGPRT	: Coarse Grains, Pulses, Roots and Tubers
ESCAP	: Economic and Social Commission for Asia and the Pacific
EU	: European Union
FAO	: Food and Agriculture Organization
FTA	: Free Trade Agreement
GAP	: Good Agricultural Practice
GDP	: Gross Domestic Product
GMO	: Genetically Modified Organism
GMP	: Good Manufacture Practice
HACCP	: Hazard Analysis Critical Control Point
MOAC	: Ministry of Agriculture and Cooperative
OTOP	: One Tam Bon One Product
SPS	: Sanitary and Phytosanitary
SMEs	: Small and Medium Enterprise

Foreword

Most Asian countries succeeded in multiplying major cereal production through the '*Green Revolution*'. This was made possible by the introduction of high yielding varieties and policy support which promoted the construction of irrigation facilities and the use of modern inputs such as chemical fertilizers and pesticides. Recently however, the growth in productivity of major cereals has reached a plateau. Agricultural diversification has a number of positive effects, among others, food security, risk mitigation, labour absorption and conservation of biodiversity. It is crucial to be aware of the driving forces and constraints to agricultural diversification to formulate policy options which realize the coexistence of sustainable agricultural development and poverty reduction in rural areas.

Responding to this vital need, UNESCAP-CAPSA conducted a three-year research project, "Identification of Pulling Factors for Enhancing the Sustainable Development of Diverse Agriculture in Selected Asian Countries (AGRIDIV)", from April 2003, in collaboration with eight participating countries, namely Bangladesh, India, Indonesia, Lao People's Democratic Republic, Myanmar, Sri Lanka, Thailand and Viet Nam.

It is my pleasure to publish "**Enhancing Sustainable Development of Diverse Agriculture in Thailand**" as a result of the first phase of the Thailand country study of the project. This volume presents a descriptive and quantitative analysis of current secondary crop agriculture and development constraints and options. This study focuses on policy recommendations, as well as areas for further study.

I thank Ms. Nareenat Roonnaphai and the members of the study team for their efforts. Continuous support from the Ministry of Agriculture and Cooperative Ministry of Industry, Ministry of Commerce and Ministry of Interior, is highly appreciated. Prof. Hitoshi Yonekura, Graduate School of Agricultural Science, Tohoku University, Mr. Tomohide Sugino and Dr. Parulian Hutagaol provided useful guidance at every stage of the study as Regional Advisor, Project Leader and Associate Project Leader respectively. I extend thanks to Mr. Matthew Burrows for his English editing.

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J.W. Taco Bottema
Director
UNESCAP-CAPSA

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Nareenat Roonnaphai
Office of Agricultural Economics
Bangkok, Thailand

Executive Summary

The objectives of the Phase I country study are to review and analyse past trends in the production, marketing, consumption, processing and related policies of major CGPRT crops, of which maize, cassava and soybean are selected. In addition, analysis of trade liberalization, agro-industries using the three selected crops, production, marketing and processing potentials and threats are conducted in an attempt to seek policy recommendations for the development of sustainable, diversified agriculture for poverty alleviation.

1. Review of historical and current status of CGPRT crops and other crops

Production, consumption and marketing

During the past ten years, the planted area and production of maize and cassava have faced decline due to competition from some other crops giving better returns. The planted area and production of soybean has also declined as the prevailing prices have not motivated production.

Utilization of maize is mostly domestic with a little for export. Local use of cassava products is 20 per cent of production and the rest is exported. Soybean production often falls short of demand and large quantities are imported for crushing.

Sugarcane is one major non-CGPRT crop that frequently competes with maize and cassava. Regarding the utilization of maize and soybean, the two crops are required in larger and larger quantities to make feed for broilers.

2. Overview of Agricultural Diversification-related Policies

The National Economic and Social Development Plan VIII specifies guidelines for the sustainable development of agriculture with major aims for a balance between production and the use of natural resources and the environment by means of restructuring land use to more diversified production promoting cropping systems of natural farming, integrated farming and New Theory Agriculture.

Regarding policy on food processing, the OTOP project has been launched with the major objective of promoting processing and developing a variety of both food and non-food products with standardization and seeking marketing opportunities for farmer groups and local communities.

3. Impact of global trade orientation on CGPRT crops

Liberalizing trade according to the WTO commitments for 1995-2003 saw more exports and less imports of maize in terms of the increase in domestic production. Therefore, tariff reduction can be said not to stimulate more imports. Regarding soybean and soy meal, after market opening, there have been more imports than what are bound within the WTO commitments because of booming livestock production. With respect to cassava, China has reduced the tariffs imposed on cassava chips and other cassava products, therefore, more such exports are made together with more exports of starch and flour to Japan, Hong Kong and the United States of America. However, exports of cassava chips to the European Union have declined due to higher subsidies on cereal production as cassava substitutes.

Quantitative analysis of the WTO impact on maize using modelling finds that the elasticity of price transmission of export price and feed factory wholesale price of maize with respect to the Chicago price of maize is estimated at 0.593 and 0.562 respectively. The wholesale price increase will transmit its effect to the price received with an elasticity of 0.659. Supply elasticity with respect to the lagged farm price is 0.492. Demand elasticity with respect to the feed factory wholesale price is -0.239.

With regard to the impact after AFTA, since 2000, Thailand has had to reduce the import taxes imposed on the farm commodities put on the Fast Track totalling 7,737 items to 0-5 per cent together with tariff reductions on 37 import items to 0-5 per cent within 2003. Maize exports to ASEAN continue to rise but with little in the way of imports. Imports of soybean and its by-products are negligible, while cassava flour makes up 17.94 per cent.

Thailand is currently under negotiation with eight countries. With China, taxes on vegetables, fruits and cassava were agreed upon to become zero as of late 2003. In the period of October 2003-April 2004, exports of cassava slices rose to 1.27 million tons from 1.05 million tons.

4. Benefits of agricultural diversification on poverty alleviation

The farm restructuring concept was introduced to ensure farming fits into the eco-system and satisfies the demand by adjusting the cropping system towards an integrated farming system based on the orientation of the agriculture restoration project to leave farm decisions to the farmers themselves. During 1997-2001 integrated farming was promoted. The policy impact raised farm income. The factors influencing success from sustainable diverse agriculture is the efficient use of the farm and natural resources, as well as the environment.

5. Demand for CGPRT crops as staple foods and their industrial importance

Maize, cassava and soybean are major CGPRT crops which are not staples of the Thais. They are food supplements and ingredients. They are also used in the non-food industry. Locally produced soybean is usually not large-scale but is popular as food supplements and as food ingredients. Soybean for crushing is mainly imported. With regard to maize, 90 per cent of maize production is used as feed, very little is processed.

Most cassava production is not readily available for direct consumption. Many industries absorb the cassava supply to produce the chips, pellets, native starch and modified starch. Between 1996 and 2003, the demand for chips grew at an annual rate of 77 per cent, whereas pelleting faced a downward trend of 21.2 per cent. Flour production rose by 3.1 per cent and in the linkage industry of flour it was a 6.3 per cent increase.

6. The driving forces of agricultural diversification

The driving forces behind agricultural diversification are expected to be the farmers in terms of being industrious, persistent and trying work step by step in improving their farming system to suit the agro-climatic factors. Irrigation is also needed to grow a crop. Co-operation must be sought among the government and private sector, as well as the farmers, in the promotion of sustainable diversification.

A limitation to sustainable agriculture is the process of building bases for the development. Quantity has been augmented but quality has not been improved. The research and development activities, including systematic transfers of sustainable agriculture, have been

few. Co-operation between officials and NGOs is inefficient for good sustainable development and delays exist in improving the public sector's role and the regulations.

7. Guidelines for the future development of sustainable agriculture

Guidelines for the future development of sustainable agriculture promote the introduction of the various methods of sustainable agriculture as an activity in the agricultural restructuring programme. The method of promotion includes extension of the information, training, support and technology for adequate farm earning. Readjustment of the farm extension programme and encouraging the private sector and NGOs to take on a more active role in terms of market access and management skills are also needed.

8. Policy recommendations

1) As most planted areas of maize, cassava and soybean are rainfed, the government should set priority for adequate irrigation systems.
2) Processing maize for added value is rare. As production potential exists for more maize, research on maize processing for non-food industries is suggested to be supported. Regarding cassava, as the world price of fuel becomes more expensive, cassava production should be expanded to produce more ethanol. Regarding the OTOP project aiming to raise the income of rural families, the government is urged to enlarge the marketing network from the local level up to the national and export levels.
3) Thailand's trade in maize, cassava and soybean is on the increase after the WTO commitments. However, non-tariff measures have been brought in instead with even more restrictions, especially the sanitary and phyto-sanitary measures. GAP at farms has to be practiced and at the processing industries, GMP and HACCP need to be introduced too. In the meantime, any imports should also be applied with such measures to be fair and balanced.
4) Maize and soybean should be supported with research on processing and soybean should be promoted in terms of consumption of the locally produced beans, which are non-GMO for value-added.
5) Guidelines for the future development of sustainable agriculture for poverty alleviation are: i) study the economic and financial returns of different cropping patterns to have as information for farm producers, consumers and public administrators; ii) extend the learning process of the farmers by transferring ideas and knowledge of farmers successful in diversifying their production systems, to be assisted with the development of the research and transfer process; iii) encourage implementation planning for building infrastructure related to sustainable agriculture within the various concerned agencies to eliminate repetition in the operations and budgeting.

1. Introduction

1.1 Background and justification

Although Thailand has made great achievements in its economic development process, agriculture is still a major sector of the national economy, especially in terms of providing employment for its population. Of the current national population of 63 million, about 32 million people are still engaged in agriculture. They cultivate about 21.01 million hectares of farmland, of which only 24 per cent is under irrigation systems. Paddy fields represent the major part of this farmland (about 10.51 million hectares). The rest of the national farmland is allocated to upland crops (4.61 million hectares), for horticulture (4.17 million hectares), and for residents and idle land (1.03 million hectares).

One of the remarkable achievements of Thailand is in the context of food production. While many other developing countries still struggle to achieve food self-sufficiency, Thailand has long been a food – surplus producing country. As a consequence, Thailand faces a rather different set of agricultural policies from that of other developing countries. The pursuit of food self-sufficiency, threat of famine, and the danger of importing too much food, among others, are all central issues for many other developing countries, but not for Thailand.

Thailand is now an agricultural products – exporting country. However, increasing the production of surplus agricultural products, including food, for export does not come about through improvements in productivity, but, mainly, through expansion of production. Indeed, average yields of most agricultural products in this country remain low compared to those of other developing countries. Improvements in the productivity level are critical for the future competitiveness of Thailand's agricultural products in the increasingly competitive global market.

A major factor behind this phenomenon is the fact that as farming is more extensive, marginal land in hilly areas becomes increasingly brought into cultivation. This marginal land not only, naturally, has low productivity, but also is very vulnerable to soil erosion, especially when it is farmed intensively. Soil erosion not only degrades further the marginal land's productivity, but also that of farmland located downstream in the river basin, especially low land, which is where most agricultural products are produced.

Poverty is a key factor behind the present soil erosion process. Despite the success in transforming its economic structure, Thailand has still not been able to eradicate poverty from its population. Until 2001, there were still some 8.2 million people (13 per cent) who lived in poverty in the country (Table 3.9). The majority of these poor people live in rural areas. Poverty has forced these people to move into the marginal land of hilly areas to grow crops, such as cassava, and maize for survival, even though this land is not suitable for farming. As a consequence, the poor farmers have to exploit their marginal land more intensively from time to time just for their subsistence, and hence, soil degradation becomes intensified. This cannot be tolerated since it will ultimately make agriculture become unsustainable.

Clearly, both poverty and soil degradation are great challenges for the sustainability of agriculture in this country. Overcoming these problems would require the government to redirect its development strategy and policy. Agricultural development can no longer be exclusive to lowland areas with existing major crops. Agricultural development should cover more diversified crops and farmland complexes. In this agricultural diversification strategy, development of secondary crop agriculture, especially on marginal land, should be given priority.

Being a food surplus country, Thailand faces a different set of food policy issues from other developing countries. For instance, attainment of food self-sufficiency is not a policy issue

in Thailand. The threat of famine and the vulnerability of high food imports are not central to our food policy formulation.

However, the existence of food surplus for export does not imply that all food related problems have been solved. Increasing food surplus does not necessarily mean that agricultural productivity has been satisfactorily rising, or that farmers' incomes have been improving.

The high growth rate has largely been obtained through the expansion of cultivated land. Average yields of most major agricultural products have remained low compared with other developing countries. Average yield statistics suggest there is still a lot of room to improve agricultural productivity. However, the statistics in the past reflect the low yields of marginal land which has been brought into agricultural use. The low yields in other parts are attributable to the continued degradation of agricultural resources, especially soil erosion and the continued decline in soil fertility may require the enactment of national policy to raise productivity by improving soil fertility to suit particular crops. This area presents difficult technical problems, which require more serious attention. It is difficult to expect average yields to increase substantially without resolving problems related to upland rainfed agriculture, especially on the marginal lands.

Another challenging problem is how Thailand can continue to diversify its agricultural production. Since 1975, a large number of agricultural products have emerged, from the former heavy dependence on rice and rubber, as significant foreign exchange earners including among them maize, tapioca, fruits and vegetables, livestock and fishery products. In view of the volatile world food market we are facing today, progress in diversification and its sustainability is important.

Upland crops such as tapioca, maize, soybean and other pulses require attention not only because of their own significance as many of them are the important crops and export items but also because of their relationships to rice cultivation. Unlike the formerly heavily regulated rice sector, which has experienced slow growth over the last several decades, upland crops, relatively free from government intervention until not too long ago, expanded rapidly both in terms of planted area and production.

A study of upland crop policies will provide an explanation of their fast growth as well as yield policy implications for a governmental sustainable diverse agriculture programme.

Of a total area of 51.31 million hectares, 21.01 million hectares are used for agriculture, 12.90 million hectares under forest cover and another 17.40 million hectares are unclassified. The farm holding may be classified by the purpose of utilization as follows: 10.51 million hectares for paddy fields, 4.61 million hectares for upland crops, 17.93 million hectares for grazing lands, 4.17 million hectares for horticulture and 1.03 million hectares for residences and idle land.

Of the current national population of 63 million, about 32 million are engaged in agriculture. Of the total farm holdings, only 4.96 million hectares or 24 per cent are under irrigation. In fact, the government has expanded irrigation since the 1960s with consequent increases in the yields of irrigated areas and the introduction of a dry season rice-crop and other multiple cropping schemes. A rapid increase in the planting of upland crops such as cassava, sugarcane, pulses, maize, sorghum, vegetables and fruits have resulted, which have called for a capital intensive and technology intensive horticultural sector.

Because Thailand exports most of its agricultural commodities, there is not a strong impulse for the government to invest in research, except the import substituting crops have claimed more research money than rice or the one-time export maize.

The Thai situation contrasts with Indonesia and India, where the drives to attain self-sufficiency have impelled their governments to invest in research and promote new technology. The key player in introducing new crops in Thailand has been the private sector and some commercial farmers. This is true, for example, for poultry and hybrid maize seed production.

Thai exports of farm commodities and agro-industrial products continued to grow by 5.44 per cent during 1988-2002. The top ten farm export items include para rubber, shrimps,

rice, marine products, timber and wood products, sugar, fruits, pulp, broiler meat and cassava. Cereals and upland crops are also important exports and for use in the domestic livestock industry as feeds which include rice, maize, cassava and soybean. As the livestock and feed industries continue to expand, the need for their sustained development is imminent. The predominant farming system is seasonal monocropping and particular farmland is suitable to a specific crop. Another consideration is that most upland crop growers are poor and they need to grow cash crops, and would switch to any other in response to a better price. As a diverse agricultural system on the same land plot is not popular, there are some smallholders who practice growing a number of crops on the same land tract with the constraint of too small farm size and, at the same time, to be self-sufficient rather than for selling purposes.

1.2 Study objectives

1) To review and analyse the historical development of production, marketing, consumption and policy of maize, cassava and soybean.
2) To analyse the impact of global trade orientation on maize, cassava and soybean.
3) To review the industrial importance of maize, cassava and soybean as well as diversified ways of consuming them and to explore the potential of product diversification to meet changes in demand.
4) To identify the major constraints and potential factors that determine the coexistence of sustainable development and diversification of maize, cassava and soybean.
5) To formulate policy recommendations to enhance sustainable diversification of maize, cassava and soybean.

1.3 Scope of the study

In this paper three major feed crops, namely; maize, cassava and soybean have been selected, based on a time series of ten years between 1993-2003.

2. General Conceptual Framework, Approach and Research Methodology

2.1 General conceptual framework

Constraints to resources currently force Thailand to seek efficient allocation of its resources, which in the meantime affects the environmental and social balance in view of the development sustainability of the resources. Agriculture in Thailand is the largest sector, holding vast resources both in the form of landholdings and labour force and is also a main foreign exchange earner. Therefore, the sustainability of agricultural development is needed with goals for the farmers to earn a good living on farms, to have safe food, good health, a place of residence and eventually a good quality of life in a good environment.

Sustainable development of the three CGPRT crops under study requires enhancing farm production efficiency, reducing the cost of production with appropriate use of farm inputs, for example, appropriate use of chemical fertilizer in combination with organic matter and lower use of farm agro-chemicals in an attempt to cause no environmental pollution, including improvement of the soils in a bid to maintain fertility and so to sustain agriculture.

2.2 Research methodology

2.2.1 Collection of data

Secondary sources of data are accessed at the respective agencies. They include the Department of Agricultural Extension, Department of Agriculture, Office of Agricultural Economics, Customs Department, and Department of Internal Trade, Department of Foreign Trade and literature from various sources.

2.2.2 Methodology

Both descriptive and quantitative analyses are used. The study employs descriptive analysis in discussing the production, processing, marketing and policies related to the feed crops complemented with relevant figures and percentages where appropriate.

Quantitative analysis uses a linear regression method to estimate the coefficients of the factors affecting the demand and supply of maize. Time-series secondary data covers 23 years, 1978-2003. Specialization Index (SP) and Simpson Index Diversification (SID) are used to quantify the degree of current status of agricultural diversification.

3. Basic Socio-economic Information of the Country

3.1 Demographic profiles

3.1.1 Population age structure (1990-2003)

The age structure of the Thai population may be classified into three groups. The first group consists of newborns up to children of 14 years of age. The second group is the workforce or the economically active people of 15-59 years old and the third group comprises of the people over 60 years of age. The workforce; 43.99 million in 2000 increased by 3.34 per cent to 46.98 million in 2002, of which both male and female numbers rose. The older population continued to rise from 2.07 million in 2000 to 2.33 million in 2002, or 6.09 per cent, of which again the numbers of both males and females contributed to the increase. However, the group of children under 14 declined from 15.82 million in 2000 to 13.49 million in 2002, i.e. -7.66 per cent, of which the number of males remained rather the same while the number of females faced a sharp decline (Table 3.1).

3.1.2 Dependency ratio

Since the youngest group faced an increasing decline and the elder group continued to grow during 2000-2002, the population of economically active people follows an increasing trend, the latter group was less responsible for taking care of the youngest group and the elder group. Therefore, the dependency ratio declined to 33.68 in 2002 from 40.68 in 2000 (Table 3.1).

3.1.3 Sex ratio

The male population rose from 30.73 million in 2000 to 31.26 million in 2003, or 0.59 per cent, the female population increased to 31.83 million in 2003 from 31.15 in 2000, or 0.73 per cent. The ratio of males to females in 2000 was 98.63, similar to that in 2003 (Table 3.1).

Table 3.1 Population structure Unit: million persons

Items	2000	2001	2002	2003	Growth rate (%)
Total population	61.88	62.31	62.80	63.09	0.66
- Male	30.73	30.91	31.14	31.26	0.59
- Female	31.15	31.40	31.66	31.83	0.73
Population aged < 15 years	15.82	15.75	13.49	n.a.	-7.66
- Male	7.98	7.92	7.81	n.a.	-1.07
- Female	7.84	7.83	5.68	n.a.	-14.88
Population aged 15-59 years	43.99	44.42	46.98	n.a.	3.34
- Male	21.83	22.06	22.35	n.a.	1.18
- Female	22.15	22.37	24.62	n.a.	5.43
Population aged ≥ 60 years	2.07	2.14	2.33	n.a.	6.09
- Male	0.91	0.94	0.97	n.a.	3.24
- Female	1.16	1.20	1.36	n.a.	8.28
Total dependency ratio (%)	40.68	40.26	33.68	n.a.	-
- Male	40.73	40.16	39.30	n.a.	-
- Female	40.63	40.36	28.58	n.a.	-
Sex ratio (%)	98.63	98.46	98.63	n.a.	-

Source: Department of Local Administration, Ministry of Interior, 2004.

3.1.4 Occupation structure

The occupation structure of the Thai population may be split into two major classifications.

- Agriculture. Involves farming, hunting, forestries and fisheries.
- Non-agriculture. Includes production of electricity, gas and water supply, construction, wholesaling, hotels and restaurants, transportation, warehouses and communication, finance and banking, real estate businesses, leasing, public administration, education, health and social welfare services, community, social and personal services, attendant services and others.

In 1998, 13.41 million people were engaged in agriculture growing to 13.88 million in 2003, or 0.60 per cent. Similarly, the number of people who are employed in non-agriculture showed an increasing growth trend too, from 16.70 million in 1998 to 19.96 million in 2003, or 3.82 per cent (Table 3.2). The population in agriculture was 48.97 per cent in 2000 falling to 47.37 per cent in 2002.

3.1.5 Population growth rates

During 2000-2003, the total population grew by 0.66 per cent from 61.88 million in 2000 to 63.09 million in 2003 (Table 3.1).

Table 3.2 Population in agriculture

Items	2000	2001	2002	2003
Population (million persons)	61.88	62.31	62.80	63.09
Percentage of population aged < 15 years	24.12	25.21	24.85	24.50
Percentage of population aged 15– 59 years	66.45	65.50	65.70	65.85
Percentage of population aged ≥ 60 years	9.43	9.29	9.45	9.65
Agricultural population (million persons)	30.30	30.02	29.75	n.a.
Percentage of agricultural population	48.97	48.18	47.37	n.a.

Source: National Statistical Office, Office of the Prime Minister, 2004.

3.1.6 Education and illiteracy

The government has launched a campaign to promote education for all in an attempt to expedite better national development. Children are encouraged to attend primary up to secondary school education free for 12 years. Moreover, as of 2004, free public kindergarten schooling was added, making a total of 14 years. As a result, the literacy rate is now 96 per cent.

In crop year 1999/2000, 70.53 per cent of the agricultural population finished compulsory education and another 19.35 per cent graduated the first and second stages of secondary school. Another 6.53 per cent graduated from vocational schools and universities. However, 8.56 per cent of the farming population are illiterate, possibly including the elder people. However, government policy is such that, in agriculture, irrespective of age, people of working age and children alike must be provided access to the educational system, formal and informal, and career training so that they can survive with their farming careers and supplementary jobs. Thus, educational attainment of the farm family members is on the increase.

3.2 Economic profiles

3.2.1 Average GDP per capita and economic growth rate

Average GDP per capita is on the increase, from US$ 1,189 per head in 1998 to US$ 1,215 per head in 2002 (Table 3.3).

The national economy grew annually by 4.2 per cent in 1999 and 4.5 per cent in 2003. Growth in agriculture was at a rate of 4.21 per cent; from US$ 7.48 thousand million in 1998 to US$ 7.78 thousand million in 2002. The non-agricultural sector achieved US$ 65.28 billion in 1998 and grew by 4.01per cent to US$ 68.56 billion in 2002.

The share of the agricultural sector in the national GDP was 10.29 per cent in 1998, which declined by 10.19 per cent in 2002. In 1998, the non-agricultural sector contributed spectacularly 89.71 per cent and grew to 89.81 per cent in 2002 (Table 3.3).

Table 3.3 GDP, agriculture and non-agriculture

Items	Unit	1998	1999	2000	2001	2002	2003	Growth rate (%)
GDP Growth	**Percentage**	**n.a.**	**4.2**	**4.3**	**1.8**	**4.9**	**4.5**	
- Average GDP	Baht/person	44,929	46,468	48,62	49,317	51.576	n.a.	3.41
per capita	(US$/person)	(1,189)	(1,230)	(1,129)	(1,127)	(1,215)		(-0.44)
- GDP	Billions of baht	2,750	2,872	3,009	3,073	3,239	n.a.	4.03
	(US$ billion)	(72.77)	(75.28)	(69.91)	(70.22)	(76.34)		(0.26)
- Agriculture	Billions of baht	283	289	310	321	330	n.a.	4.21
	(US$ billion)	(7.48)	(7.57)	(7.20)	(7.33)	(7.78)		(0.46)
- Non-agriculture	Billions of baht	2,467	2,583	2,699	2,752	2,909	n.a.	4.01
	(US$ billion)	(65.2)	(60.71)	(62.71)	(62.89)	(68.56)		(1.34)

Source: The National Economics and Social Development Board, 2004.

3.2.2 Sectoral shares of national employment

The Thai workforce was 32.41 million people in 1998, increasing to 34.90 million in 2003. In 1998, the number of employed persons was 30 million, 13 million of which worked in agriculture and the remaining 17 million were employed in non-agriculture. The number of employed persons rose to 33.8 million in 2003, as a result of an extra of 3.3 million people working in non-agriculture (Table 3.4).

Table 3.4 Labour force and employment (million persons)

Items	1998	1999	2000	2001	2002	2003	Growth rate (%)
Labour force	32.41	32.72	33.22	33.81	34.26	34.90	1.51
Employment	30.11	30.66	31.29	32.10	33.06	33.84	2.42
- Agriculture	13.41	13.80	13.83	13.61	14.04	13.88	0.60
- Non-agriculture	16.70	16.86	17.46	18.49	19.02	19.96	3.82
Unemployed	1.41	1.37	1.19	1.12	0.82	0.75	-12.71
Rate of unemployment (%)	4.40	4.20	3.60	3.30	2.40	2.20	-
Looking for work	0.46	0.39	0.32	0.28	0.12	0.12	-25.68
- Not looking for work	0.96	0.98	0.88	0.84	0.71	0.63	-8.53
Seasonal unemployment	0.89	0.69	0.74	0.59	0.38	0.31	-18.80
Rate of unemployment (%)	2.70	2.10	2.20	1.80	1.10	0.90	-

Source: National Statistics Office, Office of the Prime Minister, 2004.

3.2.3 Gini ratio of income distribution

An analysis of income distribution in Thailand showed that great disparity in income among the groups of people still remained, and the overall Gini coefficient increased from 0.453 in 1981 to 0.536 in 1992, which coincides with the beginning of the Seventh Plan and was the highest in Eastern Asia, including Malaysia and the Philippines, however, it fell to 0.515 and 0.511 in 1996 and 1998 respectively. The reduction was very small relative to the rate of economic growth as a result of the increase in income for all income groups. At the same time, it did not cause any change in income shares among income groups. The economic turmoil did not have much effect on income distribution, thus the Gini coefficient remained at almost the same level, namely 0.511.

During 1981 to 1994, the data of quintile groups showed the percentage share of the four poorest quintiles had been reduced whereas the top or richest quintile increased its income share

from 51.49 to 57.52 per cent. Income distribution improved, although its number was small. During this period, economic growth in Thailand was high and coincided with declining poverty. However, the pattern of income distribution has remained inequitable even though the incidence of poverty has clearly declined. During 1996 to 1998, the distribution of income among the different income groups was almost constant. The 20 per cent of the richest quintile saw their income shares almost unchanged while the same was true for the four poorest quintiles (Table 3.5).

Table 3.5 Distribution of income, 1981-1998 (percentage)

Quintile Group	1981	1986	1988	1990	1992	1994	1996	1998
Poorest	5.41	4.55	4.60	4.20	3.94	3.99	4.20	4.20
Second	9.10	7.87	8.13	7.38	7.02	7.29	7.50	7.60
Third	13.38	12.09	12.46	11.50	11.06	11.60	11.80	11.90
Fourth	20.64	19.86	20.66	19.26	18.95	19.60	19.90	19.80
Richest	51.47	55.63	54.16	57.67	59.04	57.52	56.70	56.50
Total Share	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
GINI Coefficient	0.453	0.500	0.485	0.524	0.536	0.527	0.515	0.511

Source: The National Economics and Social Development Board, 2000.

3.2.4 Agricultural land holdings

Total agricultural landholdings of 21.00 million hectares in 1993 increased by 0.05 per cent to 21.01 million hectares in 1999. The number of farm families increased from 5.25 million in 1995 to 5.67 million in 1999, or 7.98 per cent. As a result, the average farmland holding of 3.88 hectares in 1993 declined to 3.71 hectares per household in 1999.

The total agricultural landholdings of 21.01 million hectares in 1999 is classified as 10.51 million hectares (50 per cent) of paddy fields, 4.61 million hectares (22 per cent) of upland fields, 4.17 million hectares (20 per cent) of fruit crops and tree crops, 0.57 million hectares (2.7 per cent) of residential areas, 0.46 million hectares (2.2 per cent) of idle lands, 0.13 million hectares (0.45 per cent) of public range and pastures, 0.16 million hectares (0.75 per cent) of vegetable and flower farm holdings and 0.40 million hectares (1.9 per cent) of others.

The non-agricultural land uses include 12.90 million hectares of forest areas and 17.40 million hectares of unclassified areas (public lands, municipal zones, wetlands, royal crown property, railway areas, road areas and others) (Table 3.6).

Changes in the demand and supply of farm labour play a key role in varying farm wage rates. Consequently, in times of labour shortages, the wage rate is likely to go up. The farm activities requiring the most labour are usually during the harvesting period. On average, the farm wage rate is 100 baht or US$ 2.48 per day per head. Labourers receiving 90-100 baht or US$ 2.23-2.48 a day are hired by 56.37 per cent of the farm households whereas 60.65 per cent of the farm households earn a wage of more than 100 baht or US$ 2.48 per day. Those receiving 101-120 baht or US$ 2.49-2.97 per day per head represent 23.16 per cent of farm labour families. Further, 15.50 per cent of the farm labour households earn a wage of more than 120 baht or US$ 2.97 per day per head (Table 3.7).

Table 3.6 Land utilization of Thailand by region, 1993-1999

Unit: Hectare

Year	Total land	Forest land	Number of households	Farm size (ha/household)	Farm holding land									
					Total	Housing area	Paddy land	Under field crops	Under fruit trees	Under vegetables	Grass land	Idle land	Other land	Unclassified land
1993	51 311 502	13 352 100	n.a.	4 059 536	21 003 343	556 214	10 933 851	5 156 500	3 359 824	148 986	118 977	518 216	210 776	16 956 060
1994	51 311 502	13 248 249	n.a.	4 049 168	21 093 326	559 113	10 931 304	5 140 883	3 462 148	150 046	120 274	517 784	211 775	16 969 927
1995	51 311 502	13 148 506	5 248 815	4 038 352	21 196 571	562 989	10 926 840	5 121 790	3 571 039	153 269	121 750	515 434	223 459	16 966 425
1996	51 311 502	13 089 346	5 276 556	3 997 136	21 091 121	562 609	10 807 609	4 979 166	3 701 018	153 524	118 714	504 204	264 277	17 131 035
1997	51 311 502	13 030 586	5 301 771	3 956 640	20 977 217	560 884	10 671 352	4 816 193	3 861 125	153 789	114 983	485 808	313 085	17 303 699
1998	51 311 502	12 972 228	5 334 974	3 910 608	20 862 964	558 705	10 546 250	4 648 314	4 012 705	153 887	110 903	472 130	360 069	17 476 310
1999	51 311 502	12 897 635	5 667 506	370 792	21 014 621	572 620	10 509 919	4 605 840	4 172 079	164 130	128 386	458 275	403 373	17 399 246
Growth rate (%)	-	-0.55	1.66	-1.28	-0.11	0.29	-0.76	-2.13	3.72	1.24	0.03	-2.16	12.69	0.56

Source: Office of Agricultural Economics, 2003.

Table 3.7 Wage rates, 2003

Wage rates		Percentage proportion of farm labourers
Baht/man/day	US$/man/day	
<= 90	<= 2.23	4.97
<= 100	<= 2.48	56.37
<= 120	<= 2.97	23.16
<= 150	<= 3.71	11.54
> 150	> 3.72	3.96
Total	-	100.00

Source: Office of Agricultural Economics, 2004.

3.3 Extent of agricultural diversification

3.3.1 Horizontal diversification

Thai agriculture normally involves monocropping in rainfed areas and in areas close to natural water sources. However, before the national logging ban in 1987, vast illegal logging activities caused the agro-ecology to be badly skewed, abnormal agro-climatic conditions with irregular monsoons prevailed, and droughts and water shortages for both agricultural purposes and consumption purposes all over the geographical regions of the country occurred. Very fortunately, His Majesty the King granted farm remodeling guidelines incorporating the concept of New Farm Theory for agriculture. According to the guidelines, Thai farmers are recommended to divide their farm holdings into diversified agricultural zones. For example, rice zones, upland crop zones, and animal husbandry zones with the indispensable farm pond. Consequently, the government has delivered and extended this royal concept of farm practices to the farmers since 1992. The resultant diversified farming systems have four main cropping systems as follows:

- Rice-based farming system. The system is suitable in the low-lying areas for rotating crops in the paddy fields. After the major rice crop, certain upland crops such as soybean, sweet corn or peanut follow and some leaf vegetables may also be grown.
- Upland crop-based farming system. The system is quite suitable for sandy loam soils. Upland farming usually requires a relatively large plot of land. Farmers can also raise some animals complementarily because certain field crops such as maize, sorghum and cassava are feedstuffs for ducks, chicken and swine. The upland crop-based farming system is therefore involved with both crop rotation and relaying. In diversifying, both long duration crops and short-term crops demand the cultivation to be extended into the dry season. Therefore, irrigation systems need to be established for field crops, fruit crops, inter crops, livestock and aquaculture.
- Horticulture-based farming system. Commonly, several horticultural crops are grown for the main purpose of home consumption. Any surplus is then sold. A farmer with a readily available investment fund and farm technologies will produce for commercial purposes. Those who are smallholders will operate mixed farming.
- Integrated farming system. This system calls for growing rice, fruit and tree crops, horticulture, animal husbandry and aquaculture with at least integration of two farm enterprises, such as raising fish in the paddy field, raising poultry above the fish pond, growing fruit crops/tree crops on the fish pond bank or growing feed crops.

Normally farmers operating integrated farming systems are small holders whose farm sizes are limited and raising their income is a major continuous effort. They also want to avert natural and marketing risks and to have food for family consumption. Therefore, the mixed farm operators usually make a better living than those who practice monocropping. Currently, about 20-30 per cent of the national farm areas are under integrated farming systems.

Monocropped areas are scattered geographically. They are either grains, field crops, fruit or tree crops or vegetables, and they do not change their cropping patterns except some who do grow fruit in response to a competitive crop. Fruit and tree farming does not alter much over time due to the long duration nature of the crops.

National agricultural holdings amount to 21 million hectares, of which 11 million hectares are classified paddy fields, 5 million hectares upland crop fields, and 3 million hectares of fruit crops and tree crops. The rest are classified as vegetables, flowers and ornamentals, public ranges and grassland, idle lands and other.

Most rice production occupies low-lying lands, whereas the uplands are planted with field crops, such as maize, sorghum, cassava, sugarcane, mungbeans, soybean, peanuts, sesame, cotton and kenaf. Farm decisions are frequently based on the market involving farm prices as

the main factor of diversifying to any other field crop. In addition, experience and cropping specialization in the area together with suitability of the agro-climatic and soil conditions are included in the decisions.

Analysis has been conducted covering the past ten years to see the extent of farm diversification using the Simpson Index and the Specialization Index.

Specialization Index (SP) and Simpson Index (SID) of major selected crops

To quantify the degree of current agricultural diversification in Thailand, SP and SID of major selected crops by planted area are used to measure the two indicators. The ten major crops include maize, cassava, soybean, sugarcane, sorghum, mungbean, peanut, sesame, cotton and kenaf.

Specialization index is defined as follows:

$$Spij = Rij / Ri$$
$$Rij = Aij / \Sigma Aij$$
$$Ri = Ai / \Sigma Ai$$

Where, Spij = Specialization index of commodity i in region j.
Rij = Proportion of commodity i planted area in region j to the total planted area of commodity i in the whole country.
Ri = Proportion of commodity i planted area in the whole country to the total planted area of the ten commodities in the whole country.
Aij = Planted area of commodity i in region j.
Ai = Planted area of commodity i in the whole country.

If Spij is more than one, it means that region j is specialized in commodity i in the country.

$$SID = 1 - \sum_{i=1}^{n} Wi^2 , \quad Wi = Xi / \Sigma Xi$$

Where, Xi = Planted area of commodity i, i = 1,……., 10
Wi = Proportionate planted area of the ith commodity in the total planted area

When SID shows a value of zero, it means that the commodity is least diversified while a value of one indicates the most diversified.

Table 3.8 shows the results of the SP and SID calculations, which indicate the specialization and diversification among the three major Thai commodities.

Specialization indices

Maize

The value of calculated SP shows that the northern region of Thailand is specialized in growing maize. Its SP is the highest among regions, followed by the northeast and the central plains. However, it can be seen that the specialization among regions has not changed much during the past ten years.

Cassava

The northeast region shows specialization in planting cassava. This evidence can be seen from the highest SP value of more than two, followed by the central plains and the north. The reason behind this is due to poor soil fertility in the northeast and growing cassava is very simple, requires minimal tending, is drought resistant and is tolerant to pests and disease. Therefore, the SP values have almost been stable during the past decade.

Soybean

Specialization in growing soybean falls to the northern region. Its SP trend has increased over time from 9.16 in 1993 to 15.83 in 2002. Usually two soybean crops are cultivated in Thailand, rainy and dry season. Two growing patterns, early rainy season and late rainy season cropping are commonly practiced, especially in the provinces of Sukothai, Kampaengpet, Uttaradit and Phrae in the north with standard varieties in use in this cropping system. This system contributes to the high specialization in the north.

Simpson Index (SID)

Table 3.8 also shows that the values of SID were around 0.77 to 0.80 from 1993 to 2002. This indicates that the degree of agricultural diversification in the ten major crops in Thailand is almost stable because the values have remained almost unchanged, which might be caused by commodity prices, specialization, returns from the major crop or policy. It can be seen that maize and cassava are commodities for export which earn major foreign exchange and the farmers may not want to diversify to the others. The same is true for soybean, which is promoted for part self-sufficiency. Therefore, there has been a remarkable increase in soybean production during the past two decades.

Table 3.8 Simpson Index (SID) and Specialization Index (SP), 1993-2002

Item/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
SID	0.79	0.80	0.79	0.78	0.78	0.77	0.77	0.77	0.78	0.77
SP Maize										
- North	1.68	1.62	1.71	1.65	1.44	1.43	1.68	1.60	1.67	1.84
- Northeast	0.96	0.92	0.92	0.91	0.88	0.84	0.88	0.81	0.84	0.90
- Central	0.91	0.90	0.86	0.81	0.77	0.75	0.84	0.79	0.79	0.74
- South	0.06	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
SP Cassava										
- North	0.41	0.46	0.46	0.47	0.54	0.49	0.50	.051	0.58	0.55
- Northeast	2.13	2.38	2.28	2.22	2.36	2.19	2.02	2.02	2.19	2.14
- Central	0.90	0.97	0.98	1.01	1.12	1.10	1.03	1.09	1.31	1.27
- South	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SP Soybean										
- North	9.16	8.85	10.87	12.51	12.52	13.12	12.58	12.41	13.67	15.83
- Northeast	1.55	1.45	2.50	2.95	2.72	3.11	3.14	3.18	3.57	4.40
- Central	0.93	1.00	2.20	1.80	2.14	2.32	2.36	2.31	1.93	2.26
- South	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Data from Office of Agricultural Economics, 2003, calculated by Nareenat Roonnaphai.

3.3.2 Vertical diversification

Diversifying the maize crop vertically by processing and compounding it into feed is at present rare by the farmers. In the case of cassava, some cassava farmer groups produce clean cassava chips and starch. With respect to soybean, there are some soybean grower groups who make Chinese sauce, fermented soy grains and soy milk.

3.4 Extent of unemployment and poverty

3.4.1 National unemployment

The rate of unemployment in 1996 was 1.54 per cent, rising to 3.6 per cent in 2000 spurred by the economic crisis mid 1997, in which many business sectors, such as construction, real estate and banking, faced great losses and cut employment. Consequently, unemployment became worse.

In 2001/2002, the economically active but unemployed people in agriculture was 20.18 per cent of the total farm families. Chief causes of the unemployment included waiting for the farm working season, being seasonally unemployed for no supplementary economic activities

after the household's growing and harvesting seasons. Another 1.56 per cent of the unemployed waited for new jobs, 55.84 per cent of the unemployed are studying and 14.31 per cent are unemployed for other reasons.

3.4.2 National and rural poverty

National poverty is domestically measured based on the personal minimum daily necessities of food, consumables and utilities. A household earning less than the spending estimates is regarded as being below under the poverty line. It was 878 baht (US$ 23.23) per month per family in 1998, which increased (but decreased in US$ terms) to 916 baht (US$ 20.93) per month in 2001, or 1.23 per cent. The group of people classified as poor was found to total 7.90 million in 1998, rising to 8.20 million in 2001. The percentage breakdown by region sees poor families in the north and northeast increase to 10.60 per cent and 24.50 per cent in 2001 from 9.10 per cent and 23.20 per cent in 1998 respectively, whereas the incidences of poverty in the central and south regions dropped from 7.00 per cent and 14.80 per cent in 1998 to 4.60 per cent and 13.50 per cent in 2001 respectively (Table 3.9).

Table 3.9 Poverty line, 1998-2001

Year	Poverty line (Baht/US$/ month)	Poverty (Million/ people)	Ratio (%)	Percentage of the poor by region				
				Central	North	North-east	South	Bangkok
1998	878 (23.23)	7.90	13.00	7.00	9.10	23.20	14.80	0.60
1999	886 (23.25)	9.90	15.90	6.80	10.60	30.80	15.70	0.20
2000	882 (20.50)	8.90	14.20	5.40	12.20	28.10	11.00	0.40
2001	916 (20.93)	8.20	13.00	4.60	10.60	24.50	13.50	0.80
Growth (%)	1.23 (-4.29)	0.05	-1.12	-23.82	6.16	0.68	12.29	16.83

Source: The National Economics and Social Development Board, 2003.

Poverty in rural areas frequently occurs in big or extended families earning their living from agriculture. Often the family heads have little schooling and are likely to be young. Farm households are found to be in the poorest group, followed by farm wage labourers. The share of rural families in poverty was 29.7 per cent in 1992, which decreased to 14.9 per cent in 1996.

In cities, impoverished people are inclined to be of higher age, namely 45 years and over, together with low education, finishing less than the last year of primary school. Their main occupation is either general labourer for hire, factory worker or small vender. Most of them live in slums. The share of urban poverty was 16.3 per cent in 1992 declining to 7.7 per cent in 1996.

3.4.3 Factors affecting the extent of unemployment

1. Modernization of businesses that brings in new production technologies, for example machinery and computer systems, reduces the necessity for extensive labour use because they are labour-saving devices. Consequently, as an accepted fact, the extent needs not be illustrated.
2. A higher employment rate tends to force some businesses to decrease their number of workers in an attempt to reduce the cost of production.
3. Migration of the alien workers is well received by the local operators because migrants are always paid lower wages than the local workers, 140 baht ($3.41) a day in many areas compared to 165 baht ($4.02) a day for Thai workers in urban areas.

Based on the seminar held by the Asia Study Institute, 17th December 2004, within the last ten years there has been no evident increase in the low-end migrating labourers. This is

observed in all regions of the country. What is alarming is the enormous decrease of the farm households' farm hands, as many as 1.2 million in the northeast. Mostly they have gone elsewhere to become either wage earners, salary earners or to settle in non-farm jobs in order to offset their income shortages during the national economic crisis that began in 1997. The phenomena has created a needy gap for alien workers. After the crisis, that wages for the local workers were not adjusted upwards at all up to 2003. In fact, the large migration, currently estimated at 2-3 million, reduces any wage adjustment for the workers because the alien workers wages are very low.

3.4.4 Factors affecting the extent of poverty

1. Low work skills. Poverty in the rural areas greatly affects the low work skills of the rural families. The low educational level of many rural people, much at the compulsory level, is another factor restraining them from gaining various work skills. However, currently the Department of Skill Development is actively engaged in numerous work training programmes for those who want it and the outreach is the training facilities in the regions.
2. Farm landlessness, in rural areas in particular. Agricultural labour refers to a farm household not having any members hold a tract of farmland for farming purposes. Its members are always hired as full-time farm labourers. They may or may not be provided accommodation or meals, and payment either in cash or in kind is regarded as the family's main source of income. This suggests clearly a form of chronic poverty. The number of farm households who practiced farm labour was 666,406 in 1991/1992.
3. Large families are likely to give rise to too many dependents to take care of financially beyond the earning capacity. Desk research stresses poverty, among others, among the elderly and recommends a universal pension programme should be adopted to all people older than 60 years.
   The 30 baht ($0.73) Health Care Scheme reaches the poor much better than past attempts.
4. Unbalanced development policies of the government that stress urban planning and development and industrial development often ignore income creation of job opportunities in rural areas. Another aspect of the research finds that there is diversity among the families in terms of ability to insure oneself against income fluctuation and that this ability changed after the 1997 economic crisis. Major efforts in income creation provided for the poor have only been seen recently.
5. An increasing number of those unable to make a living or dependents in a family. From the brainstorming review and implementation research, the success factors in the public sector's implementation of poverty related policies are diverse. Leadership among local communities to initiate the needed changes is important. Moreover, emphasis was made that learning from the past and the readiness of supporting data are crucial. Communication between the poor and the public servants providing assistance are sometimes overlooked.
   There are various government improvement programmes that might have some bearing on poverty reduction. However, the ultimate contribution is either too early to tell or there is still no evidence to be conclusive.
6. Decreasing potential to make money for the people of working age. The new generation of farm labourer has demonstrated no strong desire for farming as an occupation. The low farm wages and no social safety net constantly spur migration away from agriculture, showing no sufficient incentives within the farm sector to absorb them. It has been estimated for 1989 to 1998 that the number of people migrating away from the farm sector was more than 4.6 million.
   As soon as the economic crisis began in 1997, the laid-off workers returning back home were found to be as high as 700,000 by a survey. Coupled with no desire to work

on farms, there has been a tendency of labour surplus and, subsequently, a state of more unemployment.

7. An economic crisis and fluctuations in commodity prices in the world market. The turmoil of the crisis described earlier caused fluctuations in commodity prices in the world market and certainly contributed to the instability of farm prices in a pattern of price waves from the world price down to the local farm prices received. Since gross farm income is obtained from farm production, a consecutive price depression for a few years instantly undermines a stable level of income and poverty emerges.
8. Too much debt burden. Constraints of farm households in terms of credit accessibility have been much greater since the 1997 economic crisis. Borrowing from non-institutional sources, formerly being 9 per cent of the total, jumped to 17 per cent causing the debt repayment ability to worsen and furthering the capital limitation of farming efficiency, with debt outstanding at year end rising by 50 per cent from 1995/1996 to 1998/1999.

3.5 Extent of environmental problems and deforestation rates

Forests covered 13.35 million hectares in 1993, falling by 2.41 per cent to 12.90 million hectares in 1999.

3.5.1 Factors affecting extent of deforestation

1. A greater demand for the use of wood in the logging industry, paper mills and building materials. The greater demand for wood products, as a result of the population increase, is reflected by poaching, both large and small-scale, throughout the year as is frequently reported in the dailies.

   A population increase expands the demand for farm products, and subsequently the areas for cultivation, and deforestation is one of the means. In Thailand, national land usage was clearly classified in 1961 into forest and agricultural areas. However, the government has not been able to maintain the status of the forest cover. As a result, the forests are encroached upon year by year. National forest cover was 27.36 million hectares or 53.3 per cent of the national area in 1961, this decreased to 13.67 million hectares, or 26.6 per cent of the total in 1991. Simultaneously, the agricultural area grew from 10.31 million hectares in 1961 to 21.30 million hectares in 1991. The huge decrease in forest area was largely caused by both the population boom, and the structural changes and growth of farm production towards more commercialization from traditional self-sufficiency, where the limitation of farmland forces people to encroach.
2. However, a nationwide ban on logging concessions since 1989 and public pursuance of the intensive conservation policy remarkably slowed the forest depletion between 1989-1998 to 0.16 million hectares per year, on average. Formerly, deforestation was alarmingly high at 0.46 million hectares yearly.
3. Production promotion programmes for crops and livestock for exports, for example cassava and kenaf, with no efficient land use, while some forest areas are not suitable for cultivation. The programmes have created some thrust for forest lands to be brought under cultivation.
4. Building of public infrastructure, such as reservoirs, dams, and highways. Building public infrastructure is identified to be a cause of deforestation. The total length of the highways was 38,244 kilometres in 1978. It was extended through the forests to 54,388 kilometres in 1993 to reach towns.
5. Forest fires. Annually, fire used to damage not less than 0.16 million hectares of forest area. In addition, more than 10,000 million plant seedlings were destroyed each year.

However, with better fire control now in use, forest fire damage in 2002 was reduced to 0.14 million hectares.

6. Quarry mining. A mineral resource found under forest cover requires the upper soils unearthed, therefore damaging the forest. It is difficult to elaborate the extent of deforestation because the information is not readily available.
7. Destruction of forests by both wild beasts and domesticated livestock.
8. Destruction by pests and disease causing wilting, dwarfing and death, and some plants species face extinction.
9. Awareness and participation in forest conservation is negligible.

3.6 Concluding summary

In 2000, the total population was 61.88 million and has now grown to 63.09 million. The population in agriculture accounted for 48.97 per cent of the total in 2000, which fell to 47.37 per cent in 2002.

Average GDP per capita has increased by 3.41 per cent. The share of the agricultural sector in national GDP was 10.29 per cent in 1998, which slightly declined to 10.19 per cent in 2002.

Total agricultural landholdings grew from 21.00 million hectares in 1993 to 21.01 million hectares in 1999. Agricultural land is classified as 50 per cent for paddy fields, 22 per cent for upland fields, 20 per cent for fruit crops and tree crops, 2.7 per cent for residential areas, 2.2 per cent for idle land and the rest is others.

Specialization Index (SP) shows that the northern region of Thailand is specialized in growing maize, while the northeast region shows specialization in planting cassava. Specialization in growing soybean is found in the northern region. The Simpson Index (SID) also shows the value of SID was around 0.77 to 0.80 from 1993 to 2002. This indicates that the degree of agricultural diversification of the ten major crops in Thailand is almost stable.

4. Historical and Current Status of the Production of CGPRT Crops and Other Crops in the Country

4.1 Trends of CGPRT crop production and consumption

The current status of the three selected crops; maize, cassava and soybean is discussed as follows:

4.1.1 Maize

Production

Maize has been grown in Thailand for a long time and is almost all exported in the form of grains. The major producing areas are in the north, with more than 50 per cent of the total maize areas. While the northeast and the central plains follow. Production is concentrated in the provinces of Petchabun, Nakhon Sawan, Lopburi, Saraburi, Nakhon Ratchasema, and Sakaew.

The area planted with maize of 1,339 thousand hectares in the 1993/1994 crop year declined to 1,171 thousand hectares in 2002/2003 as it gave way to more competitive crops such as sugarcane and cassava. The area planted with maize was 1,171 thousand hectares in 2002/2003, a decline of 4.80 per cent, or 1,230 thousand hectares from the previous year as the farmers, being price responsive, switched to cassava.

The area harvested of maize in the 1993/1994 crop year declined to 1,147 thousand hectares in 2002/2003 partly affected by drought in the early growing season.

The decline in area, however, was partly offset by the increase of 2.06 per cent in maize production from 3,672 thousand tons in 1992/1993 to 4,466 thousand tons in 2001/2002 due to the use of hybrid seeds as the crop was mostly adequately rainfed. Therefore, maize yield in the said period rose from 2,485 kg per hectare in 1993/1994 to 3,613 kg per hectare in 2001/2002, an increase of 3.83 per cent (Table 4.1).

Table 4.1 Maize: Area, production, yield, farm price and farm value, 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	1 339	1 218	3 328	2 485	11
1994/1995	1 413	1 351	3 965	2 807	11
1995/1996	1 335	1 263	4 155	3 112	15
1996/1997	1 386	1 315	4 533	3 270	9
1997/1998	1 397	1 198	3 832	2 744	11
1998/1999	1 441	1 380	4 617	3 203	9
1999/2000	1 235	1 207	4 286	3 470	9
2000/2001	1 248	1 215	4 462	3 574	8
2001/2002	1 230	1 196	4 466	3 632	9
2002/2003	1 171	1 147	4 230	3 613	10
Growth rate (%)	**-1.70**	**-1.03**	**2.06**	**3.83**	**-3.34**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

Maize, in Thailand, can be classified into two groups according to its growing season. The first crop is grown in the early monsoon season between March and July while the second maize crop is grown in the late monsoon season during August to February of the following year. Growing the first crop the farmer has to assume the risk of rainfall intermission during June to July when the maize is in blossom. In cases of no monsoon intermission the maize yield will be about 20 per cent more than that grown in the late season because of the longer photo-period. The harvesting period covers June to December. More harvesting is commonly done during the period of heavy rainfall, causing some difficulty and the harvest tends to absorb much moisture content and is likely to encourage fungus.

The second maize crop is grown between August and February and is less risky in terms of rain intermission but is more likely to contract diseases than the first crop. The plants are more fragile and are prone to damage in times of a windy downpour. The harvesting period usually begins in November to May. The harvests are normally of good quality because of less rains and atmospheric moisture. Eighty-three per cent of the total maize planted areas are devoted to the first crop. The remaining 17 per cent is devoted to the second crop. As the farmers usually begin to harvest their maize crop in July, the harvesting index in June is 0.03 per cent, which increases to 3.35 per cent in July. They continue to be harvested more and more and major harvests are normally made in September and December, 29.52 per cent and 21.11 per cent respectively. Afterwards, the index of harvesting faces decline to 3.29 per cent in January and little harvesting activities of 0.14-0.69 per cent in February to May (Table 4.2).

Table 4.2 Maize: Percentage harvesting pattern, 2002/2003

Year	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
2002/2003	0.03	3.35	9.75	29.52	16.30	14.76	21.11	3.29	0.42	0.69	0.64	0.14	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Using 1995 as the base year, the annual production index indicates an ascending trend of maize for annual production, due to both the favourable agro-climatic conditions and switching to the expanded use of hybrid maize seeds by the farmers. The exception was in 1997 when an extensive drought led to poor maize harvests, resulting in a lower production index by 7.77 per cent below the base year (Table 4.3).

Table 4.3 Maize: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Maize	80.11	96.47	100.00	109.11	92.23	111.14	103.17	107.39	107.50	101.35	100.22

Source: Office of Agricultural Economics, 2004.

Total consumption

More than 20 years ago, domestically produced maize was almost all exported in the form of grains. However, in connection with a booming livestock industry after 1998, the maize supply has become a local feedstuff for the domestic animal feed industry which requires the raw material nearly at the same quantity as what is produced. Shortages even occur in some years and imports are needed, particularly in a year of drought. Aside from being a feedstuff, part of the maize production is processed into starch by the only two processing plants due to conflicting requirements. Therefore, starch production is very limited. The demand for maize for feed production in 1993 was 3.30 million tons, increasing to 4.15 million tons in 2003 or at a rate of 2.25 per cent per year (Table 4.4).

Table 4.4 Maize, cassava and soybean consumption, 1993-2003 Unit: million tons

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth rate (%)
Maize	3.30	3.20	3.95	4.35	3.88	3.95	4.18	4.19	4.16	4.26	4.15	2.25
Cassava	4.30	4.53	4.27	4.72	4.13	3.72	3.63	4.03	4.40	4.30	4.85	0.03
Soybean	0.56	0.62	0.66	0.78	1.22	1.01	1.33	1.60	1.64	1.79	1.95	14.33

Source: Office of Agricultural Economics, 2004.

Problems

Most maize producing areas are rainfed, so in a year of drought, production is expected to incur losses. The overall production efficiency is not satisfactory. Labour often shows signs of shortages. Use of harvesters in the harvesting period face monsoon rains and the moisture content in the maize is high.

Marketing and processing. During the harvesting period, the market is often overwhelmed with supply causing a price depression and very little maize is processed into starch.

4.1.2 Cassava

Production

In the past 10 years (1993-2002), the planted area of cassava was reduced by 3.57 per cent. Notably, a change in the planted area reflects very much the farm prices received in the previous year. So, after a year of much reduced acreage, the farm prices received in the following year are boosted. Being price responsive, the planted area is expanded. However, the farm restructuring programme by the government in the cassava concentration areas during 1994-1996, encouraging farmers switch to a crop giving better farm returns, forced a reduction in cassava harvested areas. Projections of the planted areas for 2002 are 988 thousand hectares, against 1,107 thousand hectares in 2001, a decrease in harvested area by 10.03 per cent.

The area planted with cassava of 1,438 thousand hectares in 1993/1994 declined by 3.79 per cent to 988 thousand hectares in 2002/2003. The prices did not provide an incentive to produce and the farmers turned to more profitable crops.

Cassava production was reduced by 0.83 per cent from 20,203 thousand tons in 1993 to 16,168 thousand tons in 2002 because of the planted area decrease.

Cassava yield per hectare has risen by 2.84 per cent from 13,876 kg per hectare in 1993 to 16,938 kg per hectare in 2002. The rising yield per hectare is a response to the use of improved varieties (Table 4.5).

Table 4.5 Cassava: Area, production, yield, farm price and farm value, 1993-2002

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993	1 456	1 438	20 203	13.876	20
1994	1 411	1 383	19 091	13.533	20
1995	1 295	1 245	16 217	12.524	40
1996	1 262	1 228	17 388	13.782	30
1997	1 265	1 230	18 084	14.294	10
1998	1 071	1 044	15 591	14.557	30
1999	1 152	1 065	16 507	14.329	20
2000	1 185	1 131	19 064	16.088	10
2001	1 107	1 049	18 396	16.620	10
2002	996	988	16 868	16.938	20
Growth rate (%)	**-3.57**	**-3.80**	**-0.83**	**2.84**	**-6.95**

Source: Office of Agricultural Economics, 2003.

Cropping pattern

Two cassava crops can be grown in a year. The early monsoon crop, planted between April to May, takes 80 per cent of the total planted area. The late monsoon crop, planted between September to October, takes the remaining 20 per cent of the total area.

Cassava is also harvested all year round but most harvesting activities (65-70 per cent) are observed during December to February and the least are in April to September.

Cassava is harvested all year round beginning in October with 4.48 per cent. As time goes by, the harvesting activities become most intense, (27.59 per cent and 19.00 per cent) in January and February, with the index turning the other way in the following months, 7.69 per cent in March and around 1-2 per cent later on (Table 4.6).

Table 4.6 Cassava: Percentage of harvesting pattern, 2002/2003

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
2002/2003	4.48	11.05	18.17	27.59	19.00	7.69	2.00	1.86	1.13	1.84	2.37	2.82	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Given 1995 as the base year, the production index for cassava for 1996 – 2003 swings both above and below the base due to instability in the prices. In a year of better prices, cassava growers are given incentives to produce more the following year. On the other hand, in a year of poorer prices, cassava areas are reduced and give way to other crops (Table 4.7).

Table 4.7 Cassava: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cassava	116.19	93.27	100	104.00	89.66	94.93	109.64	105.80	97.01	105.97	112.55

Source: Office of Agricultural Economics, 2004.

Total consumption

Cassava production for local consumption uses 22-25 per cent of the total as per the breakdown by type of utilization as follows:

- Cassava chips. In order to gain more use of the chips in compound animal feed in the country a promotion campaign is underway to produce quality cassava chips together with transfers of technological knowledge for making the chips in the feed to the business operators and farmers. At present, the annual use of the chips is approximately 0.45-0.50 million tons, namely 5-6 per cent of the volume of the chip production.
- Tapioca flour is currently the most used flour domestically; about 0.7-0.8 million tons or 17-18 per cent of flour production. Types of the uses are as follows:
  - Home consumption as an ingredient in noodles and dessert preparations.
  - In linkage industries such as in food processing, sweeteners, paper and textiles.

In 1993, the demand for cassava was 4.30 million tons, increasing to 4.85 million tons in 2003 or at a rate of 0.03 per year (Table 4.4).

Constraints

Lack of soil improvement causes low yields. Marketing and processing. The cassava growers sell their produce in the form of tubers and therefore only receive the value of the tubers. Local use of cassava products is still low. On the processing side, the ordinary chips are of low quality.

4.1.3 Soybean

Production

Soybean production is concentrated in the north where agro-climatic conditions are favourable. There is some production in the northeast and the central plains. The government formulated a production promotion programme as part of the National Economic and Social Development Plan II, 1967-1972 as soybean is used as part of the manufacturing sector and for animal feed to serve the expanding livestock industry. The promotion programme expanded the soybean planted area and production. In 1989/1990 the total planted area was as high as 513.42 thousand hectares with production of 672.37 thousand tons. From then on the planted area has continued to decline because farm prices have not been a sufficient incentive and some other crops are competitive.

Therefore, in the past 10 years, 1993/1994-2002/2003, the growth rates of soybean planted area have fallen. In 1993/1994 the area was 416 thousand hectares, falling to 181 thousand hectares in 2002/2003 or a 8.97 per cent reduction in the growth rate per year. The farmers turned to sugarcane and a second rice cropping, which gave better farm returns. Projections for 2002/2003 show a decrease in the planted area of 181 thousand hectares.

The harvested area of soybean, which was 380 thousand hectares in 1993/1994 declined to 175 thousand hectares in 2002/2003, a 8.32 per cent drop.

Soybean production fell by 7.31 per cent, from 513 thousand tons in 1993/1994 to 260 thousand tons in 2001/2002 because of a planted area decrease.

Soybean yield per hectare rose by 1.84 per cent from 1,233 kg per hectare in 1993/1994 to 1,438 kg per hectare in 2002/2003. The rising yield per hectare is a response to the use of improved varieties (Table 4.8).

Table 4.8 Soybean: Area, production, yield, farm price and farm value, 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	416	380	513	1 233	32
1994/1995	436	395	528	1 211	31
1995/1996	301	275	386	1 283	33
1996/1997	271	256	359	1 323	21
1997/1998	248	236	338	1 365	27
1998/1999	235	219	321	1 368	25
1999/2000	232	225	319	1 374	20
2000/2001	223	215	312	1 397	20
2001/2002	185	176	261	1 414	23
2002/2003	181	175	260	1 438	25
Growth rate (%)	**-8.97**	**-8.32**	**-7.31**	**1.84**	**-4.03**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

Two soybean crops can be grown. The first crop is planted in the early monsoon months between May and October while the second soybean crop is planted in the late monsoon season during November to February of the following year. The harvesting period usually begins in July to February. The second soybean crop is harvested from February to May. Forty per cent of the total soybean planted areas are devoted to the first crop. As it is the rainy season during the first crop, soybean is easily damaged, while the second crop enjoys more suitable conditions.

The growers usually begin to harvest their soybean crops in July with 1.39 per cent activity. From then on the activities intensify from September to November, reaching 27.71 per cent in March (Table 4.9).

Table 4.9 Soybean: Percentage of harvesting pattern, 2002/2003

Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
2002/2003	1.39	5.39	9.79	9.99	13.29	4.03	0.13	2.06	27.71	25.42	0.79	0.01	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Again, given 1995 as the base year for the production index for soybean, the results indicate that the index faced continuous decline, from 93.13 per cent - 67.62 per cent, as soybean requires much care and, at the same time, farmers turn to other crops that are more profitable (Table 4.10).

Table 4.10 Soybean: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Soybean	133.05	139.02	100.00	93.13	87.61	83.32	82.74	81.03	67.62	69.44	69.00

Source: Office of Agricultural Economics, 2004.

Total consumption

Demand for soybean over the past 10 years grew at a rate of 14.33 per cent per year as soybean has a variety of uses: family consumption, food processing, crushing and many linkage industries, especially in feed production. Coincidentally the government set a liberal soybean import policy with zero tariffs. The demand for soybean in 1993 was 0.56 million tons, which increased to 1.95 million tons in 2003 (Table 4.4).

Constraints

The small growing plots of 1-1.5 hectares provide insufficient farm income. The production trend has seen a decline as the returns are insufficient to produce. Lack of cultivation skills is another factor and technological development is inappropriate.

In terms of marketing and processing, the growers ordinarily sell soybean of mixed grade, thus receiving low prices. Regarding processing, development of new products is limited and cottage processing is not widespread.

4.1.4 Factors affecting CGPRT crop production and consumption

Factors affecting CGPRT crop production and consumption include farm prices in the previous year, the position of competitive crops, and the pace of feed industry expansion.

Maize is used extensively in the feed industry as one of the major components in the feed formula for broilers. The ever increasing production of broilers influences the production and use of maize. With regard to soybean, supply has often been short from year to year. In this respect, factors affecting soybean production include farm income from the farm price, the suitability of the soils and the agro-climatic conditions.

Cassava, which is resistant to drought can grow quite well in the northeastern region where the soils are less fertile and the crop is widely grown. Use of cassava in the form of starch and chips is currently increasing both domestically and for export. As a result, more processing plants requiring the cassava root as their raw material have been established to satisfy demand.

4.1.5 Current status of irrigation

Most maize, cassava and soybean is planted in rainfed areas. In the irrigated areas, the government promotes the cultivation of maize and soybean after the second rice crop as the two crops need less irrigation and are high in demand. However, the promotion programme has not been well followed because the farmers are used to growing the second rice crop. Moreover, many paddy fields are clayish and water logged allowing no easy land preparation. About 30,000 hectares of low-lying paddy fields are planted with maize and 10,000 hectares are frequently planted with soybean.

4.2 Trends of non-CGPRT food crop production and consumption

The non-CGPRT food crops selected include sugarcane, durian, longan and pineapple, all of which are Thailand's major export items. Their current status of these crops is discussed as follows:

4.2.1 Sugarcane

Planted area, harvested area, production and yield per hectare

The areas planted with sugarcane were on the increase during 1993/1994 to 2002/2003 by 1.30 per cent following continued greater demand for sugar. Total production of sugarcane during 1993/1994 to 2002/2003 increased by 3.93 per cent, whereas unreliable climatic conditions cause damage and reduce the total yield in some years.

Among the selected food crops, the yield per hectare of sugarcane showed an increasing growth rate of 2.59 per cent between 1993/1994 to 2002/2003 due to the introduction of improved sugarcane strains (Table 4.11).

Table 4.11 Sugarcane: Area, production, yield and farm price, 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	857	800	37 823	44 144	18 870
1994/1995	942	923	50 597	53 717	17 360
1995/1996	1 005	985	57 974	57 706	15 110
1996/1997	1 010	980	56 394	55 822	10 260
1997/1998	944	n.a.	46,873	49 679	13 410
1998/1999	918	n.a.	50 332	54 852	12 320
1999/2000	938	n.a.	52 813	56 309	10 360
2000/2001	877	n.a.	49 563	56 517	11 220
2001/2002	1 011	n.a.	60 013	59 348	10 250
2002/2003	1 139	n.a.	74 263	65 180	11 890
Growth rate (%)	**1.30**	**n.a.**	**3.93**	**2.59**	**-5.53**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

Sugarcane has two growing periods, namely the early monsoon crop between May and June, when as much as 60 per cent of the area under production is utilized. Secondly, the late monsoon crop usually begins in October to December when the remaining 40 per cent of the area under production is cultivated. The harvesting period for sugarcane normally begins in November to May of the following year but most of the harvests are obtained in January to March (Table 4.12).

Table 4.12 Sugarcane: Percentage of harvesting period, 2002/2003

Year	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
2002/2003	0.16	11.04	25.48	23.88	24.09	13.01	2.35	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Assuming 1995 as the base year, the production index for sugarcane in 1997, 1998, 1999 and 2000 are all lower than the base year because the farmers face price declines and poor agro-climatic conditions. However, for 2001-2003, the index began to rise again as growers returned to produce more sugarcane (Table 4.13).

Table 4.13 Sugarcane: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sugar cane	68.48	79.54	100	101.73	74.97	86.82	93.24	89.72	108.07	107.84	130.12

Source: Office of Agricultural Economics, 2004.

Total consumption

The domestic demand for sugar continued to increase with a growth rate of 3.50 per cent during 1993-2003 due to the expansion of industries requiring more sugar as their raw material (Table 4.14).

Table 4.14 Sugarcane: Total consumption, 1993-2003 (million tons)

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth rate (%)
Sugarcane	1 267	1 370	1 520	1 580	1 710	1 700	1 640	1 680	1 810	1 830	1 900	3.50

Source: Office of Agricultural Economics, 2004.

4.2.2 Durian

Planted area, harvested area, production and yield per hectare

The cultivated area of durian increased during 1993/1994 to 2002/2003 by 13.31 per cent. The yield per hectare of durian has decreased by 11.48 per cent due to damage caused by poor climatic conditions in some years (Table 4.15).

Table 4.15 Durian: Area, production and yield, 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	102	98	749	7 663	880
1994/1995	644	517	773	1 495	730
1995/1996	659	582	850	1 460	900
1996/1997	672	611	918	1 501	840
1997/1998	678	616	916	1 487	590
1998/1999	693	620	464	748	810
1999/2000	701	635	781	1 230	560
2000/2001	761	648	649	1 002	598
2001/2002	782	654	826	1 263	380
2002/2003	787	669	890	1 329	360
Growth rate (%)	**13.31**	**12.61**	**-0.30**	**-11.48**	**-9.490**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

Fruit crops are usually planted during the rainy season, namely May to September. A fruit tree takes five years to be productive. The harvesting period for durian is from March to November with most of the harvesting taking place in June and July (Table 4.16).

Table 4.16 Durian: Percentage of harvesting period, 2003

Year	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
2003	0.07	6.73	12.42	23.00	35.73	12.44	7.67	1.26	0.68	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Assuming 1995 as the base year, the production index for durian for 1998-2001 appears to be low due to effects from El Nino, in 1998 in particular. However, in 1996, 1997 and 2002 the trend reverses due to expanded harvested area and favourable climatic conditions (Table 4.17).

Table 4.17 Durian: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Durian	88.16	90.90	100	107.97	107.77	54.59	91.88	76.35	97.23	104.66	92.12

Source: Office of Agricultural Economics, 2004.

Total consumption

The local demand for durian declined at a rate of -1.298 per cent between 1996 and 2003 in conjunction with the increasing export quantities, while durian production was less than the demand (Table 4.18).

Table 4.18 Durian: Total consumption, 1993-2003 (million tons)

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth rate (%)
Durian	0.728	0.746	0.801	0.852	0.843	0.392	0.670	0.565	0.709	0.804	0.683	-1.298

Source: Office of Agricultural Economics, 2004.

4.2.3 Longan

Planted area, harvested area, production and yield per hectare

The total area planted with longan increased during 1993/1994 to 2002/2003 by 12.60 per cent. The harvested area of longan also increased, by 9.03 per cent following the expanded planted areas. The yield per hectare of longan fell by 3.15 per cent due to damage caused by poor climatic conditions in some years (Table 4.19).

Table 4.19 Longan: Area, production, yield and farm price, 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	37	28	93	2 495	450
1994/1995	41	31	193	4 730	310
1995/1996	44	35	144	3 285	750
1996/1997	47	38	236	5 000	630
1997/1998	54	41	286	5 336	590
1998/1999	65	44	34	521	1 580
1999/2000	74	47	143	1 926	750
2000/2001	82	53	358	4 353	600
2001/2002	95	57	187	1 978	630
2002/2003	101	63	420	4 160	280
Growth rate (%)	**12.60**	**9.08**	**9.03**	**-3.15**	**0.661**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

The growing period for longan is May to September, and as much as 60 per cent is planted in July. The harvesting period for longan normally begins in November to May of the following year (Table 4.20).

Table 4.20 Longan: Percentage of harvesting by month, 2003

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2003	0.87	1.07	0.95	20.40	0.38	0.78	35.69	55.40	0.89	0.22	0.57	1.14	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Assuming 1995 as the base year, the production index of longan for 1993, 1998 and 1999 appears to be low due to the El Nino in 1998. However, in other years the index improves due to expanded harvested areas and favourable climatic conditions (Table 4.21).

Table 4.21 Longan: Production index, 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Longan	64.58	134.46	100.00	164.64	199.22	23.52	99.27	249.6	130.08	272.09	208.23

Source: Office of Agricultural Economics, 2004.

Total consumption

Most local demand for longan is in the form of fresh fruits, whereas consumption of longan products, for example dehydrated longan, is as little as 5 tons per year and canned longan is also consumed. Local annual consumption of longan in recent years (1993-2001) has been in the range of 10,000-100,000 tons depending on annual production and exports. Local consumption declined at a rate of -1.298 per cent between 1996 and 2003 (Table 4.22).

Table 4.22 Longan: Total consumption, 1993-2003 (million tons)

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth rate (%)
Longan	0.059	0.136	0.085	0.060	0.025	0.023	0.067	0.046	0.009	0.039	0.057	-9.886

Source: Office of Agricultural Economics, 2004.

4.2.4 Pineapple

Planted area, harvested area, production and yield per hectare

During 1993-1994 to 2002/2003, the prices of pineapples in some years were depressed and the growers had no incentive to harvest. Therefore, production fell by 1.04 per cent. The yield per hectare of pineapple fell by 1.18 per cent due to damage caused by poor climatic conditions in some years (Table 4.23).

Table 4.23 Pineapple: Area, production and yield, 1993-2002

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993	n.a.	100	2 589	25 931	40
1994	n.a.	99	2 370	23 853	50
1995	n.a.	91	2 088	23 057	80
1996	n.a.	83	1 987	23 836	110
1997	n.a.	85	2 083	24 610	80
1998	n.a.	82	1 786	21 802	130
1999	n.a.	97	2 372	24 423	40
2000	n.a.	98	2 248	22 995	20
2001	n.a.	92	2 078	22 626	40
2002	n.a.	80	1 739	21 869	10
Growth rate (%)	**n.a.**	**-1.04**	**-2.25**	**-1.18**	**-1.680**

Source: Office of Agricultural Economics, 2003.

Cropping pattern

Pineapple can be grown all year round. The harvesting period for pineapple normally begins in January to December with most of the fruit harvested in June and July (Table 4.24).

Table 4.24 Pineapple: Percentage of harvesting period, 2003

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2003	5.35	5.96	4.85	5.50	10.50	15.97	14.73	3.09	4.63	8.71	9.95	10.76	100.00

Source: Office of Agricultural Economics, 2004.

Production index

Assuming again 1995 as the base year, the production index of pineapples during 1996-1998 and 2001-2002 are all lower due to poor climatic conditions. However, in 1999-2000, the

production index increased to 112.71-176.41 as pineapple production became more efficient (Table 4.25).

Table 4.25 Production index of pineapple, year 1993-2003

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Pineapple	124.01	113.54	100.00	95.16	99.79	85.62	112.71	176.41	94.78	79.29	88.48

Source: Office of Agricultural Economics, 2004.

Total consumption

Due to increasing local production of other fruits, domestic demand for pineapple consumption is less year by year. During the period of 1996 to 2003 the annual rate of consumption fell by 0.415 per cent (Table 4.26).

Table 4.26 Pineapple: Total consumption, 1993-2003 (million tons)

Crop	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth rate (%)
Pineapple	0.489	0.356	0.341	0.409	0.418	0.339	0.475	0.400	0.500	0.300	0.400	-0.415

Source: Office of Agricultural Economics, 2004.

4.2.5 Factors affecting non-CGPRT crop production and consumption

Sugarcane

The factors include the world price of sugar, the farm price received, the domestic retail price of sugar and the f.o.b. price of sugar.

Durian

The factors influencing the production and consumption of durian are the farm price received, the f.o.b. price of durian, the prices of substitutable fruits supplied to the market in the same season, such as rambutan and mangosteen.

Longan

The affecting factors include the farm price received, the f.o.b. price of longan, the prices of longan originating from China and Viet Nam, the major Thai competitors.

Pineapple

The influencing factors are the farm price received, the f.o.b. price of canned pineapple, the f.o.b. price of Philippine canned pineapple and the prices of substitutable fruits.

4.3 Trends of perennial crop production and consumption

4.3.1 Para rubber

Para rubber is one of the major tree crops and an export item of Thailand. Its current status is as follows:

Planted area, production, yield per hectare

Since public policy to expand the area planted with para rubber in the east and northeast was introduced, cultivated area has increased by 0.38 per cent.

The area used for productive rubber plantations increased between 1993/1994 and 2002/2003 by 0.97 per cent. During 1993/1994 to 2002/2003, rubber production increased by 3.04 per cent.

The rubber yield per hectare increased by 2.66 per cent during 1993/1991 to 2002/2003 because of the improved rubber plant strains, both in the new planting regions as well as in the established southern region (Table 4.27).

Table 4.27 Para rubber: Area, production, yield, farm price and farm value, crop year 1993/1994-2002/2003

Crop year	Planted area (Thousands of hectares)	Harvested area (Thousands of hectares)	Production (Thousands of tons)	Yield per hectare (kg)	Farm price (US$/tons)
1993/1994	1 794	1 450	1 810	200	630
1994/1995	1 848	1 539	1 988	207	910
1995/1996	1 870	1 572	2 061	210	1 240
1996/1997	1 883	1 560	2 121	218	1 080
1997/1998	1 910	1 558	2 168	223	580
1998/1999	1 955	1 563	1 162	221	610
1999/2000	1 985	1 567	2 214	226	470
2000/2001	1 987	1 524	2 377	250	500
2001/2002	1 990	1 524	2 561	269	470
2002/2003	2 004	1 554	2 631	271	640
1993/1994	2 019	1 602	2 860	286	930
Growth rate (%)	**1.14**	**0.37**	**3.99**	**3.60**	**-3.68**

Source: Office of Agricultural Economics, 2004.

Cropping pattern

The crop can be grown all year round from January to December. Rubber trees take six years to become productive and ready for tapping.

Tapping for rubber latex can be practiced all year round except during the monsoon season when the sap output is less (Table 4.28).

Table 4.28 Para rubber: Percentage of harvesting by month, 2003

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
2003	11.36	7.51	5.10	5.02	6.64	9.42	9.41	8.79	10.15	8.84	7.68	10.08	100.00

Source: Office of Agricultural Economics, 2004.

Production index

For the period of 1996-2003, the rubber production index was higher than in the base year due to price incentives and the favourable climate (Table 4.29).

Table 4.29 Para rubber: Production index, 1993-2003

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Para	87.87	96.41	100.00	102.90	105.20	104.91	106.66	115.35	117.50	116.62	138.80

Source: Office of Agricultural Economics, 2004.

Total consumption

Domestic demand for industrial uses of para rubber products was on the increase during 1994 to 2000 from the expanding linkage industries requiring significantly more raw materials, namely the glove industry, elastics, vehicle tyres, broad-band elastics, rubber shoes and sandals.

Factors affecting non-food crop production

The influencing factors include the farm price received, the international rubber price, the Thai f.o.b. price and the Malaysian and Indonesian f.o.b. prices of their rubber products.

4.4 Trends of animal production

Livestock which live on feed produced from CGPRT crops include broilers and hogs. The hog population of 5.44 million heads in 1994 rose to 6.88 million in 2002, or 2.80 per cent.

The broiler population of 79.79 million birds in 1994 increased to 136.10 million in 2003, or 6.80 per cent, due to the increasing domestic demand for meat. In addition, Thailand continues to be capable of exporting more broiler products (Table 4.30).

Table 4.30 Number of swine and broilers, 1994-2003

Year	Swine (Thousands of heads)	Broiler (Thousands of birds)
1994	5 435	79 787
1995	5 369	81 657
1996	6 129	83 000
1997	6 894	92 942
1998	7 082	97 625
1999	6 360	103 173
2000	6 558	112 155
2001	6 689	125 161
2002	6 879	132 359
2003	n.a.	136 095
Growth rate	**2.80**	**6.80**

Source: Office of Agricultural Economics, 2004.

4.5 Trends in the marketing of CGPRT crops

4.5.1 Market structures

The market structures of the three CGPRT crops under study include farmers who grow the crops, the intermediaries including local assemblers, regional traders, the farmer institutions who collect the farm products and deliver to the terminal market, and users including feed mills, manufacturing plants and exporters.

4.5.2 Marketing channels

Maize

Right after the harvesting of maize, the growers usually sell their crops in need of cash and for loan repayments. Local assemblers and regional traders make a purchase offer and forward the supply to the end users. As it has been for the past 20 years, the marketing of maize eventually flowed to the exporters. However, at present almost all of the maize goes to the feed mills. Therefore, the feed mill operators play a key role in determining the price, whereas the public play a smaller role through the maize mortgage programme, only in some years, to stabilize the farm price. The marketing channels for maize may be summarized as follows:

The farmers sell as much as 50 per cent of their maize produce to the local assemblers, followed by 41.55 per cent, 4.64 per cent and 3.66 per cent of the total to the regional traders, farmer institutions and the maize mortgage programme respectively. Selling the maize directly to a feed mill is seen in Pitsanuloke province where the maize areas are close to the mill with a convenient transport system and pick-up trucks are available. The share of the direct sale to the feed plant is 0.12 per cent of the total maize produced and the farmers sell 0.03 per cent of the total to other sources.

The local assemblers collect 41.55 per cent of the total maize produced by the farmers and forward as much as 41.55 per cent of the total to the regional traders, followed by delivery of 9.35 per cent to feed mills, 0.23 per cent to exporters and 0.09 per cent to other sources.

The regional traders usually buy as much as 83.89 per cent of the total maize production from the growers, the farmer institutions as well as the maize mortgage programme and then forward most, 72.34 per cent, to the feed mills. The balance of 9.10 per cent and 2.45 per cent are sold to other sources and exporters respectively.

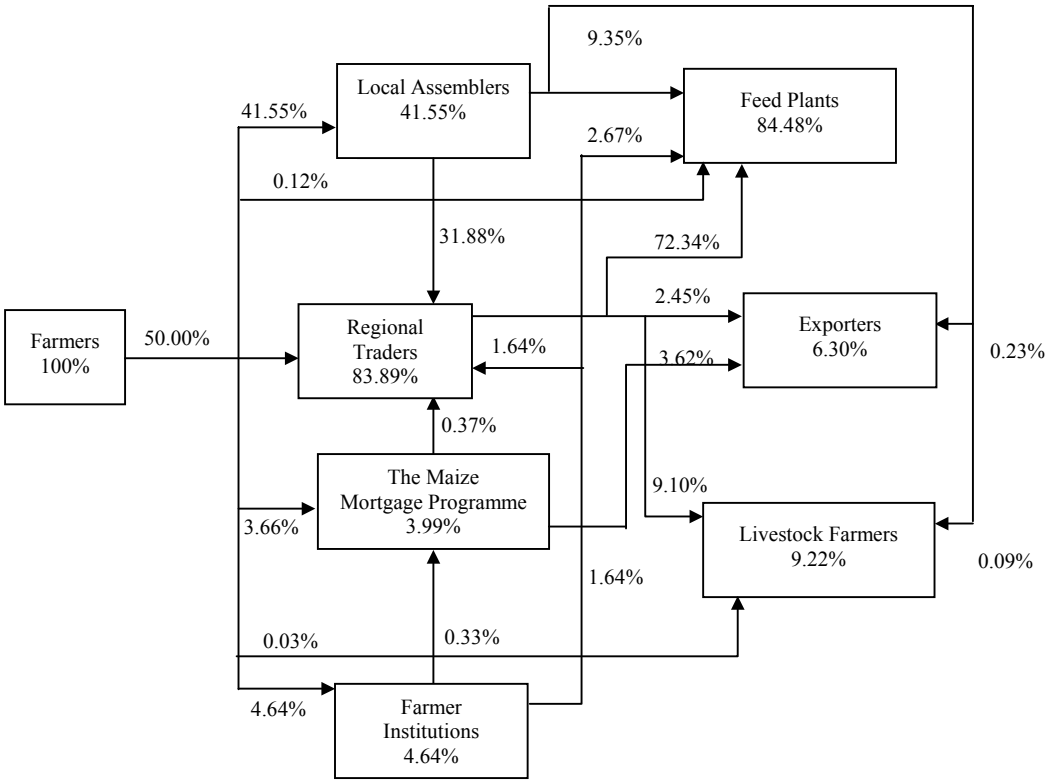
The farmer institutions purchase 4.64 per cent of the maize from its institution members as well as general maize growers for resale: 2.67 per cent of the total to the feed mills and 1.64

per cent to the regional traders. Another 0.33 per cent is put into the maize mortgage programme and unredeemed.

The maize mortgage programme

To protect the farmers from a depressed farm price, the government implemented the maize mortgage programme enabling the farmers and the farmer institutions to mortgage their maize with government agencies. They deliver their maize for mortgage and most is redeemed in due time, except by some farmers who disregard it when redemption is not financially worthwhile. Studying the marketing channels of the mortgage programme shows that the programme took 3.99 per cent of the maize total, which was unredeemable and, following government policy, is required to be exported. As some exportable maize faces constraints it is resold to regional traders. Therefore, 3.62 per cent of the maize supply in the mortgage programme is sold to the exporters and another 0.37 per cent to regional traders.

Figure 4.1 Maize marketing channels, 2003

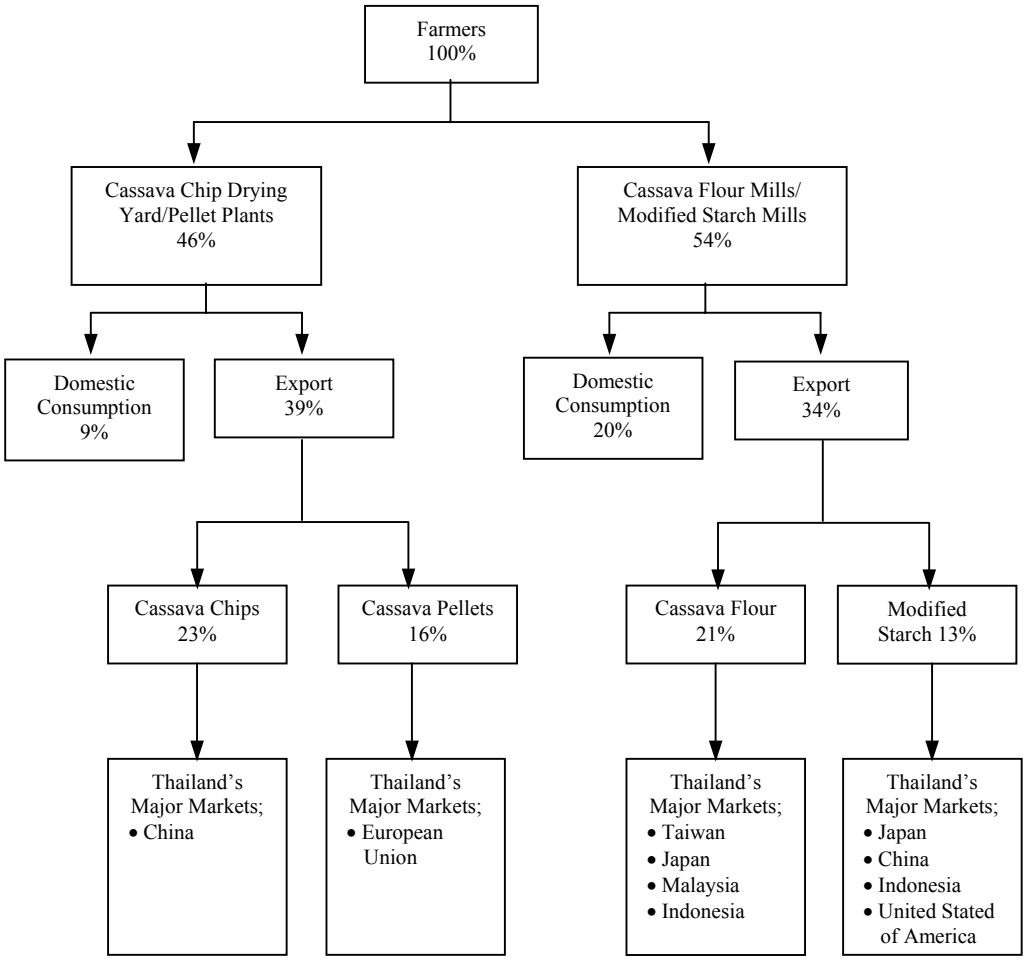


Cassava

In terms of the marketing channel for cassava in 2003, the farmers sold 46 per cent of the fresh cassava roots to drying yard operators and pellet mills, where shredded cassava and pellets are produced and exported. Twenty-three per cent of total cassava chip production is exported, mainly to China, and 16 per cent of the pellets are exported, mainly to the European Union.

To the flour mills and modified starch mills, 54 per cent of the fresh cassava roots are sold. Twenty per cent of the produce is consumed locally and 34 per cent is exported, 60 per cent of which is exported in the form of flour mainly to Taiwan, Japan, Malaysia and Indonesia. Moreover, 38 per cent of the modified starch is exported, mainly to Japan, China, Indonesia and the United States of America.

Figure 4.2 Cassava marketing channels, 2003



Soybean

Soybean is sold to the local assemblers (27.63 per cent), 61.23 per cent is sold to the regional traders and another 11.14 per cent is bought by the farmer groups and farm co-operatives.

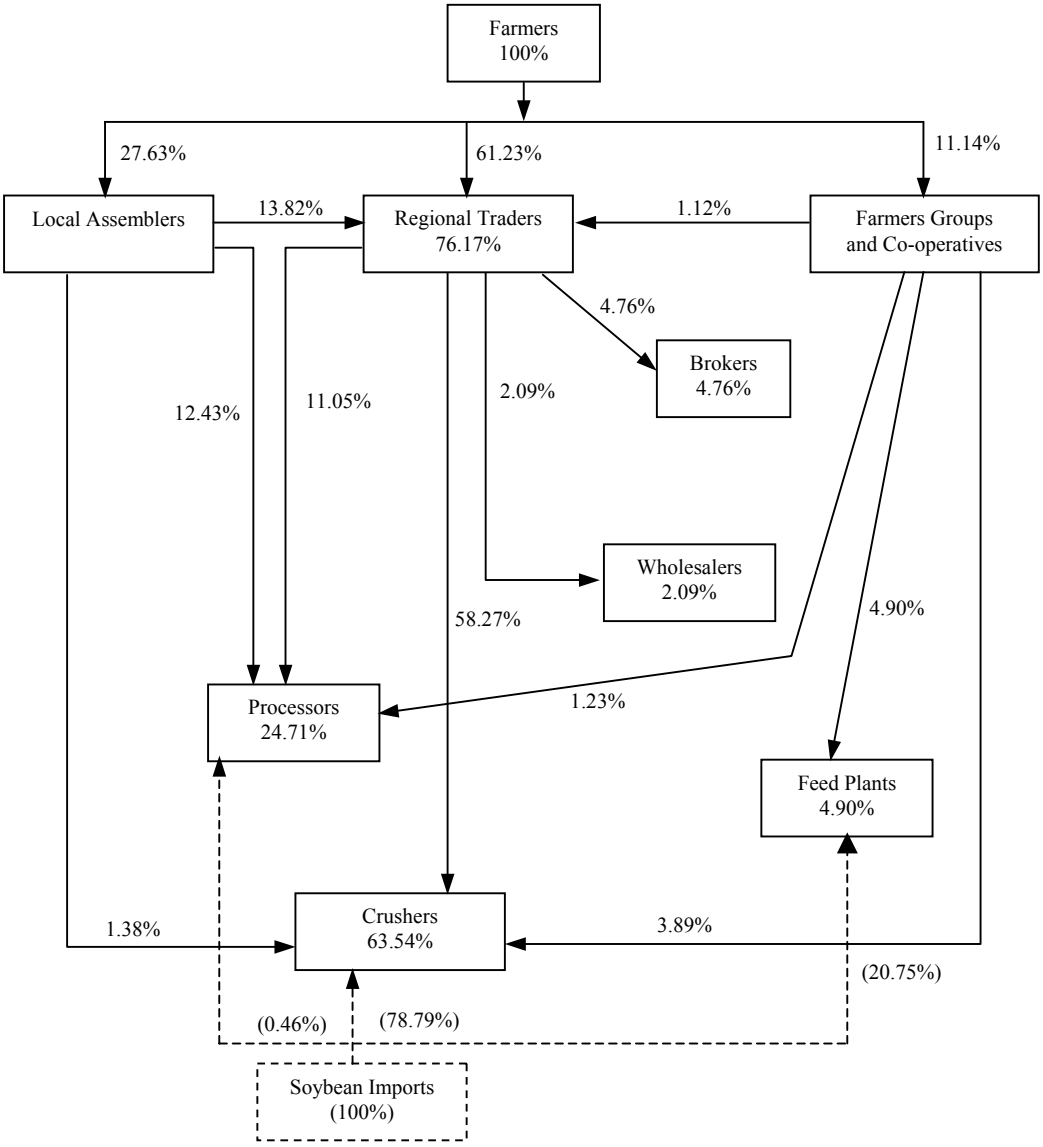
The local assemblers forward 13.82 per cent of total soybean production to the regional traders, 12.43 per cent to the processors and the remaining 1.38 per cent to the enchase.

Aside from direct buying of soybean from the growers, regional traders buy 13.82 per cent of total production from local assemblers, and 1.12 per cent from farmer groups and the co-operatives.

The traders then sell most of their supply; 58.23 per cent, to the crushers, 11.05 per cent to the food processors, 4.76 per cent to the brokers and another 2.09 per cent to the wholesalers.

The farmer groups and co-operatives sell 1.12 per cent of the total to the regional traders, 4.90 per cent to the feed mill operators and 3.89 per cent to the crushers.

Figure 4.3 Soybean marketing channels, 2003



4.5.3 Market integration

In the local soybean market, two important marketing groups emerge; the regional traders and the crushers. It is the crushers, the major buyers, who determine a price quote to the regional traders, considering the variables, namely prices of the soybean and its products in the foreign market and substitutable vegetable oils. Afterwards, the regional traders fix a buying price for the local assemblers. Finally, the assemblers fix the price for the soybean growers.

4.6 Concluding summary

The situation of production, local use and marketing of maize, cassava and soybean in the past 10 years has mostly been unirrigated. Consequently, the planted areas and production of maize and cassava faced decline as they had to compete with other major crops such as industrial sugarcane. Also the planted area and production of soybean have been on the decline as prices are not favourable. The demand for maize has continued to rise from the prosperous livestock industry and, as such, in a year of drought, maize imports rise dramatically. With regard to cassava, local consumption makes up 22-25 per cent of the production and the balance is exported. On the contrary, soybean production has always been insufficient. Demand is on the rise, for crushing in particular, and the soy meal is used as feed. At present, the demand for soybean is 1.9 million tons, all for crushing.

Regarding the production, marketing and use of non-CGPRT crops, sugarcane is an industrial crop competing with maize and cassava. In the past 10 years, the planted area and production of sugarcane has increased significantly. The major fruit crops, including durian and longan have also witnessed dramatic increases in planted area with often accompanying lower prices, which mostly occur immediately post-harvest.

The major tree crop is rubber for which there is a promotion programme directed at the northeast of the country. In spite of declining rubber prices over the last 10 years, prices since 2002 have risen remarkably as a result of greater world demand, especially from China.

The major livestock fed on maize, cassava and soybean are chickens and hogs. The production of both continues to increase.

5. Overview of Agricultural Diversification Related Policies in the Country

5.1 Public policies concerning CGPRT crop and food crop production

The objectives of the 8th Five-Year National Economic and Social Development Plan for Thailand (1997-2001) are as follows:

1. Competitiveness (in international markets).
2. Natural resources conservation and sustainable agricultural development (in line with international conventions and in light of the increase in linkages between trade and the environment).
3. To develop human resources and agricultural institutions.

To achieve the above-mentioned objectives the steps taken and to take are described as follows:

5.1.1 Competitiveness

- Adjust the structure of the agricultural sector and agricultural production systems as necessary;
- Increase production efficiency and reduce investment costs;
- Develop aquaculture, international fishery joint ventures, and expand deep-sea fishing;
- Clearly designate roles to the public and private sectors related to co-operation in research and development;
- Promote insurance for agricultural commodities and for selected fishery equipment;
- Stress the importance of the stability of prices for agricultural merchandise and domestic market prices, including the establishment of central markets, regional markets, and potential markets for the future;
- Undertake measures to establish agricultural commodity standards; and
- Promote agricultural industries.

5.1.2 Natural resources conservation and sustainable agricultural development

- Promote environmentally friendly agricultural activities;
- Prepare a plan for biodiversity management as it relates to the activities of the Ministry of Agriculture and Co-operatives.
- Change the planning and budgeting process to correspond with the management needs of natural resources, for example the management of watersheds and appropriate management of soils;
- Promote the implementation of soils and fertilizer policies to ensure positive results at the implementation level and promote the production of pesticide-free agricultural produce;
- Designate agricultural production zones to ensure that agricultural land is utilized appropriately;
- Decentralize authority for the conservation and protection of natural resources to local level organizations and communities;
- Consider the establishment and collection of an environmental (“green”) tax on users of natural resources whose activities have negative environmental impacts;

- Establish transparency in linkages between international trade and the environment; and
- Focus on improving organizations, institutions, and legal instruments that are concerned with natural resource management to make them more appropriate and effective.

5.1.3 The development of human resources and agricultural institutions

- Invest in education, and transfer technology in a methodical manner to conform to the needs of the target groups;
- Stress the importance of restructuring farmer debt;
- Accelerate the distribution of land ownership to poor farmers;
- Allow greater choice in the occupations available to increase incomes and/or stabilize incomes, including the quality of life of farmers, emphasizing their abilities to manage natural resources, production, marketing, communities and community industries;
- Promote low interest credit to allow development of agribusiness activities by agricultural institution to take place;
- Establish mechanisms for the collection and dissemination of agricultural information and data using both modern technologies and the indigenous technologies of villagers simultaneously;
- Increase opportunities for women and the youth to play roles in agricultural development;
- Promote private sector participation in developing agricultural organizations; and
- Revise, reduce, or increase government regulations to facilitate the operations of farmer organizations and institutions and control agricultural labour, including social benefits for those working in the agricultural sector.

These strategies will be applied through the operation of investment proposed by MOAC for inclusion in the Eighth National Plan. The MOAC provided projects for CGPRT crops during 1997-2001 as follow-up to these strategics.

5.2 Public policies on food diversification

The Eighth National Economic and Social Development Plan (1997 to 2001) includes the Agricultural Development Plan involving farm restructuring for sustainability to cover not less than 20 per cent of national farm holdings in a major effort to create opportunities for smallholders to earn adequate farm incomes through rural living. Farming alternatives to be decided upon include natural farming, organic farming, integrated farming, agro-forestry and New Theory agriculture.

Certain prices for CGPRT crops such as cassava and non-CGPRT crops, for example pineapple, often fluctuate wildly at harvest time when there is excess supply and the government is called to step in with huge spending. Hence, the farm restructuring committee of the government has set out a support programme to adjust farm production plans by reducing the planted area of the problem crops and encouraging replacement activities that are more profitable. The assistance includes farm inputs, namely low cost loans, farm pond digging and technical assistance for the participants of the project. The first phase of the project took place during 1994-1996 with the second phase in 1997-2001. The crops under the project include rice, cassava, coffee, pepper, pineapple, oil palm, mature coconut and recommended replacement crops including fruit crops, vegetables, flowers, mixed farming, tree crops, fast growing trees, aquaculture, dairy cattle and beef cattle. Evaluation of the project finds that a large number of the farmers face problems with the replacement activities due to a lack of management skills

and experience. As a result, loss of funding and farm debt occur, which preclude the farmers from the proposed activities.

5.3 Public policies on food processing

Food processing in Thailand continues to be developed both in terms of production and exports, and it now is a prime foreign exchange earner. Currently, competition is tight in the world market and certain importing countries attempt to exercise trade barriers. Within the Thai agro-industry itself some impediments still exist. To keep the industry from stagnating, remedial measures must be brought in. The most significant issue has been identified as trade barriers, while, secondly, shortages of raw material supply exist for some commodities, seafood in particular, and their poor quality is a problem. The third problem is in marketing, which includes poor information systems coupled with a lack of development and transfers of food processing technology, especially to SMEs.

Consequently, the government formulated a food industry readjustment programme for 2001-2006 incorporating the following strategies:

1. Reorganize the farm produce delivery system and processing firms in line with desirable grades and quantities.
2. Focus research and development activities on upgrading crop and livestock strains in an effort to continually upgrade the locally available raw materials.
3. Research and develop higher value-added products.
4. Modify the processing machinery in the agro-industrial plants.
5. Support the management of quality, food safety and the environment according to international standards, introducing HACCP from the processing level up to exports.
6. Create new individual brand names and develop food packaging.
7. Extend organic farming and the consumption of toxic free products.
8. Seek raw materials from Thailand's neighbors for processing in Thailand.

With regard to local food processing, urgent public policies have been implemented in support of the development of local and community industries expected to use local knowledge. The one tambon, one product programme is an example of enhancing sustainable business potential. Whether it be traditional or emerging, the strategy for product uniqueness, local area-specific knowledge promotion and area-specific knowledge of local processing techniques encourages local produce to be distinctive and well known.

Cassava is one CGPRT crop with major processing activities for flour production. Soybean is processed into sauces and soy oil. Only a little maize is usually processed into flour because of the supply shortage. Policies pertaining to cassava processing include processing for quality products for further use in the linkage industries, such as the food industry, textile industry and paper industry. The government has implemented, developed and promoted the processing of fresh cassava roots as follows:

5.3.1 Clean cassava chips

One of the major aims of the government is to urge the production of quality cassava products, which are in demand both locally and abroad.

- Campaign for producing clean cassava chips. The government transfers the technology needed to the prospective farmers and drying yard operators.
- The project on production and marketing chains aims to provide incentives to produce clean chips and marketing linkages.

5.3.2 Cassava starch

A promotion programme has been implemented for quality starch production and product variety.

- Training programmes are conducted for flour mill and modified starch mill operators to improve and standardize production and create awareness about environmental considerations.
- Support of co-operative efforts in the form of joint investment for modified starch production. In this process it is expected that technology transfer from high-tech countries will take place to transform modified starch into higher value-added products.

In addition, the Board of Investment (BOI) provides support to establish flour mills with soft loans and grace periods. In this regard, imports of machinery are also exempt of tariffs too.

5.3.3 Ethanol

The government provides assistance for the production of ethanol using cassava as a raw material, in a major effort to reduce the huge imports of automobile fuel, according to the following strategies and guidelines for the consumption of ethanol.

- Exemption of excise tax for ethanol.
- Reduce the funding of the fuel fund.
- Campaign for the use of gasohol as the fuel for official cars and state enterprises' cars.

The target for ethanol production for 2004-2006 has been set at 1 million litres annually to be raised to 3 million litres annually between 2007-2011. The planned annual consumption of fresh cassava roots is 1 million tons.

Additionally, the government implements policy and guidelines on the one tambon, one product project (OTOP) in an effort to establish rural development activities, create self-reliable, strong communities and eventually generate income, bringing local wisdom and resources to produce unique, quality products and services to satisfy demand, both domestic and overseas. Implementation is under the control of MOAC with significant objectives; i) to develop standardized products; ii) to provide marketing opportunities; and iii) to increase the added value and income in the communities. The project period covers 2001-2006.

The target groups of the project are communities and farmer institutions that are ready for change and growth. They must also have community-unique products and perceived marketing opportunities for which selecting and screening of the products is conducted. They have group administration with leadership too.

A shortlist of the products covers food products made from rice, cassava, soybean, vegetables and fruits. The non-food products are hand-made garments, handicrafts and artificial flowers.

5.4 Concluding summary

The Ministry of Agriculture and Co-operatives implements major policies affecting agricultural commodities in three principal directions. One is competitiveness, two is natural resource conservation, sustainable agricultural development, and human resource and agricultural institution development. The third objective is consumer safety and the farming families quality of life and financial status. In this connection, development strategies have been specified for maize, cassava and soybean. The use of improved strains is urged to improve productivity and encourage domestic utilization and processing on the marketing side.

With respect to policy on food diversification, farm restructuring is planned to encourage sustainability of not less than 20 per cent of the national farm holdings. Sustainable farming alternatives are extended to be decided upon by the farmers.

With regard to food processing, the Industry Ministry has planned to restructure the food industry through various strategies, including the arrangement of the production system to be in line with production and quality. Furthermore, research and development on crop strains and livestock breeds are essential for better raw materials.

6. Impact of Global Trade Orientation on CGPRT Crop Agriculture

6.1 Overview of the country's international trade policies for CGPRT and other agricultural products

6.1.1 WTO

International trade commitments

Thailand is the fifty-ninth member of the World Trade Organization, which sets out the Agreements on Agriculture, and Thailand is committed to comply with WTO rules as follows:

- Tariff reduction. As required for a developing country, Thailand has implemented tariff reductions for 564 farm export items out of a total of 740, which are bound by an average of 24 per cent within 10 years. Before the opening of the market, the tariff average was 49 per cent and it is envisaged to be reduced to 27-40 per cent. Regarding minimum market access, another 23 items formerly under non-tariff measures have been placed under the quota-tariff system. They include raw milk and combined milk, fat-free milk powder, rice, maize, soybean, soy oil, soy meal and palm oil. Indeed, the two CGPRT crops under study; maize and soybean are on the list of the 23 commodities and cassava is on the list of the 740 farm commodities.
- Domestic support. Thailand is committed to reduce farm support, which distorts market forces. As an example of this, the price guarantee programme was reduced from US$ 547.58 million in 1995 to US$ 477.60 million in 2003.
- Export subsidies. Since Thailand did not support an export programme in the base year, it relieves itself of this measure according to WTO rules since 1995.

Commitments by commodity

Maize

Thailand has opened the market since 1995 for more imports of maize. From 52,096 tons previously to 54,700 tons in 2004 with a fixed in-quota tariff of 20 per cent and the out-quota tariff of 80.2 per cent will be reduced to 73.0 per cent in 2004. Any imports from non-WTO member countries can be made at an unlimited quantity and time with a tariff of US$ 0.07 per kilogram and a special levy of 11.43 per cent of the tariff. In the case of imports affecting local maize producers, a surcharge of US$ 9.54 per ton is levied (Table 6.1).

Table 6.1 Market access commitments for maize to WTO agreements

Year	Market access commitments (tons)	Bound tariffs (%)		Actual access (tons)	Actual imports (tons)	In-quota applied rate (%)
		In-quota	Out-quota			
1995	52 096	20	80.20	400 000	280 205	7.50
1996	52 385	20	79.40	550 000	302 681	3.00
1997	52 675	20	78.60	350 000	235 701	0.00
1998	52 964	20	77.80	300 000	230 987	0.00
1999	53 253	20	77.00	53 253	120 675	20.00
2000	53 543	20	76.20	53 543	338 720	20.00
2001	53 832	20	75.40	53 832	6 649	20.00
2002	54 121	20	74.60	54 121	4 918	20.00
2003	54 411	20	73.80	54 411	12 415	20.00
2004	54 700	20	73.00	500 000	75 753	0.00

Source: Department of Trade Negotiations, Ministry of Commerce, 2004.

Cassava

The government is committed to reduce the import tariffs for slices, pellets and flour from 60 per cent in 1995 to 40 per cent in 2004. For dextrin and other modified starch and sorbitol, the tariff of 40 per cent imposed in 1995 is to be reduced to 30 per cent in 2004.

Tariff collection from non-WTO members is 60 per cent for pellets and native starch, 30 per cent for chips, 40 per cent or US$ 0.07 per kilogram for cassava starch, 30 per cent or US$ 0.25 per kilogram for cassava sago, 10 per cent for cassava waste, dextrin and other modified starch and 5 per cent for sorbitol (Table 6.2).

Table 6.2 Market access commitments for cassava to WTO agreements (Percentage)

Code	Item	WTO bound 2004	AFTA 2004	MFN applied 2004
071410	Cassava	40	5	60
- 0714100109	Tubers			
- 0714100204	Pellets			
- 0714100906	Chips, chilled-frozen	40 or 0.84 US$/kg	5	30
1106200118	Flour	40	5	60
1106200120	Native starch	40	5	60
1108140007	Starch	30 or 0.05 US$/kg	5	40 or 0.07 US$/kg
1903000014	Sago	40 or 0.34 US$/kg	5	30 or 0.25 US$/kg
2303100105	Wastes	9.0	5	10
3505100003	Dextrin and other modified starch	30	5	10
382460	Sorbitol	30	5	5

Source: Department of Trade Negotiations, Ministry of Commerce, 2004.
Note: Exchange rate $1 = 39.841 baht

Soybean

Soybean is subject to WTO Agreements in the form of grains, soy oil and soy meal. During 1995-2001, tariff reductions and taxation of out-quota imports can be described as follows:

- Soybean. Minimum market access in 1995 was 10,402 tons, rising to 10,992 tons in 2004. While the in-quota tariff has remained constant at 20 per cent, the out-quota tariff was 88.10 per cent in 1995 but was reduced to 80 per cent in 2004 (Table 6.3).
- Soy meal. Minimum access in 1995 was 0.22 million tons, increasing to 0.23 million tons in 2004. While the in-quota tariff is 20 per cent, the out-quota rate was 146.5 per cent in 1995 but was reduced to 133 per cent in 2004 (Table 6.4).
- Soy oil. In 1995, minimum market access was 2,173 tons, increasing to 2,281 tons in 2004. The tariff is 20 per cent for the in-quota and was 160.4 per cent for out-quota in 1995, declining to 146 per cent in 2004 (Table 6.5).

Table 6.3 Market access commitments for soybean according to WTO agreements

Year	Market access commitments (tons)	Bound-rates (%)		Actual access (tons)	Actual imports (tons)	In-quota Applied rate (%)
		In-quota	Out-quota			
1995	10 402	20	88.1	278 947	203 140	5
1996	10 459	20	87.2	426 460	418 788	5
1997	10 517	20	86.3	unlimited	869 370	0
1998	10 575	20	85.4	unlimited	687 244	0
1999	10 633	20	84.5	unlimited	1 007 983	0
2000	10 690	20	83.6	unlimited	1 290 322	0
2001	10 748	20	82.7	150 000	1 363 192	0
2002	10 806	20	81.8	unlimited	1 528 528	0
2003	10 864	20	80.9	unlimited	1 718 339	0
2004	10 922	20	80.0	unlimited	n.a.	0

Source: Department of Trade Negotiations, Ministry of Commerce, 2004.

Table 6.4 Market access commitments for soy meal according to WTO agreements

Year	Access commitments			Actual access		Actual imports
	In-quota quantities (tons)	In-quota tariffs (%)	Out-quota tariffs (%)	Quantities (tons)	Applied rates (%)	Quantity (tons)
1995	219 580.00	20	119	650 000	15	648 038.02
1996	220 799.89	20	119	830 000	15	799 989.52
1997	222 019.78	20	119	unlimited	10	1 502 125.38
1998	223 239.67	20	119	unlimited	5	957 489.89
1999	224 459.56	20	119	unlimited	5	1 017 830.79
2000	225 679.44	20	119	unlimited	5	1 331 098.81
2001	226 899.33	20	119	unlimited	5	1 560 257.09
2002	228 119.22	20	119	unlimited	5	1 693 052.13
2003	229 339.11	20	119	unlimited	5	1 957 698.59
2004	230 559.00	20	119	unlimited	5	n.a.

Source: Department of Trade Negotiations, Ministry of Commerce, 2004.

Table 6.5 Market access commitments for soy oil (HS1507100001, HS150790006)

Year	Market access commitments			Actual access		Actual imports
	In-quota quantities (tons)	In-quota tariffs (%)	Out-quota tariffs (%)	Quantities (tons)	Applied rates (%)	Quantity (tons)
1995	2 173	20	160.40	2 173	20	1 811
1996	2 185	20	158.80	2 185	20	774
1997	1 197	20	157.20	2 197	20	18
1998	2 209	20	155.60	2 209	20	0
1999	2 221	20	154.00	2 221	20	1434
2000	2 233	20	152.40	2 233	20	148
2001	2 245	20	150.80	2 245	20	2
2002	2 257	20	149.20	2 257	20	4
2003	2 269	20	147.60	2 269	20	na
2004	2 281	20	146.00	2 281	20	na

Source: Department of Trade Negotiations, Ministry of Commerce, 2004.

Note: HS1507100001 is soybean oil and its fractions, whether or not refined, but not chemically modified, crude oil.
HS150790006 is soybean oil and its fractions, whether or not refined, but not chemically modified, other than crude oil.

6.1.2 AFTA

Background

ASEAN member countries collaboratively established the ASEAN Free Trade Area (AFTA) in 1992 with the objective of enhancing ASEAN competitiveness by participating in the global trade liberalization programme, including building a better bargaining position in the world trade arena. Trade co-operation has been established through agreements on implementing equal special tariffs under the formal name of The Common Effective Preferential Tariffs (CEPT). The current ASEAN membership of ten has agreed to implement the following commitments.

- Reduce tariffs of all the industrial and agro-processing products on the Inclusion List (IL) by a gradual reduction to 0-5 per cent within 10 years for commodities on the normal track, and within seven years for the commodities on fast track. The vegetable oils, wooden furniture and rattan, garments, hides, rubber, fertilizers and pulp are the agricultural goods included on the fast track.
- Any commodity item that cannot be brought under tariff reduction within the time frame can be reserved the right to maintain its tariff by any ASEAN member and have it moved to the Temporary Exclusion List (TEL).
- Unprocessed Agricultural Products. UAPs can have their tariff reduction began later than the industrial and processed agricultural products.

Thailand's implementation

Thailand has had to reduce tariffs on the fast track and some others: a total of 7,737 items since January 2000 to 0-5 per cent. In this connection, 37 import items must have their tariffs gradually reduced to 0-5 per cent within 2003.

An additional 455,911 items need to have their tariffs reduced to 0-5 per cent between 2001-2003.

The three Thai CGPRT crops may be imported from AFTA at 5 per cent tariff.

6.1.3 Free Trade Agreements (FTA)

Background

FTAs are an active strategy for international trade seeking trade allies, enhancing trading and investment opportunities and having negotiating partner as a trading niche to neighbouring countries. The agreement framework of any country's tariff reduction is classified as follows: Fast track involves immediate reduction to zero tariff when the agreement is in force. Normal track involves reduction to zero tariff within a set time. Sensitive track involves reduction to zero tariff within an extended time.

Thailand's implementation

Thailand has been involved in FTA negotiations with eight countries and one economic group, and has finished negotiations with five countries, namely China, Bahren, India and Peru and one group; BIMST – EC (Bhutan, India, Myanmar, Sri Lanka and Thailand Economic Co-operation). The signing of an agreement with Australia is in process. The United States of America, Japan and New Zealand are three more countries engaged in negotiations.

The Thailand – China FTA has been signed prompting tariff reductions for all vegetables and fruits to zero by 2003. The reductions are issued by the Ministry of Finance and certificates of origin are issued by the Ministry of Commerce for tariff claims.

6.2 Effects of trade liberalization on CGPRT crops

6.2.1 Impact of WTO on CGPRT agriculture

Maize

The use of maize before the WTO, in 1993-1994, as feed in the domestic livestock industry grew at an annual rate of 9.34 per cent. On the other hand, after accession to the WTO (1995-2003) the growth faced decline by 42.06 per cent due to serious droughts in certain years, therefore imports was made to offset the shortages. In a year of favourable climatic conditions, the need for imports is less. However during 1993-1994, exports faced a dramatic decline of 32.27 per cent. After 1995-2003, the export growth rate was 7.78 per cent as imports in certain years created excess stock and re-exports grew as a consequence. During 1995-1998, the government permitted imports of 3-5 hundred thousand tons, which is in excess of the minimum market access fixed by the WTO due to serious droughts in a number of years. To protect farmers from being affected by possibly lower prices, the government cautiously permitted imports after the local maize harvests were out of the farmers' hands (Table 6.6 and 6.7).

Table 6.6 Thai maize exports

Year	**Quantity** (tons)
1993	212 086
1994	143 653
Growth rate (1993-1994)	**-32.27% per year**
1995	105 477
1996	53 543
1997	53 161
1998	122 713
1999	68 381
2000	19 944
2001	490 851
2002	146 049
2003	190 284
Growth rate (1995-2003)	**7.78% per year**

Source: Customs Department, Ministry of Finance, 2004.

Table 6.7 Maize imports to Thailand

Year	**Quantity** (tons)
1993	9 223
1994	10 084
Growth rate (1993-1994)	**9.34% per year**
1995	280 205
1996	302 681
1997	235 701
1998	230 987
1999	120 675
2000	338 720
2001	6 649
2002	4 918
2003	12 415
Growth rate (1995 - 2003)	**-42.46% per year**

Source: Customs Department, Ministry of Finance, 2004.

Cassava

During 1993-1994, before the WTO market access programme, exports of cassava products, namely chips, pellets, flour and starch had negative growth. However, in 1995 and 2004 export growth increased by 66.36 per cent and 7.32 per cent respectively as China reduced its import tariffs on the chips from 8 per cent in 2001 to 5 per cent in 2004. Additionally, Japan, Hong Kong and the United States of America completed their tariff reductions for flour and starch to zero. Therefore, exports of chips, flour and starch grew but the pellets faced decline by -7.85 per cent. The major market of the pellets is the European Union which subsidizes its farming more heavily, thus its cereals are favourable substitutions for the pellets (Table 6.8).

Table 6.8 Exports of cassava products, 1993-2003

Year	Chips (tons)	Pellets (tons)	Flour and starch (tons)	Total (tons)
1993	85 098	6 588 869	656 211	7 330 178
1994	13 460	4 714 610	929 419	5 657 489
Growth rate (1993-1994)	**-84.18% per year**	**-28.45% per year**	**41.63% per year**	**-92.28% per year**
1995	184 909	3 039 236	846 371	4 070 516
1996	4 002	3 724 686	894 756	4 623 444
1997	68 208	4 216 039	1 137 422	5 421 669
1998	161 759	3 187 213	770 854	4 119 826
1999	197 567	4 071 559	1 031 002	5 300 128
2000	34 015	3 212 896	1 413 781	4 660 692
2001	1 033 930	3 650 620	1 067 920	5 752 470
2002	1 369 032	1 534 998	1 328 551	4 232 581
2003	1 812 374	1 859 939	1 609 569	5 281 882
Growth rate (1995-2003)	**66.36% per year**	**-7.85% per year**	**7.32% per year**	**1.71% per year**

Source: Customs Department, Ministry of Finance, 2004.

Soybean

Before the WTO, imports of soybean and soy meal during 1993-1994 were less than 1 million tons. During 1995-2003, imports grew at 13.27 per cent and 20.06 per cent respectively, but soy oil imports fell by 9.85 per cent since the crushing volume satisfied the demand. Thailand gave more access than the commitment required due to low local production in relation to the import needs. Moreover, given that soybean imports are mainly for crushing and domestic production is mainly for direct consumption, imports do not necessarily affect locally produced soybean (Table 6.9).

Table 6.9 Quantity and value soybean, soy meal and soy oil imports

Year	Soybean (tons)	Soy meal (tons)	Soy oil (tons)
1993	44 689	598 844	7 453
1994	97 989	902 708	11 360
1995	203 140	688 514	12 109
1996	418 788	790 149	9 964
1997	869 370	1 109 126	6 518
1998	687 244	957 486	2 811
1999	1 007 983	1 331 100	3 493
2000	1 290 322	1 299 476	3 861
2001	1 363 192	1 560 258	3 421
2002	1 528 528	1 752 848	4 702
2003	1 689 627	1 917 873	5 456
Growth rate (% per year)	**26.06**	**13.27**	**- 9.85**

Source: Customs Department, Ministry of Finance, 2004

6.2.2 Impact of AFTA on CGPRT crops

Maize

During 1993-2003, imports of maize from ASEAN never totalled more than 70,000 tons, mainly originating from Indonesia, Lao People's Democratic Republic and Myanmar.

After AFTA in 1993 and up to 2003, Thai maize was predominantly exported to Malaysia, where the tariffs for maize are low and also to Indonesia and Singapore. There has been no impact on the farm price received as most ASEAN countries produce and use their own maize (Table 6.10).

Table 6.10 The volume of maize exports and imports to ASEAN countries

Year	Exports (tons)	Imports (tons)
1993	183 556	600
1994	104 580	150
1995	91 205	618
1996	45 955	89
1997	34 037	165
1998	88 870	1 717
1999	42 336	69 131
2000	13 787	1 717
2001	234 660	2 670
2002	114 268	1 147
2003	112 667	8 440
Growth rate (% per year)	**-1.301**	**40.88**

Source: Customs Department, Ministry of Finance, 2004.

Cassava

Reduction of the tariffs will lead Thailand's trading partners, namely Malaysia, Singapore, the Philippines, Indonesia and Lao People's Democratic Republic to import more cassava products, especially flour, sago and starch. After AFTA, exports of flour and starch grew by 17.94 per cent (Table 6.11).

Table 6.11 ASEAN exports of cassava products (AFTA)

Year	Chips (tons)	Pellets (tons)	Flour and starch (tons)	Other (tons)	Total (tons)
Before AFTA					
1990	-	-	-	-	-
1991	-	-	6 599	-	6 599
1992	4 200	-	110 195	303	114 698
After AFTA					
1993	10 600	-	75 994	518	87 112
1994	9	-	284 239	981	285 229
1995	-	-	267 583	1 125	268 708
1996	-	4 600	128 998	960	134 558
1997	-	-	347 253	803	348 056
1998	-	5 500	169 901	890	176 291
1999	-	11 650	215 303	1 026	227 979
2000	-	-	506 895	1 056	507 951
2001	105	5 500	598 837	967	605 409
2002	20 015	-	619 574	1 207	640 796
2003	1 936	6 704	602 853	1 116	612 609
Growth rate (% per year)			**17.94**	**4.32**	**17.41**

Source: Customs Department, Ministry of Finance, 2004.

Soybean

Before AFTA, in 1990-1992, Thailand imported no soybean or its by-products from ASEAN. However, after AFTA, such imports grew. Soybean was imported from Cambodia, soy meal from Indonesia and Malaysia, and soy oil from Singapore and Malaysia, the import volume of which was greatest during 1993-1997. During 1999-2003 however, imports fell due to growing domestic demand. Imports of soybean and soy meal from ASEAN have been irregular from year to year because soybean is mainly imported from outside ASEAN; most significantly from the United States of America and Argentina (Table 6.12).

Table 6. 12 Imports of soybean and its by-products ASEAN

Year	Soybean (tons)	Soy meal (tons)	Soy oil (tons)	Total (tons)
Before AFTA				
1990	-	-	-	-
1991	-	-	-	-
1992	-	-	-	-
After AFTA				
1993	1	11 156	4 545	15 702
1994	-	13 314	7 812	21 126
1995	12	-	7 952	7 964
1996	1 098	-	7 754	8 852
1997	6 180	-	3 917	10 077
1998	-	-	6 396	12 744
1999	4 505	-	1 316	5 821
2000	-	-	150	150
2001	-	338	24	362
2002	48	39	432	519
2003	6 616	-	478	7,094
Growth rate (% per year)			**-36.081**	**-28.418**

Source: Customs Department, Ministry of Finance, 2004.

6.2.3 Impact of FTA

After the tariffs on cassava products were reduced to zero under the Thailand-China FTA, the trade in cassava chips have increased in volume but fallen in value from 1.05 million tons worth 79.95 million dollars in 2003 to 1.28 million tons worth 64.63 million dollars in 2004. Part of the reduction in value was caused by the tariff reduction and lower exchange rate, which prompted more imports to China (Table 6.13).

Table 6.13 Thai exports of cassava chips to China

Before Thailand-China FTA (Oct. 2002 – Apr. 2003)		After Thailand-China FTA (Oct. 2003 – Apr. 2004)	
Quantity (million tons)	Value (million dollars)	Quantity (million tons)	Value (million dollars)
1.05	79.95	1.28	64.63

Source: Customs Department, Ministry of Finance, 2004.

6.2.4 Quantitative impact of WTO on the maize industry

The analysis of impacts of the WTO on the maize industry is based on regression analysis. The elasticities of demand, supply and price transmission are estimated to evaluate the effect of the WTO on maize production, demand, trade and prices. It is also based on the conclusion made by FAO (1995) that the Uruguay Round would cause the international price of maize to increase by 4 per cent. Assuming that the Chicago price of maize represents the world price, the Uruguay Round impact will raise the Chicago price of maize by 4 per cent.

In estimating the coefficients of supply, demand and price linkage equations, time series data from 1977-2003 is used. The results of the regression analysis are shown in equation 1 to equation 8. These equations will be used to assess the impacts of the increase in the Chicago price of maize caused by the Uruguay Round.

- **Supply equation of maize**

$$\ln PROD_t = 2.184 + 0.492 \ln FP_{t-1} - 0.246 \ln FER15 - 0.058 \ln FPCAS_t$$
$$(1.683)\quad (3.396)\qquad (1.584)\qquad (-1.018)$$
$$- 0.598 \ln FPS_{t-3} - 0.109D1 \qquad (1)$$
$$(-5.747)\qquad (-2.547)$$

$R^2 = 0.821$ D.W. = 2.401 n = 16 (1988-2003)

Where, PROD = total production of maize in million tons
FP = price of maize received by farmers in baht/kg
FER15 = price of fertilizer, formula 15 - 15 – 15 in baht/kg
FPCAS = farm price of cassava (baht/kg)
FPS = farm price of sugarcane (baht/kg)
D1 = Dummy variable
1982, 1987, 1990, 1998 = 1
otherwise = 0

The dummy variables represent natural disasters. The coefficient of lagged farm price variable is supply elasticities (EPROD) with respect to maize price received by farmers (FP).

- **Domestic demand for maize (QDM)**

$$\ln QDM_t = -2.714 - 0.239 \ln WSF/CPI + 0.224 \ln BR_t + 0.726 \ln FPCH_t \quad \ldots\ldots 2$$
(-3.222) (-1.006) (1.323) (2.276)

$R^2 = 0.746$ D.W. = 1.657 n = 16 (1988-2003)

Where, QDM = domestic consumption of maize in million tons
WSF/CPI = Bangkok wholesale price of maize divided by CPI (base year 1988) in baht/ton
BR = price of broken rice in baht/ton
FPCH = price of chicken in baht/ton
CPI = consumer price index

The elasticity of demand (ED) with respect to the Bangkok wholesale price of maize is its coefficient, which is equal to -0.239.

- **Export demand for Thai maize**

$$\ln EXQ_t = 8.558 - 1.261 \ln FOBB_t + 2.246\ D2 \quad \ldots\ldots 3$$
(1.066) (-1.322) (4.838)

$R^2 = 0.843$ D.W. = 1.936 n = 26 (1978-2003)

Where, EXQ = export volume of Thai maize in million tons
FOBB = export price in baht/ton
D2 = Dummy variable
= 1 export
= 0 no export

The export elasticity with respect to export price is -1.261, which is its coefficient.

- **Silo demand for maize (SILO)**

$$\ln SILO_t = 0.290 - 1.253 \ln WSS_t / CPI_t \quad \ldots\ldots 4$$
(0.164) (-1.072)

$R^2 = 0.731$ D.W. = 2.424 n = 26 (1978-2003)

Where, SILO = maize quantity in silo waiting for export in million tons
WSS = wholesale price at silo gate in baht/kg
CPI = consumer price index (base year 1988)

The silo demand elasticity with respect to silo wholesale price is -1.253, which is its coefficient.

- **Price linkage variable**

There are four equations for price linkage. They represent the relationships among the prices of maize at different price levels, namely the farm price, wholesale price and Chicago price of maize.

- **Farm price versus wholesale price at the feed factory and silo**

$\ln FP = -0.181 + 0.659 \ln WSF_t + 0.399 \ln WSS_t$ …….. 5
(-2.157) (3.536) (2.283)

$R^2 = 0.975$ D.W. = 2.109 n = 15 (1989-2003)

Where, FP = price of maize received by farmers in baht/kg
WSF = feed factory wholesale price in baht/kg
WSS = silo wholesale price in baht/kg

The elasticities of farm price (EFP) with respect to wholesale price at feed factory gate and silo gate are 0.659 and 0.399, which are the coefficients.

- **Silo wholesale price versus export price**

$\ln WSS_t = -7.372 + 1.044 \ln FOB_t$ ……. 6
(-16.604) (19.389)

$R^2 = 0.972$ D.W. = 1.814 n = 26 (1978-2003)

Where, WSS = silo wholesale price in in baht/kg
FOB = export price in baht/ton

- **Export price versus Chicago price**

$FOB_t = 1{,}964.372 + 0.761 CHP_t * EXCS_t$…… 7
(2.616) (4.080)

$R^2 = 0.857$ D.W. = 2.094 n = 19 (1985-2003)

Where, FOB = export price in baht/ton
CHP = Chicago price in US$/ton
EXCS = selling exchange rate in baht/US$

- **Feed factory wholesale price versus Chicago price**

$WSF_t = 1.765 + 0.0008 CHP_t * EXCS_t$……..... 8
(2.523) (3.830)

$R^2 = 0.813$ D.W. = 2.218 n = 15 (1989-2003)

Where, WSF = feed factory wholesale price in baht/kg
CHP = Chicago price in US$/ton
EXCS = selling exchange rate in baht/US$

Impact of an increase in the world price on maize prices

From equations 7 and 8, the effect of the Chicago price of maize transmitted to the export price and the feed factory wholesale price through their coefficients, which are estimated at 0.776 and 0.0008 respectively. This indicates that a unit change in Chicago price will change

the export price and feed factory wholesale price by 0.766 and 0.0008 units. However, if the effect of the price transmission can be estimated using simultaneous equations, then if the Chicago price rose by 4 per cent, it would cause the 2004 export price and feed factory wholesale price to increase by 3.446 per cent and 3.636 per cent respectively.

Impact on the domestic production of maize

From equation 1, the supply elasticity with respect to the lagged farm price is 0.492. The impact of the Chicago price on the lagged farm price (2003) is 2.611 per cent (from 4,116 baht/ton or 103.311 US$/ton to 4,223 baht/ton or 105.996 US$/ton), which will raise domestic production of maize from 4.473 million tons in 2004 to 4.530 million tons or an increase of 1.274 per cent. This will generate a gain in producer surplus of 0.018 million dollars.

Impact on domestic demand for maize

The impact on domestic demand for maize is estimated from equation 2. Its elasticity with respect to the feed factory wholesale price in real terms is -0.239. A 1 per cent increase in feed factory wholesale price in real terms will decrease domestic demand by 0.239 per cent. Therefore, the increase in the Chicago price of maize by 4 per cent will reduce domestic demand by 0.039 million tons or 0.864 per cent. It is estimated to decline from 4.513 million tons in 2004 to 4.474 million tons. This will cause a loss to consumer surplus of 0.7594 million baht or 0.019 million dollars.

The overall impact of an increase in the Chicago price of maize by 4 per cent is a net loss to the nation of 0.0437 million baht or 0.001 million dollars due to the loss in consumer surplus being more than the gain in producer surplus (Table 6.14).

Table 6.14 Impact of a 4 per cent increase in the Chicago price

Item		Base Scenario (1)	4% increase in Chicago price (2)	% Change (1), (2)
Production	(million of tons)	4.473	4.530	1.274
Farm price	(baht/kg)	4.151	4.310	3.830
	(US$/ton)	104.189	108.18	
Farm revenue	(million of baht)	18 567.42	19 524.30	5.154
	(million US$)	466.038	490.056	
Domestic consumption	(million of tons)	4.513	4.474	-0.864
Bangkok wholesale	(baht/kg)	4.667	4.836	3.621
price	(US$/tons)	117.141	121.383	
Domestic expenditure	(million of baht)	21 062.17	21 636.26	2.726
	(million US$)	528.656	543.065	
Exports	(million of tons)	0.119	0.114	-4.202
Export price	(baht/tons)	4 781.511	4 946.262	3.446
	(US$/tons)	120.015	124.150	
Export value	(million of baht)	568.999	563.844	-0.906
	(million US$)	14.282	14.152	
Producer surplus	(million of baht)		0.7157	
	(million US$)		0.018	
Consumer surplus	(million of baht)		-0.7594	
	(million US$)		-0.019	
Net Gain	(million of baht)		-0.0437	
	(million US$)		-0.001	

Source: Office of Agricultural Economics, 2000.
Note: Exchange rate $1 = 39.841 baht.

6.2.5 Comparative advantage

Domestic resource cost (DRC) is a social cost-benefit ratio which can be illustrated using the following formula:

$$DRC = \frac{\text{social domestic factor cost}}{\text{social value added}}$$

If the DRC is less than one it means that a country has added value in a commodity at less than its cost in the use of domestic resources and thus, has comparative advantage. It would benefit the country to increase the production of such a commodity. Contrarily, if the DRC is more than one it means a country does not have comparative advantage in the production of such a commodity. It would be better for the country to import such a commodity rather than producing it domestically for import substitution. For commodities produced for export, domestic resources should be allocated efficiently by producing commodities which increase the benefits to the country.

Tinprapha (1995) studied the competitiveness of rice and soybean in Thailand. He identified areas where rice and soybean main season crops were potentially competitive. The analysis was undertaken specifically for two provinces, Nakhon Sawan and Phisanolok, in the northern region. Mungbean was also included as a third crop, which is grown competitively with rice. A Policy Analysis Matrix (PAM) was constructed on a crop-by-crop basis for specific locations, as the production pattern varies considerably by geographical area. The PAM study used 1992/1993 as the base year. Six PAMs were constructed, one for each of the three commodities for the two provinces. A summary of the results is presented in Table 6.15.

Table 6.15 Summary of results of DRC for rice, soybean and mungbean in 1992/1993

Area	Soybean	Rice	Mungbean
Phitsanulok	1.454	0.915	1.162
Nakhon Sawan	1.204	0.856	1.811

Source: Tinprapha, 1995.

The DRC for soybean and mungbean were greater than one, which indicates that neither soybean nor mungbean production in Thailand are profitable. The DRC for mungbean in Nakon Sawan is particularly high, indicating a significant efficiency loss to the country from resources devoted to mungbean production in this province. The DRC for soybean also illustrates that the provinces have comparative disadvantage and efficiency loss because the area overproduces soybean. Rice, nonetheless, is the only commodity in which the two provinces have comparative advantage.

Tinprapha also carried out a sensitivity analysis on DRC to assess what the impact would be on the efficiency of production. The first parameters he chose in his study were the international prices for the commodities. It was found that if the price of rice fell by 10 per cent, Thailand would lose its comparative advantage in rice production. However, the price of soybean would have to rise by almost 20 per cent for soybean production to be an efficient use of resources in Nakhon Sawan, and by 35 per cent for Phitsanulok.

Tinprapha also attempted to examine the impact of raising the price of key inputs. Water is available at no charge to Thai formers, but it is a resource which has a high social opportunity cost. Rice uses considerably more water in production than soybean. This situation was simulated by assuming water charges to rice farmers. Water charges had to be five times higher for the rice farmers compared to the soybean farmers before rice lost its comparative advantage.

Labour is another factor whose social cost is likely to rise over time as the demand for labour increases. The unemployment rate is very low in Thailand, and population growth is only 1.2 per cent. Labour is already in short supply in some rural areas at the peak labour requirement. The price of labour would have to increase by 160 per cent before the relatively lower labour requirement for soybean would change its comparative advantage. Similarly soybean needs less fertilizers than rice, but the price of fertilizers would have to increase by 120 per cent before this becomes a critical factor.

Finally, the study incorporated the greater environmental benefit of soybean production compared to rice production. The higher water requirement of rice is usually followed by a greater use of chemical inputs, such as fertilizers and pesticides. Soybean is a nitrogen fixing agent, therefore, growing soybean can improve soil fertility. The sensitivity analysis illustrates

that the various environmental externalities would have to be valued equivalent to a 180 baht per rai tax on rice production plus a 180 baht per rai subsidy on soybean production before these factors would change the comparative advantage between rice and soybean.

Table 6.16 Sensitivity analyses on DRC

Scenario	Nakhon Sawan		Phitsanulok	
	Rice	Soybean	Rice	Soybean
Baseline	0.856	1.204	0.915	1.454
Changes in prices:				
Rice f.o.b. down 10%	1.017	0.979	1.099	1.304
Soybean c.i.f. up 20%	1.032	0.964	-	-
Soybean c.i.f. up 35%	-	-	1.026	0.969
Single input changes:				
Water charges for rice up 400%	1.033	0.955	1.147	1.304
Labour cost up 160%	1.002	0.997	-	-
Fertilizer price up 120%	1.024	0.970	1.197	1.305
Environmental charges:				
Rice taxed 180 baht/rai, soybean Subsidized 180 baht/rai	1.014	0.980	1.028	1.304

Source: Tinprapha, 1995.

6.3 Concluding summary

Liberalization of trade in connection with WTO and AFTA has prompted more exports of maize. However, export quantities have not been high as most production supply is required locally for feed production. However, the demand for exports to neighbouring countries is on the increase, suggesting greater potential for maize production.

After trade liberalization, increases have been seen in the export of cassava products, especially flour and starch, both to the West and ASEAN, as a result of more demand.

Reduction in the tariffs on soybean has prompted more imports. However, the imports are mainly for crushing and the locally produced soybean suffers with a clear declining production trend while local prices are higher than the soybean imports. With a higher protein content, domestically produced soybean is recommended for direct consumption.

The degraded soils, droughts and incidences of pest epidemics have led to alarmingly lower farm income and eventual poverty. To avert these risks, diversified farming systems need to be introduced, recommending crops that are suitable in conjunction with market demand.

7. Benefits of Agricultural Diversification on Poverty Alleviation

7.1 Overview of public policies aimed at poverty alleviation and their limitations

One impact of national development in Thailand during the last three decades has been the gradual decline of agricultural contributions to GDP, down to just 10 per cent. However, the persistent importance of the agricultural sector continues to be seen as it provides earnings and employment to more than 50 per cent of the total population. Furthermore, the sector is always the major source of national income from export sources totalling 6,645,896 million dollars in 1999.

The immediate response of Thai farmers to the rapidly expanding demand for farm commodities has been to change farm production towards actively commercialized monocropping on a given farm plot. This is quite obvious of the major exportables, namely rice, cassava, rubber and maize. As a result, heavy dependence on a few particular international markets has continued to make Thai farmers suffer from much lower incomes from the depressed and fluctuating commodity prices.

The natural resources have also been degraded as a result of no practical conservation and rehabilitation along with over-farming and over-use of agro-chemicals in an attempt to enhance production.

The degraded soils, droughts and incidences of pest epidemics have led to alarmingly lower farm income and eventual poverty. To avert these risks, diversified farming systems need to be introduced recommending crops that are suitable in conjunction with market demand.

7.2 Assessment of potential benefits of agricultural diversification for poverty alleviation

There are farmlands that are irrigated and unirrigated. Those that are irrigable are in an advantageous position having year-round irrigation with no real risk of water deprivation. Furthermore, with more fertile soils natural disasters are more limited in their impacts. This is not the case for unirrigated areas.

In the low-lying irrigated areas, rice is usually grown in the rainy months. After rice, pulses, vegetables, maize and other grain crops requiring less water are usual diversified to satisfy the needs of the poor farm households. Diversification gives more food intake than growing two crops of rice. Switching the second rice crop to another crop requires as much as a two-fold reduction in the water requirement than rice. This farm practice also eliminates pest and disease problems often imminent when repeatedly growing rice on the same plot.

Diverse cropping on irrigated upland areas usually involves several cropping patterns. A farmer with one piece of farmland may grow more than one crop, for example maize grown on one plot and vegetables on another plot, which has been set aside. Farmers possessing several farm parcels may choose to grow rice in the rainy season on a low-lying plot for household consumption with any surplus for sale, while their upland plots are planted with cereals. While diversity helps eliminate price risks, simultaneous multiple cropping may create a shortage of labour and more farm hands may need to be hired. However, a rise in farm income can be expected.

Away from the irrigated areas, diverse farming, when and where possible with suitable crops such as maize and cassava, would help avert risks. In cases where drought causes damage to maize, the cassava crop would be spared. On the other hand, maize monocropping might face a total loss.

7.3 Basic requirements for realizing the benefits of agricultural diversification for poverty alleviation

Assessment of the various public programmes on sustainable agriculture finds that rapid expansion of the development and adoption is yet to be satisfactory. Therefore, an analysis of factors affecting farm decisions related to sustainable diversification is required together with the factors of success.

Farm surveys found that before turning to sustainable farm diversification, the farmers in the north and northeast faced major farm problems as discussed as follows:

7.3.1 Farmers are affected by current over-farming practice using agro-chemicals

The majority of farmers have the following similar experiences:

- Drought caused by rain intermission, after growing periods in particular;
- Depletion of soil fertility; and
- Depression of farm prices after harvesting the major crops and farm debt is common.

7.3.2 Incentives to diversify

The support of the government and non-government organizations (NGO) is another important factor to induce farm diversification. Sustainable agriculture aims to correct the current farm problems with emphasis on self-reliance and the use of available farm resources for maximum benefit by:

- Dredging a farm pond;
- Supporting rice-based cropping systems to relieve the farm household's food requirement and to reduce the farm price risk to a minimum; and
- Using local raw materials such as compost and cattle dung to reduce the use of chemical fertilizers and thus reducing costs.

The NGO's role has been noted in organizing saving funds in villages to support community activities. To help farmers make their own decisions, the government will organize study tours for farmers to visit successful farms undertaking sustainable agriculture.

7.3.3 Differences in the geographical areas

Geographical differences among localities influence the pattern of sustainable agricultural development as follows:

- *Agro-climatic conditions* determine the types of crops which can be grown. In the north, where average temperatures are lower than elsewhere in the country, rice-based multiple copping is practised with cauliflower, tea, plum and lychee, which are not suitable to be grown in the other regions, while in the northeast maize, soybean and fruit crops such as mango and longan are planted in rice-based farming systems.
- *The terrain* also determines the patterns of sustainable agriculture. Ninety per cent of the terrain in the north constitutes the watershed and mountain valleys, with only 10 per cent of the plains, whereas in the northeast, it is mostly plateau. Therefore, agro-forestry on the mountain slopes coupled with forestry resource conservation seems to have a greater potential in terms of sustainable diversification, both now and in the future.

- *Sufficiency of the water sources in the localities*. The presence of water sources in a village area raises the farmer's motivation to participate in sustainable farming activities. Farming in the north and the northeast relies heavily on steady support from natural water sources, namely rainfall and the waterways, whereas the central plains is well supported with extensive irrigation systems and in the south it rains quite steadily. As such, farming in the latter two regions is less risky in terms of losses due to water shortages.

7.3.4 Basic requirements

- Farm damage from drought is usually very serious to crop production. In the irrigated areas, although irrigation is well provided, it requires good water management and all waterways leading to farms require regular maintenance.
- The principal farm inputs include investment funds for cultivation activities, farm mechanization that needs less labour and is cost effective and soil improvement materials, which include chemical and organic fertilizers, organic matter and green manure.
- Transfers of farm technologies that are appropriate greatly raise production efficiency and product quality.
- Research and development to identify suitable areas for efficient farm diversity.

7.4 Concluding summary

Diversifying farm production by means of simultaneous multiple cropping will provide better food supply to the poor farm households compared to rice monocropping followed by a second rice monocropping. The practice of multiple cropping greatly reduces the incidence of pests and disease and averts farm price risks. It also provides more employment and, better still, more farm earnings.

The basic requirement of agricultural diversification to alleviate poverty is water sources in non-irrigated areas. In addition, the major input needs include a farm investment fund, farm mechanization and cost reduction practices involving organic fertilizers and green manure. Appropriate farm technologies and research on soil suitability are also needed to contribute to the efficiency of agricultural diversification.

8. Demand for CGPRT Crops as Staple Foods and Their Industrial Importance

Thai people consume rice as a staple food, consuming 56 per cent of the total rice produced. Other CGPRT crops, not being staples, are processed into cooking ingredients, sweets or for use in linkage industries both for food and non-food production.

8.1 Extent of diversified ways of consuming CGPRT crops as staple foods and their demand as staple foods

Consumption of CGPRT crops takes many forms and can be described as follows:

8.1.1 Human food

Direct consumption of CGPRT crops includes cassava and soybean. It is maize that initially needs processing, for example into starch. Domestically there is the Hanatee variety of cassava that is sweet and may be consumed directly in the form of cassava syrup. But the strain is usually not very common and gives way to the common strains that neither humans nor animals can directly consume. Preparing or processing must be done first. Domestic soybean is not really matured and is harvested for boiling and consumption. Strains of soybean having large grains are either cooked green or canned.

Processing into food and non-food products

Some maize is made into starch for local consumption only. Maize starch is used in linkage industries such as corn syrup, dextrose and sorbitol.

Cassava is made into flour starch for use in linkage industries in producing sago, sweetener, food and beverages, seasonings and medicines. Three types of sweeteners are produced, they are glucose, high fructose and sorbitol.

Soybean is commonly processed into:

- Food, such as bean starch, soy milk, baby food, soy curd, Chinese sauce, fermented soybean and seasoning sauce. Most of these products use locally produced soybean.
- Crushing for oil for both cooking and in food canning industries and salad dressing. Most of these products use imported soybean.

8.1.2 Feed

Cassava, maize and soybean are processed into feed as follows:

Maize

Maize is processed into compound feed. In the past, most local maize production was exported. However, recently local supply has nearly been equal to the demand and even shortages have occurred in the feed industry in some years. As a result, maize has been imported for feed.

The government has set plans to promote Research and Development activities on CGPRT crop product varieties.

Cassava

Cassava roots are processed into chips and pellets due to their bulk and transportation costs. Traditional cassava chips contain low protein (2 per cent) and are often contaminated as much as 5 per cent and are less accepted by the feed millers. It is mostly fed to cows.

In the past, the export requirement in the form of pellets was quite large: 4-6 million tons annually. However, the European Union implemented policy on guaranteeing its domestic cereals at high levels and consequently, imported less cassava pellets. After implementing the CAP reform in 1993/1994, the European Union has turned to more uses of its grains.

The potential benefit of the government's clean cassava chip promotion scheme is expanding the use of cassava products in feed. The scheme conducts transfers of clean cassava chip production techniques to farmers and drying yard operators, together with uses of the clean chips in feed to the livestock farmers and co-operatives. In addition, a public relations campaign has been extended on the benefits of clean chips in feed, including healthier livestock and a lower veterinary drug requirement. The prices of the clean chips are cheaper in relation to maize and soybean prices.

Soybean

A new industrial practice has emerged; steaming the soybean to obtain full fat soy for use in making feed. Soy meal is a by-product of crushing soybean for oil. In 2003, total domestic utilization of soy meal was 2.9 million tons; 34 per cent from domestic supply and 66 per cent from imports.

8.2 Extent of industrial uses and industrial demand for CGPRT crops

8.2.1 Industrial uses and demand for cassava

Industrial uses

The cassava processing industries can be classified as follows:

Production of cassava chips

The chips are obtained from the cassava tubers at a conversion ratio of 1 : 2.2-2.5 depending on such factors as slicing, drying and month of operation. However, the main factor is the starch content in the fresh tubers.

Cassava pellets

The slices are processed into pellets in an attempt to reduce the bulkiness and thus the transportation cost. The conversion ratio of cassava chips to pellets is 1.02-1.05 : 1 depending on the precision of the scale, moisture content and additives in the slices.

Cassava starch

The starch is classified into two groups.

- *Native starch* is obtained from cassava tubers and has readily available physical properties for direct utilization and in linkage industries. The conversion ratio of cassava roots to native starch is 4.2-4.5 : 1.
- *Modified starch*. Formerly, modified starch was produced from native starch. However, at present it is made directly from the fresh cassava tubers.

Linkage industries using cassava starch

Currently, there is widespread use of cassava starch, locally and abroad, in substitution for wheat flour, potato flour and rice flour. Having, relatively, the lowest price among them, cassava flour has comparable chemical properties in water absorption. The inexpensive price of

cassava starch helps diversify the linkage industries and will eventually expand domestic starch production.

Industries requiring the cassava starch raw material may be classified as follows:

- Food and beverages. The beneficial property of cassava starch in this regard is its ability to increase viscosity, thus keeping food in a desirable state. It is often used in producing bread, ready-prepared wheat noodles, noodles, seasoning sauce, ice cream, feed and confectioneries.
- Sweetener industries. Sweetener production includes:
  - Glucose. Used in the production of carbonated water, syrup, confectioneries and drugs.
  - High fructose. Used in the production of fruit drinks, dairy products, desserts, fermented products and prepared foods.
  - Sorbitol. Used in the cold storage industry, meatball production and imitation crab meat.
- Textile industry. Cassava starch is used in most stages of textile production including:
  - Shape sizing. Used to smooth the filaments and for flexibility.
  - Printing. Used to fix colour steadiness of the printing colours.
  - Finishing. Used for durability and to give a glossy finish.
- Paper industry. A good cohesive agent and cheap, the cassava starch is used throughout paper production.
  - Beater sizing. Addition of the starch at this stage of paper production produces a viscous paper.
  - Surface sizing. Use of the starch raises the ink property not to permeate the paper pad with a smoother surface.
  - Surface coating. Starch used at this stage of paper production acts as a holding agent and thickens the paper texture as well.
- Glue industry. Glue made from cassava starch is usually viscous and the viscosity is maintained longer. The glue is frequently used in the production of textiles, paper, metal molding, colour, printing ink, postage stamps and letter envelopes.
- Plywood production. Uses the starch mixed with the glue, a major step in making plywood.
- Seasoning.
- L-lysine production. L-lysine is an essential amino acid.
- Organic acid production. The production includes, among others, lactic acid and citric acid.
- Medicine industry. Starch is used as a solvent in pills and capsules.
- Bio-degradable materials. The starch is made into a plastic-like material and bio-degradable polymer is added. The resultant compound can be made into various products.
- Containers. Cassava starch can be made into containers.
- Cassava sago is made from the starch.

Industrial demand

As mentioned previously, cassava tubers are processed into slices, pellets and starch. The cassava chips and pellets used to make up 55 per cent of tuber production and starch the rest. However, since the European Union implemented the CAP reform beginning in 1993/1994, there has been more use of European Union domestic cereals. Consequently, Thai pellet exports fell dramatically and the manufacturers reduced slice and pellet production and turned to expanding starch production in line with the greater demand. Therefore, slice and pellet

production fell to 45 per cent and starch production grew to 55 per cent of total tuber production.

During 1996-2003, industrial demand for fresh roots followed an increasing trend.

- Demand from the slice drying yards grew at an annual rate of 77 per cent.
- Demand from the pellet mills grew at an annual rate of 21.66 per cent.
- Demand from the flour mills grew at an annual rate of 3.12 per cent.
- The linkage industries of starch production, namely seasoning, sweeteners, paper, textiles and household consumption grew at an annual rate of 6.3 per cent.

8.3 Extent of scope to expand industrial uses and demand for CGPRT crops

In order to increase the number of industrial uses and therefore demand, the following needs to be implemented:

8.3.1 Production side

Enhance the production efficiency of the raw materials to reduce the industrial cost of production and raise their competitiveness against the substitutes, for example, the cassava pellets and the European Union cereals in the use as feed. The raw materials need to have their crop strains and the soils improved to realize better yield per unit area. In the case of cassava, the starch content should be increased.

Arrange for a year-round, steady delivery system to the mills. This is one way to reduce production costs and satisfy demand throughout the year.

Reduce the operation cost burden of the processing factories, namely the tariffs on machinery, imported chemicals for use in industry and utility costs, especially power. In peak hours the power price per unit in some industries is quite high but while the consumers show steady demand for the products, manufacturing cannot postponed.

Support the potential industrial investors of the BOI with, among others low cost loans and grace periods, and tariff exemption on machinery imports, including foreign investment in the industrial development of CGPRT crops.

Extend the introduction of technology. A flour mill has the potential to use bio-gas power from its wastewater disposal system.

Quality control of the products to promote consumer confidence.

8.3.2 Marketing side

Organize promotion programmes on the use of cassava chips, maize and soybean in feed; and cassava, maize flour and soy oil through media, exhibitions and demonstrations.

Bilateral and multi-lateral trade negotiations to reduce trade barriers, and domestic and export subsidies. Currently, WTO members are liberalizing more of their trade and have free-trade agreements.

At the same time, however, these very countries introduce more non-trade barriers such as more stringent SPS regulations as follows:

For maize

- China requires importers to submit quarantine certificates issued by the exporting countries to China's Export-Import Examination Administration.
- India demands a MOAC permit as proof of being disease and chemical free.

For cassava

- The European Union has required pellet mills to observe GMP and HACCP since July 2002.
- Taiwan fixes the sulfur dioxide content to be not more than 150 ppm.

For soybean

- Imports from a WTO member, including Lao People's Democratic Republic and Cambodia, must be backed up with an import permit and tariff payment in line with commitments to WTO rules.
- Follow the production and trade situations with widespread use of the CGPRT crops to create an information service for the business operators/exporters.
- Seek new markets to counter the clustering of existing markets, namely cassava pellets in the European Union, chips in the Chinese market and flour in Asia.
- Arrange export co-operation between the state and the private sector to prevent price cutting.

8.3.3 Extension of local processing

The MOAC has encouraged groups of women from the co-operatives and farm wife groups nationwide to process food and non-food from cereals, vegetables, fruits, fishery products and livestock products, including CGPRT crops. Inputs are provided, including machinery and equipment, farmer training and seminars, employment for product research and development activities, exhibitions, leaflets and public relations through the media.

In terms of development, experts are designing ways to enhance marketing potential. Support is also provided for exhibitions and sales in department stores and co-operative stores, networking product distribution and direct sales together with the development of packaging and the production of packages.

8.4 Concluding summary

Maize, cassava and soybean are major CGPRT crops, which are not staples of Thai people. Indeed, they are food supplements and ingredients, and are also used in non-food enterprises. Locally produced soybean is usually little in quantity but popular as food supplements, like soy milk and as food ingredients. Soybean for crushing is mainly imported. With regards to maize, 90 per cent of maize production is used as feed, very little is processed into starch or used in other linkage industries.

Most cassava production is not readily available for direct consumption. Many industries absorb the tuber supply to produce chips, pellets, native starch and modified starch. Since the European Union's CAP reform in 1993/1994, pellet exports to the European Union have fallen dramatically. Consequently, more starch is now produced in response to the expanding demand from the linkage industries.

Expansion of potential demand can be made possible through the enhancement of farm production efficiency, especially for raw materials in the linkage industries. Supply management for processing industries is needed as is a reduction in the plant costs, exemption of machinery imports and BOI privileges. More technological adoption is urged, especially power generation from the management of wastewater.

9. Potential Scope for the Development of Diversified Agriculture

The main guidelines for developing the farm sector, policies and measures for implementation are discussed below:

Sustainable agriculture is a significant, reliable alternative for Thai society and the farmers that offers a balance of both local wisdom and modern technology to raise farm productivity. Sustainable agriculture also affects natural resources and the environment in a positive way. It is in response to the need of the local people as a base for their living, for national economic development as well as being a tool for trade and competition.

9.1 Extent of driving forces for agricultural diversification

The development of sustainable agriculture, paying more attention to efficient uses of natural resources, and at the same time, conserving them together with the environment, is attainable when the following factors are realized:

- *The farmers* should always be industrious, persistent and try to work step by step in improving their farming systems to suit agro-climatic factors.
- *The resource base* deserves attention in farm decisions. Areas where there are insufficient water sources will need to grow crops with a lower water requirement. On a high slopes, contour farming must be considered and particular crops grown to prevent soil erosion.
- *Demand of agro-industry* is an important factor to extend diversified agriculture with more export demand for cassava flour and higher domestic feed demand after WTO and FTA agreements.
- *Monocropping* often leads to fluctuations in farm prices. Farmers growing maize only or soybean only will earn less farm income when prices are depressed. Therefore, it is important to grow more than one crop in a single growing season in an attempt to keep price risks to a minimum.
- *Repeated monoculture* often degrades the fertility of soils and complicates soil erosion, thus the agro-conditions. Consequently, the farmers have seen a need to diversify. For example, soybean is grown after rice and maize is grown replacing cassava.
- *Topography and the suitability of the soils* are other important factors that encourage farmers to diversify. On poor soils or in drought stricken areas, like in the northeastern region, cassava is one of the best suited crops.

9.2 Extent of constraining forces for agricultural diversification

Past development efforts faced inhibiting factors as follows:

- The process of building bases for development was not very successful because the focus was put on the expansion of quantity and not on quality. It can be seen that research and development activities, including systematic transfers of sustainable agriculture, have been very limited, harming the learning process.
- Co-operation between the government and NGO's is inefficient for good sustainable development due to poor co-ordination, different conceptual frameworks, work methods and goals. The public sector usually wants to see sustainability in terms of numbers of farm families, whereas the NGOs work qualitatively seeking understanding

and acceptance of the sustainability process at the household level. Unfortunately, current NGO coverage of farm families is relatively small.

- The public administration process does not favour the sustainable development of agriculture. Although the MOAC has the policy to support NGOs and farmer participation, and the empowerment of sub-districts, however, delays exist in improving the role and regulations of the public sector.
- When the farm size is too small, the return on farm investment may not even break even if practicing simultaneous multiple cropping.
- Suitability of the agro-climatic conditions is the major factor when choosing a crop to grow. Field crops are suited to the uplands. A drought stricken area planted with cassava yields better than maize. Soybean prefers a milder climate.
- Mechanization on a large farm plot may not be suitable for multiple cropping on a same plot where those crops require different mechanized cultivation and harvesting practices. For example, planting and harvesting maize and cassava use different equipment, which may reduce effective management.
- Farm families who have limited household labour but attempt to over diversify gain less production efficiency.

9.3 Concluding summary

Driving forces for agricultural diversification are such that the farmer should always be industrious, persistent and work to improve their farming systems to suit the agro-climatic conditions.

Demand from agro-industry for the raw materials increasingly keeps pace with both more demand for exports as a result of the WTO and AFTA trade liberalization and domestic demand.

Deterioration of the soils caused by repeated traditional cropping forces the farmers to improve the soil condition, switching to other crops. Coupled with this is the driving force to consciously diversify because of soil suitability and topography.

The forces limiting diversification are: (i) a too small farm size to achieve economies of scale; (ii) some areas have no production potential accentuated by poor agro-climatic conditions; (iii) the existence of a large farm plot which may be suitable for monocropping using the same mechanical means; and (iv) family farm labour for multiple cropping.

10. The Development of Sustainable, Diversified Agriculture for Poverty Alleviation in the Region: A Search for Effective Polices

Farmers grow maize and cassava both large-scale and on smallholdings. Some smallholders even grow the three crops mixed with others.

Sustainable diversified farming to alleviate poverty should be directed as follows:

10.1 Guidelines for production and marketing development

Maize

- Develop the dry season maize crop (second maize) in the low-lying paddy fields. Maize has a lower water requirement, higher price received and no aflatoxin.
- Supplement household income by exploiting farm residuals, for example charcoal can be produced from maize cobs.

Cassava

- Improve the soils with green manure or chicken manure.
- Appropriate farm technology transfers.
- Research and develop field test technology suitable to specific soil groups and conduct farm trials for chemical fertilizers applied in conjunction with organic fertilizers to enhance cassava yields in various soil groups.
- Promote clean chip production extending technology to the farmers/co-operatives.
- Encourage the swine, cattle and dairy farmers to add more cassava slices to the feed.

Soybean

- Conduct farm trials of appropriate technology in each producing area and extend the proven technology to the farmers located in the area.
- Encourage growing soybean before and after the first rice in potential areas.
- Focus research and development activities on the high yielding cultivars with shorter duration and resistance in the hot and humid climate.

10.2 Guidelines for processing and adding value

The demand for maize, cassava and soybean for both domestic consumption and export continue to rise. Thailand has the potential to produce more maize and cassava, having distributed improved seeds and saplings to 80 per cent - 90 per cent of the producing areas. The WTO Agreement on Agriculture offers more exporting opportunities and fuel prices have a tendency to increase, acting as a driving force to seek substitutable power from organic sources. In addition, the three crops are not yet extensively processed leaving a lot of potential for processing expansion.

To this end, local processing should be promoted and might be included in the OTOP project aiming to sustainably develop local communities creating more job opportunities employing local labourers to produce unique products of high quality. The guidelines are as follows:

1. Provision of new processing technologies, package design and training courses for co-operatives.
2. Support the farmer groups to operate their own processing enterprises and create a unique brand name for their own top products and farmer groups.
3. The government continues to promote marketing activities such as merchandise contests and arranges exhibitions, both locally and abroad.

10.3 Guidelines for the future development of sustainable agriculture

1. Promote the introduction of the various methods of sustainable agriculture as activities in the agricultural restructuring programme and the degraded land rehabilitation scheme. The promotion should include extension of the information, training, support and technology for adequate farm earnings.
2. Farm support with the provision of a farm pond and improving irrigation, marketing services and farm inputs necessary for sustainable farm restructuring.
3. Readjust the farm extension programme, from extension agents to co-ordinating the roles of the concerned parties and farm recommendations for alternative decisions
4. Urge a bigger role of the private sector and NGOs for market access and management skills.
5. Support the farmer processing groups to use their own products for added value and income through training on processing technology, including investment in processing infrastructure.
6. Encourage the private sector to see the importance of improving raw material supply for their processing activities, including farmer participation in the company network.
7. Support organic fertilizers to improve the soils.
8. Support the management of reducing soil erosion from repeated monocropping.
9. Support the new crops that have market potential to be produced with CGPRT crops.
10. Support processing and value adding using by-products and more income earning alternatives, for example the cassava leaves for feed.
11. Support the processing of diverse products, like ethanol and others.

11. Conclusions and Policy Recommendations

11.1 Conclusions

1. According to WTO commitments for 1995-2004, Thailand has reduced tariff on the 740 items of farm commodities including cassava and open market access for 23 farm items including maize and soybean.
   The impact of the commitments for 1995-2003 on maize is such that exports increased and astonishingly imports fell as local production increased. Therefore, tariff reductions did not motivate maize imports. With regard to soybean and soy meal, more imports took place than the minimum access requirement as a result of more tariff reductions than the WTO commitments with no impact on the farmers who produced insufficiently. Soybean imports are for crushing only.
   After the market opening, cassava exports of chips, flour and starch grow annually as China reduces its cassava tariffs. Moreover, as Japan, Hong Kong and the United States reduced the tariffs imposed on the flour and starch to zero, more exports occurred. However, pellet exports fell by 7.85 per cent due mainly to the EU's increase in its farm support.
   Impact after AFTA. Since 2000, Thailand has had to reduce the import taxes imposed on the farm commodities put on the fast track together with some others totalling 7,737 items to 0–5 per cent together with tariff reductions on 37 import items to 0-5 per cent within 2003. Maize exports to ASEAN have climbed with few imports at the same time. Imports of soybean and its products are very limited, while cassava flour exports grew by 17.94 per cent.
   Impact after the FTA. Thailand is currently in negotiation with eight countries. With China, the taxes on vegetables, fruits and cassava were agreed upon to become zero as of late 2003. In the period of October 2003 – April 2004, exports of cassava slices rose to 1.27 million tons from 1.05 million tons.

2. The driving forces for agricultural diversification are such that the farmers should be industrious, persistent and try to work step by step in improving their farming systems to suit the agro-climatic factors and water supply needed to grow a crop. Co-operation must be sought among the government and private sectors as well as the farmers in the promotion of sustainable diversification.
   A constraint to sustainable agriculture has been the focus of development on the expansion of quantity not quality. Research and development activities, including systematic transfers of technology, have been insufficient. Co-operation between officials and NGOs is inefficient and delays exist in improving the public sector's role and regulations.

3. Agricultural diversification provides food supply to poor farmers. They have a higher quality of food intake and diversification reduces price risks, requires more farm labour to be hired, and can mitigate drought.

4. Limitations to agricultural diversification are small farm sizes, the poor suitability of agro-climatic conditions, and mechanization on large farm plots may be unsuitable for multiple cropping which requires different types of mechanization in cultivation.

5. The guidelines for the future development of sustainable agriculture are to promote the introduction of the various methods of sustainable agriculture as activities in the agricultural restructuring programme. The method of promotion includes extension of the information, training, support and technology for adequate farm earnings. Readjustment of the farm extension programme and to encourage a larger role of the private sector and NGOs for market access and management skills.
   Support the farmer processing groups to use their own products for added value and through training on processing technology, including investment in processing infrastructure.

11.2 Policy recommendations

1. Enhancing the farm production efficiency of maize, cassava and soybean is considered to have had rather small increases in growth in spite of promoting the use of good seeds and seedlings. However, as most planted areas of CGPRT crops are rainfed, the government should set priority for adequate irrigation systems.

2. Promote farmers to grow crops in suitable soils, agro-climatic conditions, environments and emphasize the use of green manure and chemical fertilizers.

3. Analyse the suitability of soils with crops in sub-districts, as information for farmers.

4. Current processing of maize and soybean to add value is significant. As production potentials exist for maize, research on maize processing for non-food industries is suggested to be supported. Regarding cassava, as the world fuel price becomes more expensive, production should be expanded to produce more ethanol.
   Regarding the OTOP project aiming to raise the income of rural families, the government is urged to enlarge the marketing network from the local level up to the national and export levels.

5. Thailand's trade in maize, cassava and soybean has been on the increase since WTO commitments. Since 1995 up to the present day, exports of cassava products have boomed, especially to China whose tariff reductions have already been implemented. However, non-tariff measures have been brought in instead with tighter restrictions. For example, China specifies no more than 0.40 ppm cadmium contamination and 0.70 ppm arsenic contamination in cassava. Taiwan fixes the sulfur dioxide (SO_2) content in the flour and Asian countries need to be very aware of the sanitary and phyto sanitary measures (SPS) at all farms through to the tables and export. On farms, GAP has to be practiced and at the processing plants, GMP and HACCP need to be introduced too. In the meantime, such measures should also be applied to imports to be fair and balanced. Furthermore, in the FTA, Mutual Recognition Agreement (MRA) should be settled bilaterally.

6. Maize should be supported with research on processing as now almost all maize production goes to the mills.

7. Campaigns should be launched to encourage the consumption of locally produced soybean, which is non-GMO for added value. Also, research and development activities regarding product variety deserve more attention.

8. Study the economic and financial returns of the different patterns of sustainable agriculture to use as information for farm producers, the consumers and public administrators.

9. Extend the learning process by transferring the ideas of the farmers successful in diversifying their production systems, to assist with the development of research and the transfer process.

10. Encourage implementation planning for building infrastructure relating to sustainable agriculture of the various concerned agencies to eliminate repetition in operations and budgeting.

    In order to implement sustainable agricultural development, regular co-operation and co-ordination in the form of networking among the state bodies, the NGOs and the farmers is crucial. In addition, formulation of the policy, goals and support measures together with studies on indicators and good information systems are significant issues for integrated implementation to make sustainable development a real choice for the farmers in the national development effort.

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Telephone: (62-251)-356813, 343277
Fax: (62-251)-336290
E-mail: capsa@uncapsa.org
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