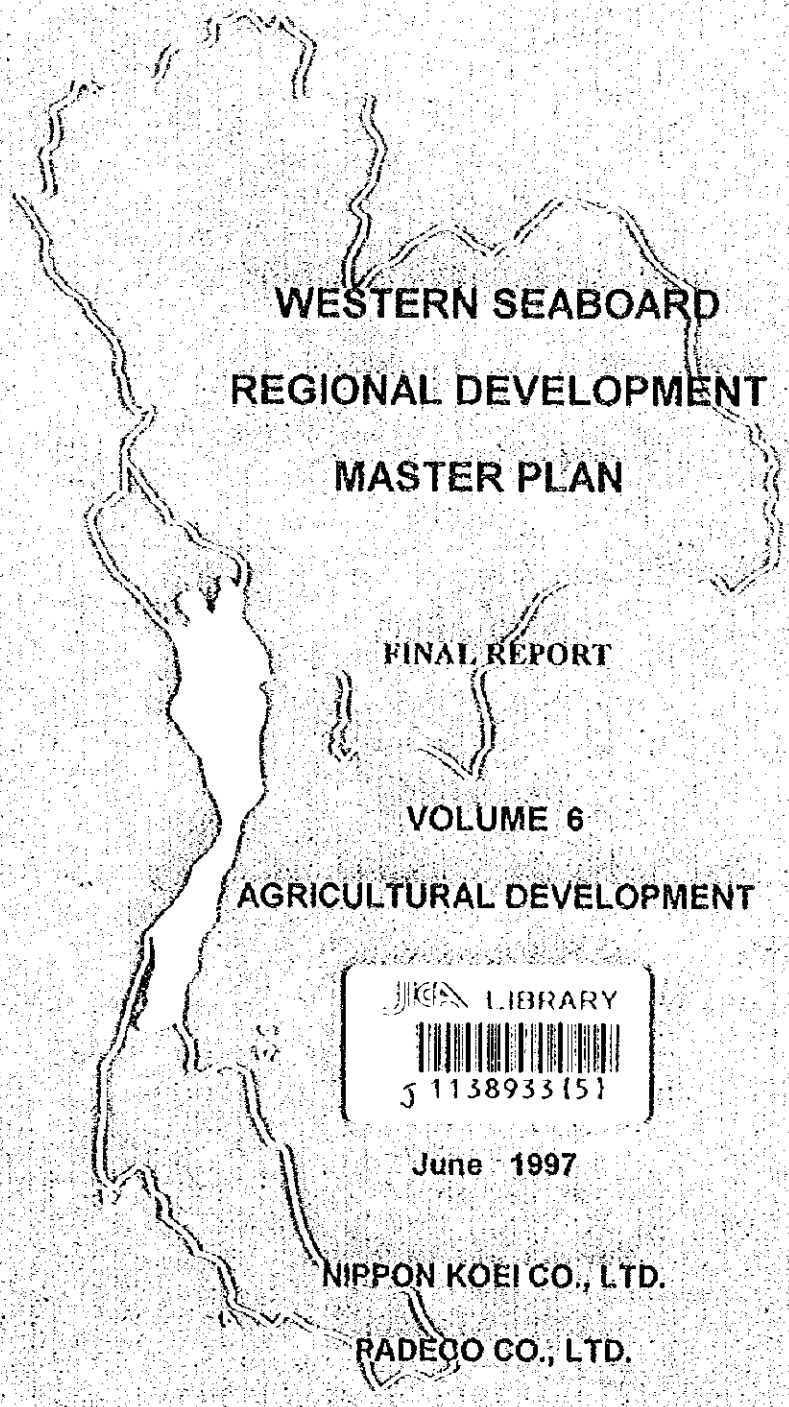
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL ECONOMIC AND
SOCIAL DEVELOPMENT BOARD (NESDB)
OF THE KINGDOM OF THAILAND

WESTERN SEABOARD REGIONAL DEVELOPMENT MASTER PLAN



FINAL REPORT

VOLUME 6

AGRICULTURAL DEVELOPMENT

June 1997

NIPPON KOEI CO., LTD.

RADECO CO., LTD.

THAILAND WESTERN SEABOARD MASTER PLAN Volume 6 Agricultural Development June 1997

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MASTER PLAN

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LIST OF REPORTS

(This Volume is indicated by [redacted])

Executive Summary

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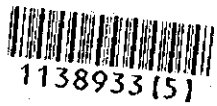
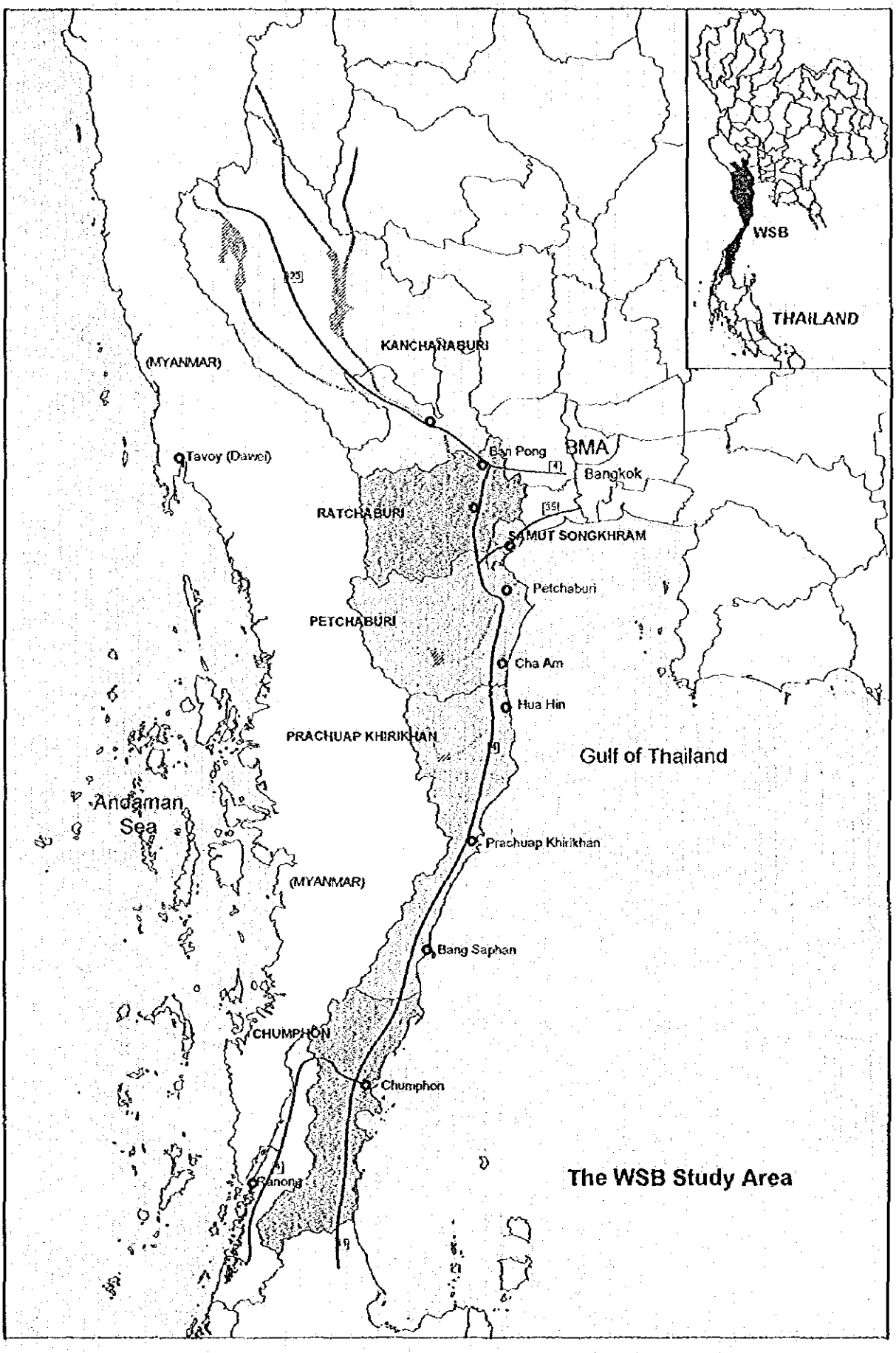


Currency Equivalents

US$ 1 = 25 Baht

1 Baht = US$ 0.04

(As of Mid 1996)


WSB
THAILAND
KANCHANABURI
(MYANMAR)
Tavoy (Dawei)
Ban Pong
BMA
Bangkok
RATCHABURI
SAMUT SONGKHRAM
Petchaburi
PETCHABURI
Cha Am
Hua Hin
PRACHUAP KHIRIKHAN
Gulf of Thailand
Andaman Sea
Prachuap Khirikhan
(MYANMAR)
Bang Saphan
CHUMPHON
Chumphon
Ranong
The WSB Study Area

VOLUME 6 AGRICULTURAL DEVELOPMENT

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Chapter 1 AGRICULTURAL DEVELOPMENT

1.1 Thai Agriculture Overview

1.1.1 Evolution of Thai Agriculture

In the 1960s and early 1970s, Thailand was an agrarian and less-developed economy. The agricultural sector played an important role in the development of Thailand's economy by contributing substantially to the national economy, providing employment and generating foreign exchange earnings through export. Since the 1960s, this sector has undergone substantial changes.

The first changes occurred in the 1960s when the contribution of rice to the economy started to decline as substantial forest area was cleared for agricultural use. A high demographic growth rate of about 3 per cent per annum created a natural pressure to bring more land under cultivation. Since most of the new land had a clear comparative advantage for crops other than rice, the agricultural structure started to diversify itself away from rice. Production of maize expanded in the 1950s, sugar cane in the 1960s, and finally cassava in the 1970s. These expansions were possible due to the two main factors: (i) existence of abundant land, and (ii) high agricultural prices throughout the 1970s. In the early stage, growth of this sector was high at more than 5 per cent per annum.

The relatively high rates of growth in agriculture during this period primarily came from expansion of cultivable land, at the expense of forest land. In 1975, farmland covered 17.9 million hectares and forest land covered 20.9 million hectares. By 1988, farmland had increased to 21.25 million hectares and forest land had fallen to 12.85 million hectares. Until the latter half of the 1970s, the amount of land cultivated per worker was actually increasing, an expansion that was in part made possible by the growing availability of tractors. Estimates indicate that, in the boom period of the 1960s and mid-1970s, land expansion was the single most important factor accounting for about 30 per cent of output growth per capita. However, as growth has been achieved through expansion rather than intensification, agricultural yield in Thailand has remained low by Asian standards.

The role of the agricultural sector as the major contributor to GDP ended in 1979 when the contribution of this sector was overtaken by that of the industry. The change in the relative importance of agriculture and industry reflected the comparatively low rate of growth of value-added in the agriculture sector compared to that in other sectors.

GDP Growth by Sectors

Unit : %

Period	Agriculture	Industry	Services	Total
1960-70	5.7	11.6	8.1	8.0
1970-80	4.2	8.9	7.1	6.9
1980-86	3.7	6.5	7.0	5.3
1986-91	4.5	14.6	5.8	10.7

Source : Bank of Thailand

In the 1980s, an increase in productivity as measured by the growth of yield per rai played an important role in maintaining agricultural income. Although the cultivated area for some crops such as rice, sugar cane, and rubber was reduced between 1980 and 1986, their production levels remained stable as a result of an improvement in productivity. Since 1986, the cultivated area of some major crops experienced a continuous decline, and their production has not been offset by gains in productivity.

Changes in Cultivated Area and Value Added

Unit : %

Crops	Land Use		Value Added	
	1980-86	1987-92	1980-86	1987-92
Major rice	0.7	(0.1)	3.1	0.3
Second rice	2.4	(3.8)		
Cassava	1.3	(0.4)	3.6	3.3
Maize	4.7	(5.6)	8.3	1.0
Rubber	(0.9)	2.9	8.2	9.6
Sugar Cane	(2.2)	11.0	15.2	11.2
Soy Beans	18.0	(1.6)	24.2	3.9
Vegetables	(0.1)	(2.2)	0.2	2.8
Tree crops	8.1	(0.9)	4.0	10.0

Source : NESDB, TDRI.

Automatic agricultural diversification through land expansion, which started in the 1960s, had virtually came to an end in the mid-1980s. A second round of agricultural diversification occurred after this period. Although the share of agricultural contribution to GDP has gradually declined, this sector has continued to diversify and has shifted towards production of higher value added products such as livestock and non-traditional crops. New agricultural products such as frozen chicken, sugar, and canned pineapple have been added to the traditional export commodities such as rice, cassava, and maize.

In addition, exports of a number of high-value products such as coffee, pepper, cut flowers, orchards, fruit, and vegetables have gained momentum. Marine and aquaculture products have also become major exports. The livestock sub-sector has increased its share in the agricultural sector.

Agricultural Share, 1980-93

Unit : %

Year	Crops	Livestock	Fisheries
1980	84.0	13.9	2.1
1981	84.9	12.9	2.2
1982	85.2	13.1	1.7
1983	85.3	12.9	1.8
1984	85.9	12.3	1.8
1985	86.2	12.1	1.7
1986	84.5	13.7	1.8
1987	82.8	15.1	2.1
1988	84.4	13.9	1.7
1989	84.7	13.8	1.5
1990	83.3	14.9	1.8
1991	83.7	14.5	1.9
1992	84.1	14.3	1.6
1993	83.0	15.3	1.8

Source : NESDB, TDRI.

The overall agricultural sector grew at an average of 3.6 per cent per annum over the 1980-1993 period, of which the livestock sub-sector grew at an annual rate of 4.8 per cent followed by crops at 3.5 per cent and fisheries at 2.3 per cent. Although the crops subsector maintained its share at about 83 per cent, the livestock subsector increased its share from about 14 per cent in 1980 to 15.3 per cent in 1993. The share of the fisheries subsector decreased from 2.1 per cent to 1.8 per cent during the same period.

Crops Sub-Sectoral Shares 1980-93

Unit : %

Year	Paddy	Cassava	Maize	Rubber	Sugar Cane	Soybeans	Vegetables	Tree Crop
1980	47.7	6.1	5.0	9.5	1.6	0.5	12.6	9.4
1981	47.1	6.0	5.5	9.3	3.7	0.7	12.0	8.5
1982	44.5	5.9	4.1	10.4	7.1	0.6	11.8	8.5
1983	47.4	6.0	5.2	9.9	4.3	0.9	10.8	8.0
1984	46.7	5.8	5.9	10.0	5.0	1.2	10.9	8.2
1985	45.0	5.8	6.5	10.9	4.1	1.5	10.4	8.8
1986	43.8	5.9	5.8	12.5	4.7	1.7	9.8	9.2
1987	42.3	5.2	3.3	15.0	4.5	1.4	11.1	10.6
1988	40.5	5.7	5.8	13.6	4.9	2.2	9.8	10.5
1989	39.9	5.9	4.9	15.0	5.6	2.6	8.5	10.6
1990	34.0	6.6	4.2	17.0	5.2	2.1	10.0	13.0
1991	36.2	5.2	4.1	17.4	5.3	1.6	9.7	13.0
1992	36.0	4.8	3.6	18.6	5.7	1.7	9.5	13.1
1993	34.4	5.0	3.0	19.0	3.9	1.8	10.1	15.2

Source : NESDB, TDRI.

The above table shows the evolution of the crops sub-sector. It is clear that traditional crops such as rice, cassava, and maize have gradually lost shares to other crops such as rubber, sugar cane, tree crops, and flowers. Rubber production has shown rapid and steady growth since 1980. Sugar cane showed a strong gain between 1980 and 1986, but its growth slowed between 1986 and 1993. Tree crops and flowers showed only slow growth during the 1980-86 period, but increased at a more rapid pace between 1986 and 1993. Growth in vegetable production was rather stagnant between 1980 and 1986, but showed some gain after 1986.

Livestock Subsectoral Share, 1980-93

Unit : %

Year	Cattle	Swine	Poultry	Eggs	Dairy	Other
1980	35.2	33.8	14.4	14.7	0.4	1.5
1981	34.8	34.2	13.6	15.3	0.4	1.7
1982	35.6	33.6	15.6	12.8	0.5	1.9
1983	38.5	32.4	14.3	12.2	0.6	2.0
1984	38.7	30.3	16.0	12.1	0.8	2.1
1985	37.7	30.0	18.7	11.6	0.9	2.2
1986	38.2	28.7	18.7	11.4	0.9	2.1
1987	41.2	25.0	17.9	12.4	1.1	2.4
1988	41.7	24.0	17.6	12.7	1.3	2.6
1989	41.8	23.8	18.1	11.7	1.5	3.2
1990	40.7	24.4	17.9	11.9	1.5	3.5
1991	38.3	22.0	20.9	13.4	1.7	3.8
1992	36.0	21.3	23.1	14.3	1.5	3.9
1993	36.1	23.1	20.9	14.0	1.8	4.2

Source : NESDB, TDRI.

The above table presents the evolution of the livestock subsector in Thailand. During the 1980-93 period, this subsector as a whole increased by about 5 per cent per year. While cattle and swine production remain important, the growth of this subsector has been relatively slow. Dairy production has particularly shown a robust performance, followed by poultry, duck, and egg production.

The structural changes of the agricultural sector in Thailand reflect the dynamism of national economic development as well as the evolution of the comparative advantage of Thai agriculture. These changes have taken place for the following reasons: (i) the limited scope for expansion of agricultural land; (ii) low agricultural prices; (iii) an increase in the cost of inputs; (iv) shortages of water for irrigation, and (v) an increase in per capita income due to strong national economic performance.

1.1.2 Contribution of Agriculture to the Economy

A detailed discussion of the macroeconomy and the contribution of each sector to the national economy are presented and discussed in Volume 3 of the Master Plan Study. Only the main findings and characteristics relative to agriculture are extracted and presented here to make this agricultural sector report more comprehensive.

The contribution of agriculture to the national economy is summarized in the table below. The table allows a comparison of the contribution of various sectors in different regions. In the Study Area, the contribution of agriculture reached 19.3 per cent in 1994, about 9 points higher than the national average. The WSB is comparable to the Northeastern region in terms of its agricultural contribution to the economy, but its industrial sector is more developed.

Sectoral Origin of GDP in 1994
(per cent)

	N. Eastern	Southern	Western	WSB	Thailand
Agricuture	19.0	36.0	17.0	19.3	10.2
Industry	22.5	15.2	37.0	34.8	39.3
(Manufacturing)	10.2	5.1	24.8	23.3	28.2
Services	58.5	48.8	46.0	45.9	50.5
Total	100	100	100	100	100

Source : NESDB

The sectoral origin of GDP by province in the WSB in shown in the table below. It is evident from the table that Chumphon is heavily dependent on agriculture (41.1 per cent), while on the other hand Ratchaburi depends predominantly on the industrial sector (50.3 per cent).

Sectoral Origin of GDP by Province in 1994
(per cent)

	Kanchanaburi	S. Songkhram	Ratchaburi	Petchaburi	P.K.Khan	Chumphon
Agricuture	17.8	16.2	12.5	13.2	23.4	41.1
Industry	30.0	22.1	50.3	30.3	36.1	15.9
(Manufacturing)	16.3	13.5	41.9	12.7	23.2	7.8
Services	52.2	61.7	37.2	56.5	40.5	43.0
Total	100	100	100	100	100	100

Source : NESDB

1.1.3 Recent Trends and Constraints

Thai agriculture is facing new challenges at the moment. Continuing economic growth will increase not only the per capita income but also the cost of production such as land, labor, and water. There is increasing pressure on land, particular in the area around Bangkok and major cities, for use in the industry and services sectors. Agricultural land is being taken away from farming as farmers receive attractive prices for their land as compared with the relatively low return from farming. This situation is being exacerbated by the migration of young farmers to the urban area, which in turn is creating a labor shortage in rural areas. In a free economic system, this trend is difficult to reverse as "money making" is part of everyone's motivation. However, it is deemed necessary to protect forest areas, environmentally sensitive areas, and irrigated areas where the Government has invested substantially in the construction of infrastructure.

Land prices have been increasing at an extremely rapid rate. Land along the coastline in the WSB's prime tourist area is reported to cost around 4 million Baht per rai (about US$1 million per hectare), while the cost of average farming land about 200 km from Bangkok varies between 100,000 to 200,000 Baht per rai (US$25,000 to 50,000 per hectare). The same farmland would have cost about 20,000 to 30,000 Baht per rai five years ago.

Increasing labor cost is another factor eroding the comparative advantage of the Thai economy, particularly in the labor-intensive sectors such as agriculture, agro-processing, and light industry. It is reported that there are a large number of legal and illegal workers from neighboring countries working in construction, fisheries, and farming. The Government is in the process of formulating a policy on labor from neighboring countries. In 1995, the minimum wage was set by law at 145 Baht for Bangkok, 126 Baht for a number of cities (Ranong, Phangnga, Chonburi, Saraburi, Nakhon Rachasima, and Chiang Mai), and 118 Baht for other provinces. In reality, a wage of about 180 Baht (about US$7.20) per person-day is being paid to unskilled labor in Kanchanaburi and Ratchaburi. From a pure financial point of view, the flow of illegal labor from neighboring countries into Thailand is foreseeable. Wages received in Myanmar for example, just on the opposite side of the WSB, are estimated at about 50 to 100 kyats (about US$0.40 to 0.80) per day.

Although the economic cost of water is also rising, farmers are not at the moment charged for water distributed for farming use. There is an ongoing debate among Government officials and academics in Thailand as to whether or not to charge for the

use of water for farming use. Under the present and near-term political environment, it is difficult to foresee this happening. While "not-charging" farmers is understandable from a social equity point of view, this mechanism will not encourage farmers to improve the efficiency of their water use. As the water is free, farmers cannot be expected to make efforts to minimize water use, e.g., by diversifying their cropping system to reflect real economic costs. In addition, whether or not giving subsidies to farmers in the form of free water will be deemed acceptable under international trade agreements is yet to be seen.

The experience in other developed countries clearly indicates that an increase in per capita income as well as living standards also implies changes in food consumption patterns. Generally, consumption of grains such as rice would be reduced, while consumption of vegetables, fruit, meat, and various dairy products will increase. In addition to changes in food consumption patterns, consumers will also require better quality of food; as they become more conscious of their health, healthy foods and chemical-free agricultural products will gain popularity. This phenomenon generally starts with urban dwellers and then gradually spreads to other parts of the country. The Bangkok Metropolitan Area (BMA), with a population of about 10 million, is playing and will continue to play an important role in shaping consumption patterns in Thailand.

One of the main concerns of the Thai Government in formulating development policy is the large and increasing income gap between urban and rural areas, which is due mainly to the difference between the income-generating capacities of the agricultural sector and that of other sectors. It is imperative that development measures be designed to include components that will mitigate and harmonize this disparity.

Analysis of rural income indicates that non-agricultural income has become increasingly important to farmers' incomes, amounting to more than 50 per cent of the total income in some areas. It is probable that this non-agricultural income will continue to increase and dominate farmers' income. In order to increase the supplementary income of farmers, the linkage between the agricultural sector and the industrial as well as services sectors should be encouraged and promoted.

1.1.4 Government's Agricultural Policy

The Government of Thailand has recognized the need for diversification, particularly away from rice, for a number of years. Under the **Sixth National Five Year Plan (1987-91)**, the Government set out what it saw as its role with respect to agricultural

diversification; this was to carry out research and development, stratify production zones and identify suitable zones for diversified crops, improve communications within these zones, and ensure adequate provision of inputs and credits.

Under, the **Seventh National Five Year Plan (1992-1996)**, a number of specific objectives for the agricultural sector has been defined, including:

- achieving a reasonable growth rate for agriculture of not less than 3.4 per cent per annum;
- raising the level of farm income and supporting a fair distribution of income;
- preserving and protecting natural resources in agriculture; and
- improving the quality of life of farmers through education, nutrition, and health.

In the **8th National Five Year Plan (1997-2001)**, the main focuses in connection with the agricultural sector are: (i) development of human resources; (ii) improvement of the quality of life through the strengthening of regional and rural area development potentials; and (iii) preservation of natural resources and environment. More specifically, the agricultural policy for the Eighth Plan has been set forth in four main broad items:

(i) Production Policy

- placing the importance on the agricultural restructuring program by upgrading the agricultural structure towards the production of high-value crops and activities such as fruit trees, cut flowers, livestock, and coastal fisheries
- adjusting agricultural activities based on natural resources
- improving quality and efficiency
- promoting public-private sector coordination in research and development

(ii) Trade Policy

- strengthening public-private sectors coordination in international trade
- placing more emphasis on the study of overseas demand

(iii) Natural Resources and Environment

- strengthening natural resource conservation and sustainable agricultural development
- mobilizing the private sector and local communities in preserving the environment

(iv) Human Resource and Technology Transfer

- strengthening farmers' capacity in response to rapid changes under the globalization of the economy
- improving the Management Information Systems (MIS) and Geographic Information Systems (GIS)

1.1.5 Major Agricultural Projects and Programs

Agriculture has been one of the main sectors in Thailand, and numerous projects and programs have been implemented. Major agricultural programs promoted by the Government that are likely to have an impact on the agricultural development of the WSB have been selected as follows:

Agricultural Rehabilitation Program

Objectives

To reform the agricultural sector, the Ministry of Agriculture and Co-operatives (MOAC) formulated an Agricultural Rehabilitation Program that aims at: (i) increasing farmers' income; and (ii) assisting farmers in upgrading their farming systems. These objectives were to be achieved by: (i) providing technical assistance and information on production planning; and (ii) providing credit, inputs, and technology.

Period, Area

- 1992 - 1996
- It covered 44 provinces, 128 districts, and 9,400 villages.

Impact

Over the project period, about 205,000 farmers participated in the program, and about 6 billion Baht was disbursed as credits to farmers. An initial assessment of the program indicates that the impact has been positive particularly for small and poor farmers as their agricultural incomes increased from about 8,500 Baht to about 15,000 Baht per annum. In addition, farmers adopted new farming systems by decreasing rice area and increasing the area used for cattle raising, and fruit and integrated farming.

Agricultural Restructuring Program

Objectives

The aim of the Agricultural Restructuring Program has been: (i) to induce farmers to grow less rice, cassava, coffee, and pepper in unsuitable areas; (ii) to encourage farmers to cultivate other crops better suited to local soils and presenting few problems in marketing; and (iii) to increase farmers' income.

Period, Area and Budget

- The program was launched in 1994 and is scheduled to last until 1997.
- It covers the whole Kingdom of Thailand.
- A budget of 10 billion Baht to support credit and farm inputs has been provided.

Strategy

The program emphasizes the following concepts and principles:

- Farmers are free to make their decisions regarding participation in the programs
- Farmers are guided to produce high-value crops adaptable to the local area
- Farming institutions are promoted and strengthened
- Coordination among agencies and NGOs is promoted
- Incentives are given to farmers in terms of subsidized credit and inputs

Evaluation

To date, there has been no formal evaluation of the impact of the program. The Government is in the process of reviewing the program and modifying some aspects in order to improve its performance. However, it is very likely that the Government will extend this program beyond 1997, its initial expiry date, to continue to support the agricultural restructuring process. The main intervention by the Government in the program is the provision of technical support and the supply of credit at low rates of interest.

1.2 Agriculture in the Western Seaboard (WSB)

1.2.1 Physical Conditions, Population, and Agricultural Institutions

The topography of the WSB region is diversified and composed of a mountain range in the west, and plains, river basins, and a coastal area in the east. The Thanow Thongchai mountain range stretches from Chiang Mai in the north, passes through Tak province to Kanchanaburi, and then joins the Ta Nao Sri range, which separates Thailand and Myanmar. There are many important rivers and streams originating from the Ta Nao Sri mountain range, such as the Khwae Noi and Khwae Yai. These two rivers meet in Kanchanaburi, where they form the Mae Khlong River in Kanchanaburi.

The central area of the WSB consists mainly of plateau, plains, and undulated land. The many small streams found in this area keep the land nourished, rendering it suitable for agriculture, particularly for highland crops such as sugar cane, pineapple, cassava, and fruit trees. The Tha Chin Basin, which is part of the Chao Phraya Delta, and the Mae Khlong Basin, which is located in Kanchanaburi, Ratchaburi, and Samut Songkhram provinces is an important feature of the Upper WSB and environs. The coastal part of the WSB starts at Samut Songkhram and continues southward to Petchaburi, Prachuap Khirikan, and Chumphon.

Soils in the WSB region are mainly composed of Alfisols, Entisols, Inceptisols, and Ultisols (see Figure 6.1.1). Alfisols, found in a relatively small area in the Mae Khlong river basin, have low to moderate organic matter. Entisols, with fine texture, poor drainage capacity, and fair fertility, are found in the coastal areas. Inceptisols, found in the Lower Mae Khlong river basin and flat coastal areas, are mainly utilized for rice cultivation at present. Ultisols, the most dominant soil type in the WSB, are low in organic matter and sometimes acidic; their natural fertility is generally low. Generally,

the soils in the WSB region are not particularly fertile, except for some areas in the lower Mae Khlong river basin. Careful management is required for supply of organic matter, water application and logging, and erosion control in agricultural development.

Annual rainfall in the WSB differs from area to area depending on its location in relation to the Ta Nao Sri mountain range. The northwestern area of Ratchaburi and the western area of Petchaburi and Prachuap Khirikhan have a relatively low average annual rainfall of less than 1,000 mm due to the high mountain range shielding them from the southwest monsoon from the west coast. The northwestern area of Kanchanaburi has a high average annual rainfall of 1,600-2,400 mm. The western part of every province has an average annual rainfall of 1,000-1,200 mm. Chumphon province is extremely humid most of the year and has an annual rainfall of 1,800 mm. On average, the WSB has 94 rainy days per year. Temperature in the WSB varies from season to season: 34-37 degrees Celsius in summer, 27-34 degrees Celsius in the rainy season, and 18-24 degrees Celsius in winter.

The evolution of land use in the WSB, by province, is shown in the table overleaf. The total land area of the WSB is estimated at about 4.37 million ha (or 27.3 million rai), representing about 9 per cent of the total land in Thailand (51.31 million ha). In 1992, of the total land in the WSB, 38 per cent was forest land, 26 per cent farmland, and the remaining 36 per cent unclassified. The WSB farmland total of 1.12 million ha (or 7.03 million rai), represents about 5 per cent of the total farmland in Thailand (21.13 million ha).

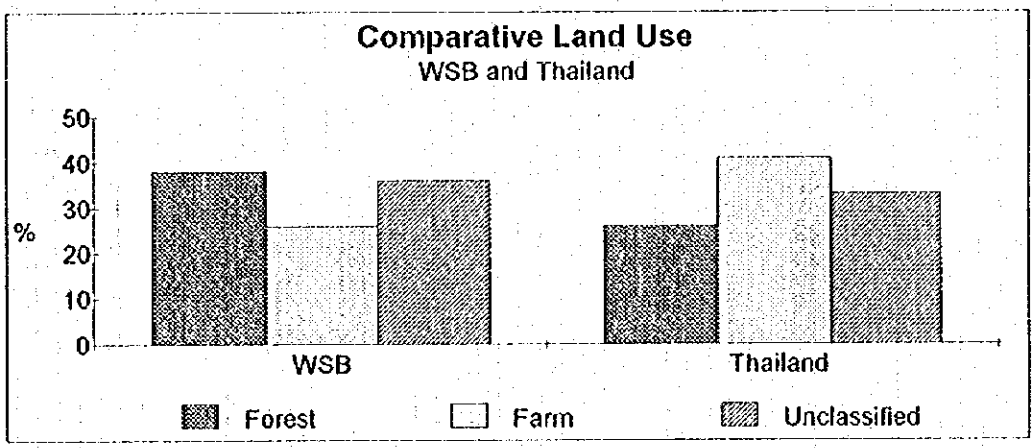
Comparison of land use in 1984 and 1992 in the WSB shows that the forest land has been reduced from about 41 per cent to 38 per cent, while farmland has increased from 22 per cent to 26 per cent. The area under "unclassified" remains constant. Although the forest area has been reduced since 1984, the forest cover in the WSB in 1992 (38 per cent) is still larger than the average for the whole of Thailand (26 per cent).

Evolution of Land Use in WSB

Unit : 000 rai

Province	1984				1992			
	Forest	Farmland	Unclassified	Total	Forest	Farmland	Unclassified	Total
Kanchanaburi	7,400	1,735	3,042	12,177	6,739	2,047	3,391	12,177
S.Songkhram	16	85	159	260	0	110	150	260
Ratchaburi	629	1,402	1,217	3,248	829	1,297	1,122	3,248
Phetchaburi	1,466	925	1,500	3,891	1,375	686	1,828	3,890
P. Khirikhan	879	957	2,144	3,980	810	1,314	1,856	3,980
Chumphon	925	1,022	1,809	3,756	718	1,575	1,463	3,756
Total WSB	11,315	6,126	9,871	27,312	10,472	7,029	9,810	27,311
(in 000 ha) 1/	1,810	980	1,579	4,370	1,676	1,125	1,570	4,370
(% of Total)	41	22	36	100	38	26	36	100
Total Thailand					84,344	132,051	104,302	320,697
(in 000 ha)					13,495	21,128	16,688	51,312
					26	41	33	100
WSB versus Thailand (%)					12	5	9	9

Source: Agricultural Statistics of Thailand, Crop Year 1994/95.
1/ one rai = 0.16 ha.



Evolution of land use by province in the WSB is shown in the table on the next page. Kanchanaburi province is by far the largest province in the WSB with a total area of about of 1.9 million ha (12.17 million rai), while Samut Songkhram is the smallest with an area of only about 42,000 ha (0.26 million rai). The total area in the remaining four provinces is quite similar, varying from about 0.51 to 0.64 million ha each.

Although the forest area has been reduced substantially from 61 per cent of the total area in 1984 to 55 per cent in 1992, Kanchanaburi still has the largest forest cover in WSB. The extreme case is Samut Songkhram where the forest cover is nil. While forest cover has seen a decrease since 1984, only Ratchaburi has been successful in expanding its forest cover from 19 per cent to 26 per cent of the total area.

Evolution of Land Use in WSB by Province, 1984-1992

Province	1984				1992			
	Forest	Farmland	Unclassified	Total	Forest	Farmland	Unclassified	Total
I. Area (000 rai)								
Kanchanaburi	7,400	1,735	3,042	12,177	6,739	2,047	3,391	12,177
S.Songkhram	16	85	159	260	0	110	150	260
Ratchaburi	629	1,402	1,217	3,248	829	1,297	1,122	3,248
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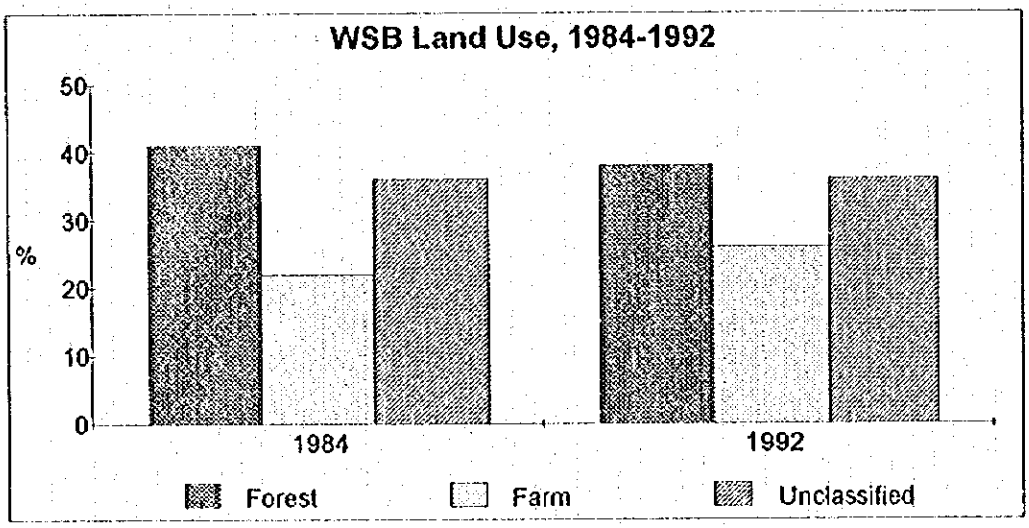
Total WSB	11,315	6,126	9,871	27,312	10,472	7,029	9,810	27,311
(in 000 ha) 1/	1,810	980	1,579	4,370	1,676	1,125	1,570	4,370
II. In Percentage (%)								
Kanchanaburi	61	14	25	100	55	17	28	100
S.Songkhram	6	33	61	100	0	42	58	100
Ratchaburi	19	43	37	100	26	40	35	100
Petchaburi	38	24	39	100	35	18	47	100
P. Khirikhan	22	24	54	100	20	33	47	100
Chumphon	25	27	48	100	19	42	39	100
Total WSB	41	22	36	100	38	26	36	100

Source: Agricultural Statistics of Thailand, Crop Year 1994/95.
1/ one rai = 0.16 ha.



The total population of the WSB was estimated at 2,896,000 in 1994. Ratchaburi is the most populous province with 767,000 people, while Samut Songkhram is the least populous with only 199,000 people. However, Samut Songkhram has the highest population density with 477 people per square km followed by Ratchaburi with a density of 148 people per square km. Other provinces are less populated, with a density around 65 to 70 people per square km.

Employment in different sectors is shown in the table below. Agriculture is still the main source of employment and absorbed more than 50 per cent of the total labor force in 1994. As in the case of its contribution to the national economy, employment in the

agricultural sector has also shown a declining trend: 65 per cent in 1980, 63 per cent in 1990, and 51 per cent in 1994. While this declining trend was rather slow in 1980-1990, there has been a sharp decline since 1990 as about 183,000 jobs were eliminated from agriculture in four years. However, one should be cautious with the definition of "agricultural employment". A person could be defined as a farmer even if he or she also works part time in other sectors. It is very difficult to know exactly the percentage of total agricultural employment that depends "purely" on the agricultural sector. The evidence is that more than 50 per cent of total farm income derives from the non-agricultural sources in many areas.

Employment by Sectors in the WSB
(per cent)

	1980	1990	1994
I. Employment (persons)			
Agriculture	764,770	1,002,937	819,884
Industry	122,052	198,217	356,232
Services	289,008	378,725	433,109
Total	1,175,830	1,579,879	1,609,225
II. Per cent			
Agriculture	65%	63%	51%
Industry	10%	13%	22%
Services	25%	24%	27%
Total	100%	100%	100%

Source: NSO Census 1980, 1990 and 1994.
Labor Force Survey.

In Thailand, there are mainly three administrative levels to support and supervise the agricultural sector: central, regional, and provincial. Five provinces in the WSB (Kanchanaburi, Samut Songkhram, Ratchaburi, Petchaburi, Prachuap Khirikhan), belong to the Western Region, while only Chumphon province belongs to the Southern Region. Each region has a Regional Office to deal with agricultural issues in the region and to support Provincial Agricultural Offices in each province. In addition to Regional and Provincial Agricultural Offices, the following agricultural institutions are operating in the WSB:

Kanchanaburi
- Horticulture Station,

Samut Songkhram
- Coastal Aquaculture Development Center,

Ratchaburi
- Rice Research Station,
- Animal Breeding and Improvement Station,
- Land and Soil Development Center,
- Inland Fisheries Station,
- Field Crops Breeding Center,

Petchaburi
- Horticulture Research Center,
- Plant and Feed Experimental Center,
- Inland Fisheries Station,
- Brackish Fisheries Station,
- Land and Soil Development Station,
- Farming System Center,

Prachuap Khirikhan
- Tissue Culture Center,
- Aquaculture Development Center,

Chumphon
- Horticulture Center,
- Rubber Tree Center,
- Mulberry Research Center,
- Land and Soil Development Center, and
- Marine Fisheries Development Center,

1.2.2 Overview of Agriculture in the WSB

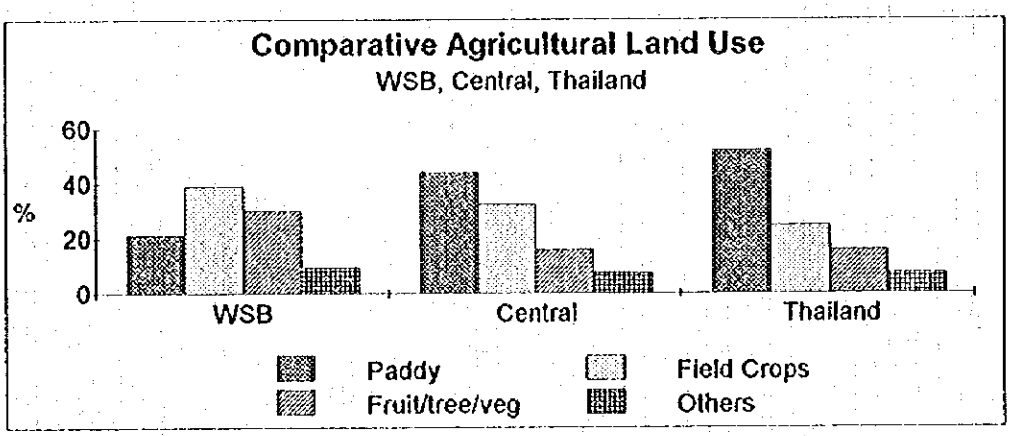
Agriculture in the WSB is, by comparison with the overall agriculture sector in Thailand, well diversified; it has transformed itself over the past few decades from a production system based primarily on traditional crops such as rice towards the production of higher value crops and agricultural activities such as livestock.

Comparison of Farm Holding Land Use in Thailand in 1992

Unit : %

Purpose	Farm Holding Land								
	k.buri	SS.Khram	R.buri	P.buri	P.K.Khan	C.phon	WSB	Central	Thailand
Housing Area	2.9	4.2	4.1	4.7	3.1	2.6	3.3	2.8	2.6
Paddy	20.0	7.9	38.7	49.5	6.3	9.9	21.3	44.1	52.1
Field Crops	68.2	0.0	44.2	29.1	42.1	1.9	39.1	32.6	24.8
Fruit trees	4.6	84.2	7.3	14.1	40.0	77.4	30.2	15.9	15.8
Vegetable	2.2	1.1	3.7	0.7	2.0	1.4	2.1	1.1	0.7
Grass land	0.2	0.0	0.0	0.9	0.9	0.0	0.3	0.5	0.6
Idle land	1.6	1.4	0.1	0.8	4.5	6.3	2.8	1.4	2.5
Others	0.3	1.3	1.8	0.3	1.1	0.5	0.8	1.5	0.9
Total	100	100	100	100	100	100	100	100	100

Source : Office of Agricultural Economics.



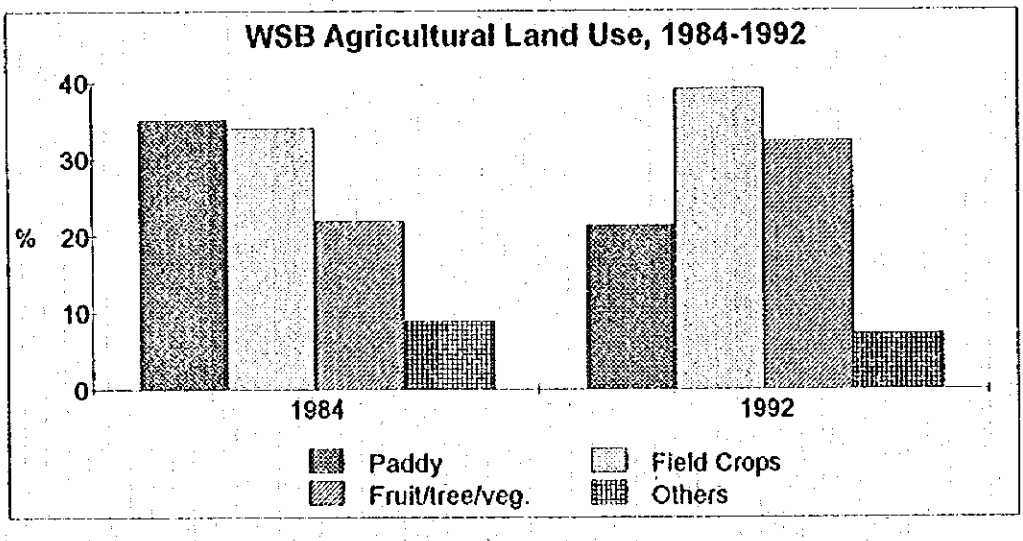
The above table and graph show a comparison of agricultural land use in the WSB, the Central region and the whole of Thailand. Rice (paddy) has been grown in Thailand for centuries, and there have been great efforts by the Government as well as farmers to diversify from rice to other crops. In 1992, the area used to produce rice represented 52 per cent and 44 per cent in the whole of Thailand and in the Central region, respectively. However, the WSB is even more advanced in its effort to diversify its agricultural structure as the area used to produce rice represented only 21 per cent of total agricultural land in the region. As a result, the proportion of land used for field crops and fruit trees is larger in the WSB as compared with the Central region and with the country as a whole. The proportion of area used for vegetable production is also high.

Farm Holding Land Use in the WSB

Unit : 000 rai

Purpose	Farm Holding Land							
	(% 1984)	1984	1985	1986	1988	1991	1992	(% 1992)
Housing Area	2.9	175	190	201	243	230	233	3.3
Paddy	35.1	2,152	2,102	2,136	1,813	1,484	1499	21.3
Field Crops	34.1	2,087	2,237	2,360	3,022	2,814	2751	39.1
Fruit and trees	21.0	1,284	1,383	1,418	2,044	2,107	2125	30.2
Vegetable/Flower	1.0	60	70	70	100	161	147	2.1
Livestock	1.0	60	63	64	994	49	22	0.3
Idle land	3.2	196	191	250	571	305	199	2.8
Others	1.8	112	110	134	115	100	55	0.8
Total (in 000 rai)	100.0	6,126	6,346	6,633	8,902	7,250	7,031	100.0
- In 000 ha		980	1,015	1,061	1,424	1,160	1,125	

Source : Office of Agricultural Economics.



A comparison of agricultural land use in the WSB between 1984 and 1992 clearly indicates that the proportion of area under rice/paddy has been reduced substantially, from 35 per cent to 21 per cent; at the same time the area planted with field crops and fruit trees has increased from 34 per cent and 21 per cent to 39 per cent and 30 per cent, respectively. This change clearly indicates the dynamism of farmers in their endeavors to transform their farming practices towards the production of high-value crops. Rice has been the major loser, while field crops and particularly fruit trees have been the winners. Vegetable and flower production have also shown a slow but steady gain, from 1 per cent to more than 2 per cent of total agricultural area.

The WSB region produces a wide variety of crops and agricultural produce. From the north to the south, various crops have been selected and planted according to the agro-climatic conditions of each area. The following are the main crops observed: sugar cane,

rice, cassava, maize, various vegetables, pineapple, coconut, oil palm, rubber, coffee, and various fruit trees. In addition to the development of various crops, tremendous efforts have been placed on promoting meat cattle, dairy cattle, and agro-industries.

1.2.3 Overview of Agriculture by Province

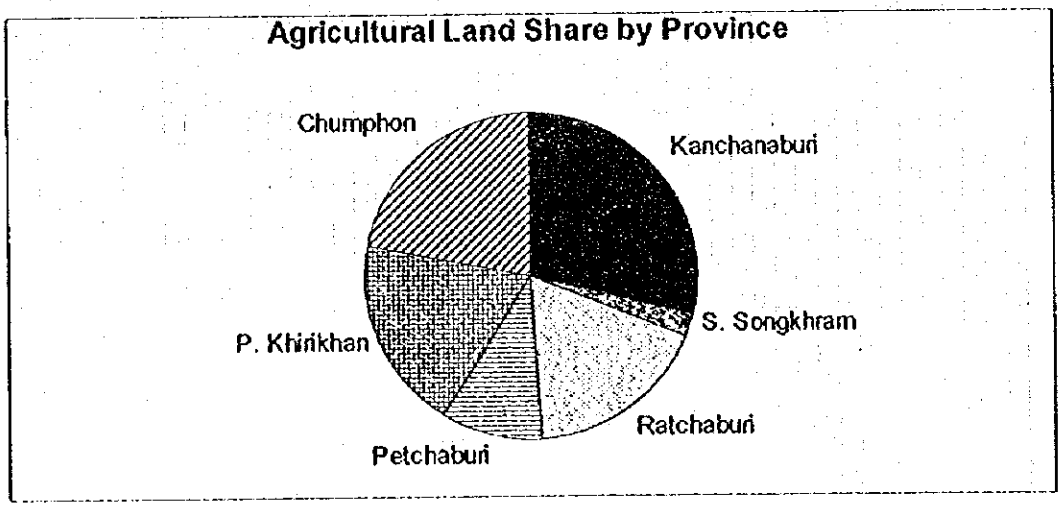
Agricultural land use by province is summarized in the table below. Total agricultural land in the WSB was estimated in 1992 at 1.12 million ha, representing 25 per cent of agricultural land in the Central region, or about 5 per cent of agricultural land in Thailand. Kanchanaburi has by far the largest agricultural area in the WSB with about 29 per cent of the total agricultural land, while Samut Songkhram has only 2 per cent of the total. Chumphon, Prachuap Khirikhan, Ratchaburi, and Petchaburi had respectively 22 per cent, 19 per cent, 18 per cent and 10 per cent of the total. Agricultural characteristics by WSB province are presented in Figures 6.1.2 to 6.1.4.

Agricultural Land Use in WSB by Province in 1992

Unit : 000 rai

Purpose	Farm Holding Land								
	K.buri	SS.Khram	R.buri	P.buri	P.K.Khan	C.phon	WSB - a/	Central - b/	Thailand - c/
Housing Area	60.4	4.6	53.2	32.2	41.1	41.0	232.5	994.0	3,462.0
Paddy	410.1	8.7	502.1	339.9	82.3	155.4	1,498.5	12,360.0	68,836.0
Field Crops	1,395.4	0.0	573.3	199.5	552.6	30.6	2,751.4	9,133.0	32,795.0
Fruit trees	95.1	92.8	94.7	96.6	525.9	1,219.4	2,124.5	4,449.0	20,849.0
Vegetable	44.7	1.2	48.5	4.6	26.1	21.7	146.8	319.0	882.0
Grass land	3.8	0.0	0.0	6.1	11.9	0.0	21.8	150.0	750.0
Idle land	32.6	1.5	1.6	5.5	58.9	98.6	198.7	383.0	3,320.0
Others	5.4	1.4	23.9	1.9	14.8	8.0	55.4	423.0	1,159.0
Total	2,047.5	110.2	1,297.3	686.3	1,313.6	1,574.7	7,029.6	28,211.0	132,053.0
*(in 000 ha)	327.6	17.6	207.6	109.8	210.2	252.0	1,124.7	4,513.8	21,128.5
(as % of a)	29	2	18	10	19	22	100		
(a/b - %)							25		
(a/c - %)							5		
(b/c - %)								21	

Source: Office of Agricultural Economics.



The evolution of agricultural land used by province in Kanchanaburi, Samut Songkhram, Ratchaburi, and Petchaburi is presented in Tables 6.1.1 to 6.1.4. With the exception of Samut Songkhram, which is predominantly covered by fruit and tree crops (coconut), agricultural land use in provinces in the northern part of the WSB is characterized by a relatively high share of rice and field crop production. In general, the share of rice cultivation area has decreased while field and tree crop production has increased.

Kanchanaburi (Table 6.1.1): Agricultural land in Kanchanaburi is estimated at about 328,000 ha, the largest in the WSB. In 1992, 68 per cent of agriculture land was used for field crops (predominantly sugar cane), 20 per cent for paddy, 4.6 per cent for fruit, and 2.2 per cent for vegetables and flowers. Compared with that of 1984, the area for rice production decreased, while that of field crops, fruit trees, and vegetables and flowers increased. The main characteristic of agriculture in Kanchanaburi is its high proportion of land used for field crops, mainly sugar cane. As irrigation is relatively well developed in this province, rice production is also important.

Ratchaburi (Table 6.1.2): With an agricultural area of about 208,000 ha, this province occupies about 18 per cent of the total agricultural land area in the WSB. In 1992, rice area in the province was high at 39 per cent of the total agricultural area. However, this area has been substantially reduced from 61 per cent in 1984. Field crops are another important type of crop in the province occupying 44 per cent of the total area. The area under rice and field crops is more than 80 per cent of the total agricultural land in the province. The area under fruit and tree crops, and vegetables and flowers has been expanded respectively to 7 per cent and 4 per cent in 1992. The main agricultural feature of this province is its higher share of land used for rice and field crops.

Samut Songkhram (Table 6.1.3): Agricultural land in Samut Songkhram is estimated at only about 18,000 ha, the smallest of any province in the WSB. Of the total area in 1992, 84 per cent was occupied by fruit and tree crops (largely coconut), and about 8 per cent by paddy. The field crop area had been reduced to nil in 1992 to the benefit of fruit and tree crops. The main characteristic of this province is its high proportion of land used for fruit and tree crops. The forest cover in this province is also nil.

Petchaburi (Table 6.1.4): Agriculture in Phetchaburi is characterized by a high share of the area under rice cultivation, about 50 per cent in 1992. This share was reduced from 59 per cent in 1984. Although field crops have expanded their share since 1984, it reached only 29 per cent in 1992. Fruit and tree crops have become increasingly

important, with their area reaching 14 per cent in 1992. Petchaburi province has an agricultural area of about 110,000 ha, or 10 per cent of the agricultural land in the WSB.

The evolution and main features of agricultural land used by province in Prachuap Khirikhan and Chumphon are shown in Tables 6.1.5 and 6.1.6. The main agricultural characteristic of these two provinces is its high share of land used for fruit and tree crops, while the production of rice is marginal.

Prachuap Khirikhan (Table 6.1.5): With a total agricultural land area of 210,000 ha, this province is predominantly occupied by field and perennial crops. In 1992, field crops accounted for about 42 per cent and fruit and tree crops accounted for 40 per cent of the total agricultural area. At the same time, Prachuap Khirikhan is a major pineapple area (defined as a field crop) producing about 70 per cent of the total WSB pineapple production or about 40 per cent of Thailand's production. Thus, the greatest share of land under field crops is being used for pineapple (about 54 per cent of total field crops). It is also worth noting that land used for pineapple has been stabilized at about 300,000 rai in Prachuap Khirikhan. The area under rice production is small at only about 6 per cent of the total agricultural area.

Chumphon (Table 6.1.6): The most striking feature of agriculture in Chumphon is its high share, about 77 per cent, used for fruit and tree crops. This share has been gradually increased since 1984, when it was about 65 per cent. Coffee production in Chumphon alone represents about 64 per cent of total coffee production in Thailand. Apart from coffee production, this province is a major center for the production of palm oil, coconut, rubber, and various kinds of tropical fruit trees. The area under paddy was small at less that 10 per cent of the total area in 1992, with this area reduced substantially from about 18 per cent in 1984. Chumphon is the second largest agricultural province in the WSB, after Kanchanaburi, with about 252,000 ha or 22 per cent of the agricultural land in the WSB.

1.2.4 Crop Production

(1) General Situation

The evolution of land use and the production of major crops in the WSB is shown in the table overleaf. Rice and sugar cane are by far the most important crops in the WSB. These two major crops are followed by pineapple, cassava, maize, coffee, and oil palm. The total agricultural land in the WSB is estimated at 7.03 million rai (1.12 million ha) in

1992, with the difference of about 2.5 million rai accounted for mainly by various fruit trees and tree crops that are not included in the table. Systematic statistics on the area of various fruit trees and production are particularly scarce, which hampers detailed analysis of the fruit sub-sector.

Evolution of Major Crops in WSB

Crops	1992	1993	1994	1995	Average
I. Area (000 rai)					
Major rice	1,224.6	1,298.3	1,375.2	1,334.7	1,308.2
Second rice	402.2	325.6	337.0	434.0	374.7
Sugar cane	1,561.7	1,502.1	1,201.5	1,242.4	1,376.9
Pineapple	339.8	386.1	443.6	440.0	402.4
Maiz	450.6	405.2	431.9	368.1	414.0
Cassava	405.4	407.2	401.3	370.8	396.2
Oil palm	196.3	195.4	243.6		211.8
Coffee	276.9	272.4	276.8	270.0	274.0
Total (000 rai)	4,857.5	4,792.3	4,710.9	4,460.0	4,758.1
Total (000 ha)	777.2	766.8	753.7	713.6	761.3
II. Production (000 tons)					
Major rice	421.9	454.1	533.3	476.6	471.5
Second rice	224.6	187.6	200.6	254.8	216.9
Sugar cane	11,602.0	9,690.9	8,719.8	10,039.8	10,063.1
Pineapple	1,135.6	1,307.4	1,606.6	1,446.9	1,374.1
Maiz	136.7	127.3	133.0	125.2	130.6
Cassava	961.9	1,029.2	935.0	881.9	952.0
Oil palm	192.3	247.9	317.4		252.5
Coffee	47.3	42.7	46.0	48.6	46.2

Source : Agricultural Statistics of Thailand, Crop Year 1994/95.
1/ one rai = 0.16 ha.

(2) Production by Crop

Major Rice: The evolution of the area and production of major rice (rainy season rice) by province in the WSB is presented in Table 6.1.7. Average major rice production in the WSB at 472,000 tons per annum represents only about 3 per cent of the total major rice production of Thailand. Ratchaburi, Kanchanaburi, and Petchaburi are the main producers. Over the 1992-1995 period, the major rice area has been increased by about 9 per cent. Average rice yield in the WSB is estimated at 2.36 tons/ha, which is higher than the national average of 2.11 tons/ha.

Second Rice: Second rice (dry season rice) is largely grown in Ratchaburi and Kanchanaburi provinces (Table 6.1.8). The production of second rice in the WSB averaged 217,000 tons per annum, which represents about 8 per cent of Thailand's second rice production. These statistics implies that the ratio of land use for second rice

over major rice in the WSB is higher than that of the national average due mainly to the development of irrigation schemes in the WSB. Over the 1992-1995 period, second rice area was increased by about 8 per cent. However, the average yield in the WSB is estimated at 3.73 tons/ha, about 10 per cent lower than the national average of 4.14 tons/ha.

Sugar Cane: Sugar cane is almost exclusively produced in Kanchanaburi with 63 per cent of the total WSB sugar cane area and Ratchaburi with 27 per cent (Table 6.1.9). Sugar cane production in the WSB represented about 20 per cent of the national production in 1995. Area under sugar cane decreased sharply by about 20 per cent between 1992 and 1995. Area reduction was even more acute in Kanchanaburi, with the area reduced by about 23 per cent over the same period. As a result of this decline, the share of WSB sugar cane in national production was reduced from 25 per cent in 1992 to only 20 per cent in 1995. Yield is quite low by any standard at only about 47 tons/ha (7.53 tons/rai), and this figure is lower than the national average of 48 tons/ha (7.72 tons/rai). The fluctuation of yield was quite substantial between 1992 and 1995, with a variation of 25 per cent.

Pineapple: The WSB is the main producer of pineapple in Thailand (Table 6.1.10). It represents 70 per cent in terms of national area and 60 per cent in terms of national production. Pineapple production is concentrated predominantly in Prachuap Khirikhan province, which produces about 70 per cent of the total pineapple in the WSB, or about 43 per cent of total pineapple production in Thailand. Although Prachuap Khirikhan is the main producing area in the WSB, the yield in the province is low compared to that of the WSB average, which in turn is lower than the national average.

Maize: Production of maize in the WSB (about 130,000 tons per annum) represents about 4 per cent of the total maize production in Thailand (Table 6.1.11). Kanchanaburi is the major maize producing province in the WSB with about 45 per cent of the total maize area; this province is followed by Chumphon (27 per cent of the total WSB area). There was a clear decreasing trend in maize production area between 1992 and 1995, when the area was reduced by about 20 per cent. Over time, yield in the WSB appears to be stable at about 2.18 tons/ha, but this yield is about 23 per cent lower than that of the national average at 2.84 tons/ha. Yields in Kanchanaburi and Chumphon are higher than the WSB average.

Cassava: The share of cassava production in the WSB, at 882,000 tons in 1995, is estimated at about 5 per cent of the total cassava production of Thailand (Table 6.1.12).

In the WSB, cassava is predominantly cultivated in two provinces: Kanchanaburi (53 per cent of total area) and Ratchaburi (40 per cent of total area). While planted area has been stable over the last few years, this area was sharply reduced by nearly 10 per cent in 1995. Average yield in the WSB estimated at about 15.3 tons per ha is higher than the national average of 14.0 tons per ha.

Oil Palm: With total production of 317,000 tons, the WSB produces about 17 per cent of the total national oil palm production (Table 6.1.13). In the WSB, only Prachuap Khirikhan and Chumphon are producing oil palm, and Chumphon alone produces more than 90 per cent of the total production of the WSB. Of the total planted area of 39,000 ha, only about 65 per cent can be harvested; this indicates that there is large area of new plantation. With an average yield of 11.9 tons per ha, the yield in the WSB is about 10 per cent lower than that of the national average of 13.2 tons.

Coffee: Coffee production in the WSB (48,600 tons in 1995) is quite important to the national coffee production as it accounts for about 57 per cent of the total (Table 6.1.14). As in the case of oil palm production, only two provinces in the WSB are producing coffee: Prachuap Khirikhan and Chumphon. Again, the production is concentrated in Chumphon province as it produces more than 98 per cent of total WSB production. The Government is encouraging a reduction in coffee in areas unsuitable for its production. However, statistics indicate no sign of reduction in coffee area in the WSB. Average yield in the WSB is estimated at 1.17 tons per ha, slightly higher than that of the national average.

Coconut: Coconut plantation in the WSB appears to be very significant in the region, particularly in the southern part. However, statistics by province and thus for the WSB is not available. Nationwide, coconut was planted on an area of 2.4 million rai and producing 1.47 million tons in 1994. This area had been reduced by about 8 per cent since 1985. National average yield is estimated at about 670 kg per rai.

Rubber: Similarly, rubber plantation is also significant for agriculture in the WSB (particularly in Chumphon Province); however, statistics are only available for the whole of Thailand. Nationally, rubber is planted on an area of 12 million rai (or 1.9 million ha) producing 1.8 million tons of rubber, making Thailand one of the most important producers in the world. The area planted with rubber has been continuously increased over the past decade, and the increase has been estimated at 15 per cent over the 1985-1994 period. Yield has averaged at 160 kg per rai (1 ton per ha).

Area of Field Crops in the Western Region in 1994/95

Crops	1994/95		Share
	'000 ha	'000 rai	
Sugar cane	319.6	1,997.6	60%
Pineapple	77.1	481.9	14%
Maize (for animal feed)	57.4	358.7	11%
Sweet corn (human consumption)	3.8	23.9	1%
Cassava	52.9	330.6	10%
Mung bean	3.7	23.3	1%
Sunflower	2.5	15.9	0%
Cotton	4.4	27.8	1%
Sorghum	1.6	9.7	0%
Soybean	2.3	14.2	0%
Others	9.8	61.5	2%
Total	535.2	3,345.1	100%

Source : Western Regional Agricultural Extension Office.

(3) Fruit and Vegetables

Statistics on fruit and vegetables are only available in a "lump-sum" form, and detailed statistics by product are scarce. Although general trends can be identified, such as an increase in "fruit and tree" area and in "fruit and flower" area in the WSB, it is not possible to undertake a detailed analysis by product. However, reliable statistical information can still provide a general idea of the magnitude and kind of fruit and vegetable production in the WSB. It is clear from the statistics that the "fruit and flower" area has been increased from 1.28 million rai in 1984 to 2.13 million rai in 1992; and the area under "vegetables and flowers" increased from 60,000 rai in 1984 to 147,000 rai in 1992.

The two tables overleaf show the areas under vegetables and fruit in the Western region. It should be treated with caution here as the Western region is by definition different from the WSB region. The Western region includes eight provinces: Kanchanaburi, Suphanburi, Ratchaburi, Nakhon Pathom, Samut Songkhram, Samut Sakhon, Petchaburi, and Prachuap Khirikhan. Suphanburi, Nakhon Pathom, and Samut Sakhon are not included in the WSB. Chumphon province is in the WSB but is not included in the Western Region.

Area of Vegetables in the Western Region in 1994/95

Crops	1994/95		Share
	'000 ha	'000 rai	
Baby corn	14.5	90.5	17%
Asparagus	14.1	88.1	17%
Chili	11.6	72.3	14%
Watermelon	9.4	58.5	11%
Various beans	5.5	34.4	6%
Cucumbers	3.6	22.2	4%
Kale	2.8	17.8	3%
Sweet potatoes	2.0	12.7	2%
Shallot	1.8	11.0	2%
Radish	1.6	10.2	2%
Others	18.1	113.1	21%
Total	84.9	530.8	100%

Source : Western Regional Agricultural Extension Office.

Area Planted with Fruit in the Western Region in 1994/95

Crops	1994/95		Share
	'000 ha	'000 rai	
Mango	34.8	217.3	36%
Jackfruit	13.2	82.7	14%
Banana	12.6	78.8	13%
Lemon	10.0	62.8	10%
Guav	3.5	21.9	4%
Grap	2.9	18.0	3%
Roseapple	2.7	16.7	3%
Pomelo	2.7	16.7	3%
Papaya	2.3	14.2	2%
Tamarin	2.2	13.9	2%
Cashew nut	1.7	10.5	2%
Banana	2.6	16.0	3%
Duria	1.0	6.1	1%
Lychee	0.8	5.3	1%
Longa	0.0	0.3	0%
Mangosteen	0.0	0.3	0%
Rambuta	0.0	0.2	0%
Others	4.5	28.1	5%
Total Western Region	97.6	609.8	100%

Source: Western Regional Agricultural Extension Office.

Although the two tables do not exactly show data on the WSB, they generally show the magnitude, importance, and type of various crops grown in the Study Area excluding Chumphon province. As shown in these tables, sugar cane is by far the most important field crop, followed by pineapple, maize, and cassava. Main vegetables in the area are: baby corn, asparagus, chili, and watermelon.

However, analysis and assessment of fruit production in the WSB has to be undertaken in combination with the area planted with fruit in Chumphon province, as shown in the table below.

Area Planted with Fruit in Chumphon Province

Crops	1994/95		Share
	'000 ha	'000 rai	
Coconut	64.4	402.4	43.2%
Duria	21.2	132.2	14.2%
Rambuta	10.4	64.7	6.9%
Mangosteen	9.3	58.2	6.2%
Pomelo	3.0	19.0	2.0%
Long Kong	2.3	14.1	1.5%
Gold	0.8	4.8	0.5%
Gogo	1.2	7.2	0.8%
Pineappl	6.1	38.2	4.1%
Papaya	2.2	13.8	1.5%
Guav	1.1	6.8	0.7%
Young coconut	0.8	5.3	0.6%
Other fruits & tree crops	26.4	165.1	17.7%
Total Chumphon	149.1	931.8	100%

Source: Chumphon Provincial Agricultural

It is clear that the Western region, which excludes Chumphon province, is predominantly producing a number of traditional fruits, namely mango, jackfruit, banana, and lemon. However, the production of other major tropical fruits such durian, rambutan and mangosteen are marginal; durian is planted on only 1,000 ha, rambutan on 30 ha, and mangosteen on 50 ha. On the other hand, durian, rambutan, and mangosteen are concentrated mainly in the province of Chumphon. In 1994, Chumphon produced: 67,500 tons of durian on 21,200 ha, 60,000 tons of rambutan on 10,400 ha and 24,700 tons of mangosteen on 9,300 ha. Other important fruit crops in Chumphon are: pomelo, long kong, papaya, guava, and banana.

(4) Profitability of Crop Production

Indicative Crop Models

Results of a crop model analysis for various crops in the area are summarized in Tables 6.1.15 and 6.1.16. These data were based on a detailed analysis carried out by the Office of Agricultural Economics of the Ministry of Agriculture and Co-operatives. Crops included in the analysis are classified into rice, vegetables, field crops, and fruit crops.

Interpretation of the results of this analysis must be handled with great care because: (i) it is a static analysis that does not reflect the dynamism of prices of outputs as well as of inputs; (ii) water charges are not included as there is no financial cost to farmers; and (iii) family labor has been costed and included in the cost calculation.

Net revenue per rai is the only criteria available from the analysis. Comparison of net revenue of different types of crops indicates broadly that: (i) the production of vegetables is generally more profitable than that of rice and field crops; (ii) more labor used for the production of vegetables; (iii) the net return to major rice (rainy season rice) production is negative as family labor in included; (iv) net return of field crops is relatively low; (v) labor used for the production of sugar cane is high and; (vi) the net return from the production of fruit is high, and the labor requirement is low, except for the production of bananas.

From Tables 6.1.15 and 6.1.16, the net return from selected crops is summarized in the table below:

Summary of Crop Models

Items	Unit	Net Return per Rai
I. Rice		
First rice	Baht/rai	-1,680
Seconce rice	Baht/rai	1,470
II. Vegetable		
Chili	Baht/rai	5,040
Kale	Baht/rai	2,310
Cabbage	Baht/rai	6,040
Baby corn	Baht/rai	6,850
III. Field crops		
Cassava	Baht/rai	280
Sesame	Baht/rai	1,850
Sugar cane	Baht/rai	840
Pineapple	Baht/rai	380
IV. Fruits		
Rambutan	Baht/rai	1,230
Banana	Baht/rai	6,710
Mango	Baht/rai	2,620
Durian	Baht/rai	2,550
Lemon	Baht/rai	5,260

Note: one rai = 0.16 ha.
Source: Office of Agricultural Economics, MOAC, Thailand

Farm Income Survey

The results of the above crop model analysis are also broadly supported by the socio-economic survey of household agricultural income carried out by the Office of Agriculture Economics of the MOAC. Findings and characteristics of farm income are presented in Table 6.1.17.

Farm households that produce only traditional and monoculture crops tend to receive the least income from farming activity. Agricultural income levels tend to rise gradually with the changing of the farming system from mono-cropping traditional crops to higher value products such as fruit, flowers, livestock, and fish from aquaculture. Farm income will further improve if farmers adopt a mixed cropping system, as well as livestock and fisheries. The survey also reveals that the divergence in agricultural income depends more on the farming system and less on whether the farming depends on irrigation or rain.

A summary of the results of the farm income survey is presented in the table below:

Summary of Farm Income per Household

Items	Income/H.hold in Baht
I. Under Irrigation	
1. Monocropping	
Rice	90,573
Field Crops	89,108
Vegetable	61,697
Fruits/Tree	116,744
Flowers/Tree	129,297
Livestock	158,468
Aquaculture	146,642
2. Mixed Cropping	
Rice/Flower/Tr	187,734
Flower/Tree/Aquaculture	144,975
Rice/Fruits/Livestock	205,189
Rice/Livestock/Aquaculture	242,122
II. Under Rainfed	
Field Crops	89,027
Livestock	295,369
Field Crops/Livestock	401,964
Fruits/Tree/Aquaculture	52,633

Note: one rai = 0.16 ha.
Source: Office of Agricultural Economics, MOAC, Thailand.

1.2.5 Livestock Production

(1) General Situation

The livestock subsector, particularly buffalo and cattle, has been traditionally very important to the agricultural sector and rural communities by providing draught power as well as supplying animal protein. With the rapid growth of the national economy together with the mechanization of agricultural works, the importance of buffalo and cattle as providers of draught power has decreased. Currently, the role of buffalo and cattle is shifting from being a source of draught power in the agricultural sector to one that supplies meat, milk, and other dairy products.

Pig and poultry production has also been expanded over the past few decades to satisfy increasing demand for meat in domestic as well as international markets. However, the pig and poultry production system is becoming more commercial, and a large part of the production is being supplied by medium and large private companies. Larger private companies are adopting an integrated approach in their operations: producing animal feed, undertaking animal production, and marketing products to domestic as well as overseas markets. These companies appear to be in good position in terms of financial resources and technical aspects. However, they still need support and assistance from the Government in the area of disease control.

Milk production has also been promoted over the past few decades by the Government with the assistance of foreign donors including JICA. Although milk production has been expanded, this production has not been able to satisfy the growing demand. While demand in the market is estimated at about 2,000 tons per day, the current supply of milk is only about 800-900 tons, representing less than 50 per cent of total demand. The rest is being supplied by imports. Milk production has been promoted generally through the establishment of farmers' co-operatives that run milk factories as well as collect fresh milk from their members. This activity generally involves many small farmers who require all kind of support such as funds, technology, management, and marketing. The Government has also been directly involved in milk production through the establishment of the Dairy Farming Promotion Organization of Thailand (DPO).

The Government of Thailand recognizes the importance of livestock development as a means to provide and increase income to rural areas. The Government, through the Department for Livestock Development (DLD), is currently emphasizing improvement of animal health, preventive veterinary health care, and disease control by regulating the

movement of animals and establishing "disease-free" zones. In the area of livestock production, the DLD emphasizes: (i) artificial insemination to improve the breeding stock; (ii) production of high performance animals through the establishment of Cattle Breeding Centers; and (iii) animal feed production.

(2) Potentials and Constraints

Demand for livestock products and dairy products in Thailand has been increasing and this trend will continue. While Thailand already exports frozen poultry and other meat products, beef, pork, and poultry is in high demand within the country. Growing cities and the expansion of the tourist industry require a substantial amount of livestock products, particularly beef, which cannot be satisfied by domestic supply. To fill the gap, currently, a large number of cattle has been brought into Thailand, legally and illegally, from neighboring countries particularly across the border from Myanmar. Based on statistics on meat consumption and hide production, it has been estimated that about 500,000 to 600,000 cattle are brought into Thailand each year. In addition, high quality beef is imported from the United States and Australia.

While this cross-border livestock trade is inevitable from an economic point of view as Thailand is a major meat consumer in the region, the influx of cattle from neighboring countries imposes a high risk of epidemics affecting the national livestock population, particularly with regard to foot and mouth disease (FMD). The prevalence of this disease in the country hinders the export potential of beef and pork to export markets such as in Japan.

It is likely that demand for meat and dairy products will increase in the future in line with the economic growth in Thailand, as these products have a high income elasticity of demand. Thus it is reasonable to suggest a Government policy to increase and promote meat and dairy products. However, there are a few constraints relevant to livestock development in Thailand, particularly in the WSB. These constraints are:

- Limitation of cheap animal feed; i.e., fodder. Increases in land price, particularly around the big cities, will make production of fodder financially less attractive. This problem has already been experienced in Ratchaburi and Kanchanaburi. Although concentrate could be partly used to supplement natural feed, its cost tends to be prohibitive for cattle farmers.

- As noted above, animal disease is widespread, particularly FMD. The Government has made many attempts to create "disease-free" zones in Thailand, but it will take time until such plans can be realized. This situation will continue to limit the prospect for exports, even of pork.

- The livestock business, particularly dairy farming, requires a great deal of labor. In areas where wages are rising and there are alternative job opportunities, meat and milk production often proves to be less attractive to farmers. Furthermore, although raising cattle might be financially profitable, it is less attractive to most farmers as this activity requires permanent labor, similar to the type of labor required to raise children. This situation is reported to be less popular with Thai farmers as it limits their freedom.

- Finally, the environmental aspect will be increasingly crucial to Thai society in the future. Livestock activity has been viewed widely as a dirty business. People will weigh the financial returns and the "quality of life" when undertaking a livestock business. The negative impact of livestock on the environment has to be considered also in combination with the development of tourism.

(3) Production in the WSB

Buffalo and Cattle

The evolution of the number of buffalo and cattle in the WSB by province is shown in Table 6.1.18. In 1993, the number of buffalo in the WSB was about 67,400 head, representing only about 1 per cent of the total number of buffalo in Thailand. It is worth noting also that this number has been continuously decreasing since 1988, because buffalo has been generally raised and used for agricultural work and seldom for meat production. Therefore, when the need for their services declines, the number of buffalo declines. Nearly 80 per cent of buffalo in the WSB are concentrated in two provinces: Chumphon (42 per cent) and Kanchanaburi (35 per cent).

Contrary to the trend of buffalo in the region, the number of cattle in the WSB has been increasing since 1988. The total number reached about 635,000 head in 1992, which represents about 11 per cent of the total cattle population of Thailand. More than 80 per cent of the total cattle population of the WSB is concentrated in three provinces: Kanchanaburi (33 per cent), Ratchaburi (32 per cent), and Petchaburi (11 per cent). Cattle production in the WSB can be characterized as follows:

- Most of the cattle in the area is raised mainly for meat, particularly for markets in Bangkok.

- Part of the cattle is brought into Thailand across the border with Myanmar and fattened for a limited period before they can be sold to a slaughterhouse;

- Part of the cattle in Kanchanaburi, Ratchaburi, and Petchaburi are milk cows that supply milk to the Nongpho Dairy Co-operative in Ratchaburi and the milk plant in Pran Buri of the Dairy Farming Promotion Organization of Thailand (DPO).

- There is a restriction on the movement of animals from the north to the south as the Government is trying to create a "disease-free" zone in the southern part of the country, starting from Prachuap Khirikhan province.

Generally, buffalo and cattle are raised by farmers, and small to medium operators. Commercial companies are less directly involved in this business, although they are major suppliers of concentrate feed and major inputs. Cattle fattening activity is quite popular among farmers in the WSB, particularly in Kanchanaburi, Ratchaburi, and Petchaburi. As these provinces are located near the border with Myanmar, cattle can be quite easily brought into the WSB provinces for further fattening. This fattening business appears to be financially appealing to farmers. One of the main constraints is the shortage of natural fodder, due partly to a rise in land prices.

Dairy Production

Statistics relevant to milk production in Thailand in 1992-1994 are shown in the table below. The growth of milk production was spectacular as it increased more than 50 per cent between 1992 and 1994. Even with this high rate of growth, the supply of milk cannot satisfy the increasing demand in the country. As noted earlier, the demand for milk is estimated at 2,000 tons per day, while the current milk supply reaches only about 800-900 tons per day. Per capita milk consumption has increased from about 2 liters 6-7 years ago to the current level of about 10 liters. With the new Government-supported drive to introduce milk for school children together with the increase in the purchasing power of Thai consumers, it is expected that per capita milk consumption will increase in the future.

Evolution of Milk Production in Thailand

Item	Units	1992	1993	1994
Milk farms	'000	7.9	9.8	11.3
Milk cows	'000	43.9	55.7	72.5
Milk production	000 ton/year	134.0	157.3	205.4
Milk production	ton/day	367.0	431.0	563.0

Source : Department of Livestock, MOAC, Thailand.

Dairy development in the WSB has been promoted through the creation of farmers' co-operatives such as Nongpho Dairy Co-operative in Ratchaburi and the establishment of the DPO in Pran Buri. However, over the past few years, private commercial companies have started to enter this dairy business. They are involved more directly in upstream activities, e.g., production of final products such as yogurt, and less involvement in downstream activities. Milk production in the WSB is concentrated in two provinces: Ratchaburi and Prachuap Khirikhan (Pran Buri). Milk production in these two provinces is shown in the table below.

Evolution of Milk Production in the WSB

Unit: ton

	1989	1990	1991	1992	1993	Share 1/
Ratchaburi						
- Nongpho	36,026	38,976	41,064	46,225	53,917	79%
- Zon-Ta	262	323	415	429	553	1%
S.total	36,288	39,299	41,479	46,654	54,470	79%
P. Khirikhan	11,230	13,596	15,128	14,059	14,098	21%
Total WSB - a	47,518	52,895	56,607	60,713	68,568	100%
Total Thailand - b				134,011	157,287	
a/b (%)				45%	44%	

Source : Department of Livestock, MOAC, Thailand.
1/ Share in the latest available year.

It is clear from the table that milk production in the WSB is quite an important component of total milk production in Thailand as its share reached 44 per cent in 1993. Production in the Nongpho co-operative is particularly important, and its performance from 1989 to 1993 was good with a annual growth rate of about 50 per cent over the period. At the same time, annual growth of milk production in Prachuap Khirikhan was about 25 per cent.

Although the performance of Nongpho Dairy Co-operative has been impressive since its establishment in 1970s, discussions with senior managers suggest that the co-operative is facing a problem in its efforts to expand its operation, namely the increase in land prices

around its factories in Ratchaburi where competition for land from other sectors is acute. To cope with this structural issue, the co-operative is considering expansion of its operation to the southern part of the WSB, although this option would require the co-operative to resolve two principal issues: (i) the expansion to the southern part will inevitably strain the milk collection system which, at present, operates within a radius of about 30 km; and (ii) the co-operative is a provincial-based organization, and thus its members have also to be registered in the same province. The DPO, operating in Pran Buri, also has stated a similar concern, and collects milk as far away as Chumphon province. Currently, the DPO's headquarters is planning to establish another processing plant with a capacity of 60 tons per day in Surat Thani in the near future.

Pig and Poultry Production

Statistics on the production of pigs and poultry in the WSB are shown in the Table 6.1.19. The system of pig and poultry production is characterized by the dominance of medium and large companies, although a small portion of the production is still being undertaken by small farmers for home consumption. These private companies produce pork and chicken for both local and international markets. Some are also involved in investing in other Asian countries as part of their multinational operations. In the FMD zone, meat has to be heat-treated before it can be exported.

In the WSB, pig production is quite important as it contributed about 8 per cent of the total production in 1993. Duck and chicken production contributed respectively 4 per cent and 3 per cent to national production. Ratchaburi could be considered as the "livestock" province in the WSB as it is number one in the region in all aspects of livestock production. In addition to milk production, it accounts for 55 per cent of pig production in the WSB, 66 per cent of the duck production, and 29 per cent of the chicken production. After Ratchaburi, Chumphon is important in the production of chicken and pork.

1.3 Overall Agricultural Framework

1.3.1 Factors Affecting the Future Shape of Agriculture

There are a number of factors that will affect shape of future agricultural development in Thailand, and thus are also crucial in the formulation of the agricultural development plan for the WSB region.

(1) Economic Growth and Increase in Production Costs

The Thai economy is well known for its dynamism over the past few decades with average economic growth of more than 8 per cent per annum. It is expected that this economic dynamism will continue to be maintained during the plan period. This economic environment will inevitably increase the cost of agricultural inputs such as labor, land, and water as there will be competition for these resources from other sectors. At present, farmers are not charged for water used in the agricultural sector. However, there are several discussions among Government officials and Thai academics as to whether or not to charge for water used by farmers in agriculture. All of these increases in production cost will eventually erode the comparative advantage of Thai agriculture in the future.

The impacts of these increases have already been felt in the Study Area. The wages of unskilled labor have increased substantially over the past few years, and labor availability is also becoming a problem for agricultural activity. Young Thais prefer to work in urban centers such as Bangkok, while leaving only older people to undertake agricultural work in rural areas. Also, the Study Area is adjacent to Myanmar, from where large numbers of legal and illegal migrants come to the WSB to work in agriculture, fisheries, and construction. Wages per day for unskilled labor have been increased from about 80-90 Baht in 1990 to about 180 Baht at present.

As water now distributed free to farmers, another factor that impedes agricultural development in the area is the increase in land prices. Current economic growth stimulates demand for land from other sectors such as industry and services. Land is in high demand for construction and industries, and particularly the pressure is high in the area adjacent to Bangkok, i.e., in Kanchanaburi, Ratchaburi, and Petchaburi. One rai of average farmland situated about 200 km from Bangkok has increased from about 30,000 Baht to about 200,000 Baht in five years.

(2) Subregional Cooperation with Myanmar

Economic relations with the neighboring country Myanmar has been initiated and promoted at the grassroots level, e.g., with the flow of labor from Myanmar into Thailand. This can be regarded as a natural phenomenon as labor is mobile in search of better opportunities and rewards. Although it is unlikely that large-scale economic cooperation between the two countries will be realized in the foreseeable future, there are compelling reasons for close economic relations between Myanmar and Thailand. To

this purpose, preparatory works are underway to open the Kanchanaburi - Tavoy corridor, which would promote economic cooperation as well as fully utilize resources in both countries.

A detailed survey of the agricultural sector in the area of Myanmar opposite the WSB, is not available at present. However, discussions with knowledgeable officials in Myanmar and a short visit to the Tavoy area suggest that the agro-climatic conditions in the two regions are almost identical, and similar crops are being produced on the Myanmar side, although enormous efforts would be required to improve the quality of the output. As the production cost is cheaper on the Myanmar side, it is inevitable that the price of agricultural commodities will be cheaper than that in Thailand. In short, Myanmar has a comparative advantage over Thailand in producing agricultural products. Labor cost is estimated at about US$0.40-0.80 per day in Myanmar as compared with US$ 7.20 in Thailand.

(3) Commitment to the Free Trade Regime

The commitment of the Government to comply with free trade rules recommended by AFTA and WTO will also change the horizons of Thai agriculture. Although details of these regional and international trade agreements are still to be finalized, what is clear is that international trade will become freer, and that it will become increasingly difficult for any Government, including Thailand, to adopt protectionist policies. Subsidies to agricultural production will be reduced and tariffs lowered. Thus, international trade will be carried out depending more on the rule of comparative advantage.

Discussions with the authorities concerned indicates that the Thai Government is willing and prepared to adopt a more liberal trade regime, to keep its economy open to international competition, and to restructure the agriculture landscape accordingly in order to respond to the new international environment.

(4) Entering into a Mature Society

Although it is difficult to predict with precision when Thailand will become a "developed country" or a mature society, it is quite clear that Thailand is heading toward this direction. To meet this objective, many conditions will be required not only in the economic aspects but concerning also social, cultural and environmental aspect. It is likely that the Thai Government together with its people will work hard to achieve this goal as a firm commitment is indicated in the 8th Plan. People will be more conscious of

culture, environment, health, and quality of life. Agricultural expansion will not be achieved at the expense of the environment as has happened in the past. Furthermore, people will seek a better balance between financial satisfaction and the quality of life. For example, internal and external migrant workers will be reduced for the benefit of better family life.

1.3.2 A Vision for Agricultural Development

Agriculture in Thailand has been the foundation for the economic development of the nation. It has been a major source for income, employment, and export earnings. However, with the country's rapid economic development, the contribution of agriculture to GDP has gradually decreased, and it is likely that this trend will continue. This sector only contributed about 10 per cent to GDP in 1994. From a purely economic point of view, it is clear that agriculture will not be a driving force for the national economy, although a large proportion of the labor force is still depending on this sector.

At the same time, however, the agricultural sector is closely linked with the national culture, the natural environment, rural areas, and its people. In 1994, about 51 per cent of the labor force still depended to varying degrees on the agricultural sector. Although this proportion may be overstated, it broadly indicates the magnitude of the influence of the agricultural sector on the life of people, particularly in rural areas. It is clear that agricultural income is not comparable to that of industry and services, but at the same time it is unlikely that the industrial and services sectors will have the capacity to absorb all labor from rural areas nor will agricultural labor be flexible enough to be readily absorbed smoothly in the industrial and services sectors over a short period.

Thus, the agricultural sector in Thailand should be regarded as "in transition" towards one that will: (i) create higher value for farmers in order to narrow the gap between agricultural income and non-agricultural income, and (ii) at the same time continue to provide job opportunities for rural people as well as preserve social values and the natural environment. In other words, the development objective of agriculture should be weighed and assessed based on economic as well as non-economic criteria, the latter encompassing social, cultural, and environmental values.

One of the main concerns of the Thai Government in formulating development policy is the large and increasing gap between urban and rural incomes. It is imperative that developmental measures be designed to include components that will mitigate and harmonize the gap. Analysis of agricultural income reveals that non-agricultural income

has become increasingly important to rural household income, and currently its share is more than 50 per cent of the total income in some areas. It is very probable that non-agricultural income will continue to increase and dominate farmers' income. Thus, linkages of the agricultural sector with the industrial as well as services sectors should be encouraged and promoted.

As described in the previous section, there is a clear trend towards the globalization of the Thai economy and freer trade. It will become increasingly difficult to take protectionist stands on international trade issues. Trade among nations will be basically determined on the rule of the comparative advantage, i.e., only commodities of good quality and having competitive price will find markets. Thus, with its economic performance, Thailand will gradually lose its competitive edge in commodities that are intensively based on natural resources and labor. In addition, the continuing economic growth in Thailand as well as in the Asian region implies that the purchasing power of people will rise, and thus there will be increasing demand for vegetables, fruit, and meat and dairy products (refer Chapter 3).

Another aspect that will affect the agricultural sector in Thailand is the internal migration of young members of the labor force to urban areas, while leaving only older people to undertake agricultural work. Although rural areas can provide a good environment for living, if incomes in the agricultural sector are far below those in the urban sector, it will be very difficult to stop young people from migrating to urban areas.

1.3.3 Overall Agricultural Development Framework

Taking into account the vision and limiting factors discussed above, the following is proposed as an overall framework and direction for the agricultural development of the WSB:

(1) Restructuring of Agriculture

In order to respond to new requirements, e.g., (i) increasing rural incomes, and (ii) changing market needs, it is imperative that this sector be restructured. In fact, this restructuring concept is not new as Thai agriculture has been restructured and transformed before; indeed the Government has undertaken substantial efforts over the last few years to diversify and restructure agriculture. The national Agricultural Restructuring Program has been implemented since 1994, with the clear objective of increasing the income of rural people by promoting high-value crops as well as of

upgrading the agricultural sector in response to emerging market new requirements. Promotion of high-value crops, e.g., fruit and vegetables, as well as cattle fattening, dairy, aquaculture, and agro-processing products will continue.

As the Government program for agricultural restructuring is being implemented and will continue at least until 1997, it is premature to draw definite conclusions. However, the experience and lessons from this program will be very useful in designing further development programs and projects for agricultural development.

(2) Improvement of Efficiency Rather Than Expansion

As described in the previous section, agriculture in the WSB region is well diversified, and natural resources are almost fully utilized. Growth through expansion of land and natural resources appears virtually complete, and thus efforts for future agricultural development should be focused on the improvement of efficiency rather than expansion in land and other natural resources. It will be economically as well as environmentally costly to further expand agricultural operations; this finding is particularly obvious for land and to some extent water resources. In the past, agricultural land has been expanded at the cost of depleting forested areas; and the new development of water resources will be even more economically and environmentally costly. Thus, agricultural development in the WSB should stay within the framework of the existing availability of natural resources. Emphasis should be concentrated on how to use resources more efficiently rather than expanding the quantity of resources.

(3) Within the Free Trade Regime

Globalization of the world economy is underway, and the AFTA and WTO trade agreements will accelerate the process further. In the future, there is little doubt that world trade is heading toward a free-trade regime. Experience in industrialized countries suggests that with the development of the economy, the agricultural sector will gradually lose its position as a major contributor to the national economy. To harmonize the gap between agriculture and other sectors, Governments in developed countries usually take various measures to protect the agricultural sector from foreign competition and adopt subsidy policies in order to boost and harmonize rural incomes. However, such policies and measures will be unpopular and difficult to implement in the future. The open trade system together with the ever-changing nature of the demand for agricultural products will present an immense challenge in planning for the agricultural sector. In order to respond to internal as well as external markets, production will have to change from the

mass production type towards smaller quantity but higher value products for sophisticated niche markets. In addition, producers will have to be flexible enough to respond to changes in market demand.

(4) Development of Human Resources

The freer trade regime combined with ever-changing consumption patterns implies that market demand in terms of quantity as well as commodities will be rather volatile and harder to predict in the future. To respond to this evolution so as to take advantage of emerging market opportunities, producers, i.e., farmers will have to be ready and equipped; they should be able to identify future opportunities in the market place, to change their cropping patterns, and to market their products to consumers smoothly. Inflexible and isolated farmers producing only traditional crops no matter how markets are changing will not be able to benefit from the emerging opportunities offered by the new markets. Therefore, farmers' education and knowledge will have to be continuously upgraded and improved; this will be a time-consuming process, involving all steps in the educational system. Short-term technical training courses prepared for farmers would provide some help, but such courses would not comprehensively meet the requirements of the new market opportunities. Formation of farmers' associations and establishment of a lifetime training system is therefore recommended.

(5) Strengthening Extension Services and Research

As farmers will face challenges arising from the emerging environment described above, it is imperative that Government institutions extend support to farmers in their endeavors. These institutions should assist farmers in identifying potential new crops, in familiarizing farmers with new crops and new technologies, in training farmers to allow them to adjust to the new cropping pattern, in assisting them in marketing, and in assisting in the resolution of issues that may arise. In short, the Government institutions should support frameworks in which farmers can take initiatives to respond to new opportunities offered by markets.

Strengthening of the agricultural research and extension services would be instrumental both in upgrading agriculture toward the production of high-value crops as well as in improving crop productivity by introducing for example appropriate varieties resistant to disease and/or by providing effective measures for crops protection at a reasonable cost to farmers. At the same time, as wages will likely continue to increase in the future, research and development on agricultural mechanisation should be strengthened to

mitigate labor constraints. In the past, agricultural mechanisation was quite modest as labor was still abundant in Thailand. This situation will not be the case in the future. Rise in labor cost will provide a good ground for enhancing agricultural mechanisation. Mobilising resources and initiatives from the private sector will be important in this undertaking.

(6) Dissemination of Technical and Market Information

As consumption patterns change continuously, agricultural production should be diversified accordingly; thus technical as well as marketing information needs to be disseminated to the main players in agricultural production. Activities in disseminating this information to farmers should be strengthened as part of the effort to train farmers and assist them in their endeavors to cope with the new market environment and opportunities. Efforts should be made to use new communications technology to disseminate information.

(7) Protecting the Environment and Improving the Quality of Life

Preserving and protecting the environment is a goal that should be applied throughout the country, including the WSB. Thus, there is no reason to emphasize only the environment in the WSB. Although forest cover in the WSB region has been reduced from about 41 per cent in 1984 to about 38 per cent in 1992, the forest area in the WSB is still relatively larger than in most other areas of Thailand. In addition, the WSB is endowed with a mountain range and coastline, which constitute valuable assets for tourism development. Therefore, agricultural development programs should be designed in such a way that the environment can be preserved and quality of life in the area can be improved. Adequate measures should be implemented to protect and improve residential amenity, sensitive areas, and cultural and tourist assets of the WSB. To achieve these objectives, a good land use policy should be formulated and zoning worked out and implemented in each important area with the participation of concerned people. Increasing the green area by establishing parks, green belts and the like should be promoted.

(8) Linkage with Emerging Opportunities

As discussed in the foregoing sections, Thailand is heading toward becoming a developed country and the environmental aspect will be more important to everyday life of the people. These two conditions provide a good ground for the development of the

"agro-tourism" and "eco-tourism" as being developed and promoted in developed countries. Agricultural development in Thailand should take into account these emerging opportunities for the benefit of people living in rural areas in the future. This concept would benefit not only to farmers by increasing rural incomes but will also create momentum for the protection of the environment. If many people can make a living and have a reasonable quality of life in rural areas, migration to urban area will be reduced. This achievement would in turn create a good balance between rural and urban areas.

1.4 Spatial Agricultural Development Plan

1.4.1 Spatial Framework

To coordinate the process employed in the WSB Master Plan Study and to facilitate presentation of the Study, the Study Area has been divided into three parts based on agro-climatic conditions and the requirements of other sectors (Figure 6.1.5).

Upper WSB: This area, including Kanchanaburi, Samut Songkhram, Ratchaburi, and Petchaburi, is covered with large irrigation schemes. Water resources are available for dry-season farming over a large area. The production of grains, vegetables, flowers, and cash crops such as sugar cane are concentrated in the Upper WSB area. This area also benefits from its proximity to the major consumption center of Bangkok, which has about 10 million inhabitants. Thus the development of the Upper WSB area would be closely linked with the Bangkok market. Promotion of industrial development through the use of natural gas from Myanmar is also planned in this area.

Central WSB: This area, defined broadly as encompassing the southern part of Petchaburi and a substantial part of Prachuap Khirikhan, presents special characteristics for agricultural production. Pineapple, sugar cane, and coconut production is concentrated in this area. A large number of pineapple and other fruit factories are also located in this area. In the overall development planning, this area has been selected for the development of tourism, and for educational and research centers.

Lower WSB: This area, which is defined to include the southern part of Prachuap Khirikhan and the whole of Chumphon, is considered quite different from the Upper and Central WSB. It produces predominantly tree crops such as

coconut, oil palm, rubber, coffee, and other tropical fruit crops. Agriculture in this area is basically commercial plantation-type farming. Agro-processing factories are concentrated in this area. The existing farming system appears economically and agronomically suitable for this area, where irrigated water resources are relatively scarce for dry-season farming. Development of the Bang Saphan deep-sea port, an industrial zone, and a new airport is ongoing in this area.

Based on the foregoing concepts and approaches, the following framework is suggested for the development of agriculture in the WSB area.

1.4.2 Upper WSB Agricultural Development Plan

(1) Main Features

For agricultural development, the major features of the Upper WSB are set out below.

(i) It is the backyard of Bangkok. Agricultural commodities produced in the area can be transported for sale in Bangkok markets within two to three hours.

(ii) Competition from other sectors for land, labor and water is acute. This implies that the production cost would be higher in the Upper WSB than in other parts of the country.

(iii) A large part of the area's agricultural land is covered with irrigation schemes. This feature would facilitate changes in cropping patterns towards the production of high-value crops.

(2) Strategy and Policy

To fully exploit the comparative advantage of the Upper WSB, the strategy for agricultural development of this area is proposed as follows:

(i) Encourage the production of high-value crops such as fruit, vegetable, and cut flowers mainly for the Bangkok markets.

(ii) Encourage the production of exotic and healthy products (such as asparagus) for niche markets in Bangkok. This activity would be carried out through contract farming and the formation of farmers' associations is required to assure quality as well as timely delivery.

(iii) Encourage the production of meat and dairy products for Bangkok markets. In this connection, the production of crops that can be used as well for animal feed (such as baby corn) should be encouraged.

(iv) Encourage the production of high-quality beef for niche markets in Bangkok. This activity could be regarded as "import substitution" of imported high quality beef.

(v) Discourage the production of traditional crops such as rice and sugar cane if prices prospects are not promising and production is not economically sound.

(vi) Encourage agro-processing industry. Some of the required raw materials could be produced in Myanmar and supplied to agro-processing factories in the area.

(3) Outline of Agricultural Development Projects and Programs

Sugar Cane Area and Alternative Use

Kanchanaburi and Ratchaburi are the major sugar cane producing areas in the WSB, accounting for 63 per cent and 29 per cent of the total sugar cane area in the WSB in 1995, respectively. The total sugar cane area in the WSB, estimated at about 1,242,000 rai (about 200,000 ha) in 1995, represented about 21 per cent of the total sugar cane area in Thailand. The same area occupies about 18 per cent of the total farm area of the WSB.

The sugar cane area in the WSB has shown a clear declining trend in recent years. During 1992-1995, the area was reduced by about 20 per cent, with the rate of area reduction particularly acute in Kanchanaburi. Field surveys confirm this declining trend: (i) sugar factories are moving out of the area to the northern part of the country, (ii) farmers are losing interest in sugar cane production as production costs have increased and yields are low and declining. Most sugar cane production area is rainfed, with only about 30 per cent of the area under irrigation. Increase in labor and land prices appear to be the major

constraints on sugar cane production in the Upper WSB. In addition, sugar cane consumes a large quantity of water, which will also be a scarce input in the future.

An agricultural program is required to assist farmers to smoothly and swiftly move from the production of sugar cane to the production of other crops and activities. Discussions with farmers indicate that they are making efforts to achieve this transformation by themselves. Those who are relatively advanced and wealthy can shift their farming to the production of high-value crops such as fruit and vegetables. However, there are farmers who have to shift back to rice production due to a lack of knowledge as well as a shortage of funds. The ongoing Agricultural Restructuring Program discourages the production of rice, coffee, cassava, and pepper, but this program does not cover sugar cane. The price of sugar in the future is unpredictable, thus the decision on participation in the program should be left to the farmers.

The program must be formulated and proposed to answer mainly two issues:

(i) How to smoothly and quickly facilitate this transition, and
(ii) How the area used up by sugar cane can be effectively used in the future.

For (i), it is considered essential that incentives in terms of concessionary credits be made available and at the same time technical support be provided to sugar cane farmers. Concerning (ii), a number of alternatives for land use can be envisaged; land could partly be taken up by other sectors, partly used for fruit and vegetables, partly for inland fisheries, partly for the production of animal feed, and the rest for other activities such as cattle raising for meat production. The area covered by irrigation should be kept and promoted for the production of fruit and vegetables destined to niche markets in Bangkok.

In addition to the production of traditional fruits such as mango, jackfruit and lemon, a number of fruits have been identified as having high demand in the market, and thus are very popular among farmers. They are also in high demand by fruit-canning factories for mixing with pineapple. These fruits can be harvested year-round and thus seasonal price fluctuations are minimal. As a result, farmers can receive regular incomes from such fruit. A number of fruits have been stated by farmers and agro-processing operators as having the above characteristics, including banana, papaya, and guava. These fruits should be taken as indicative as there will be other popular fruits, and the relative popularity of particular fruits will change continuously.

Rice Area and Alternative Use

Rice is another crop that occupies a large part of the agricultural area of the WSB. Area under rice production was estimated at about 21 per cent of the region's total agricultural area in 1992. Of the total rice area, more that 30 per cent (about 430,000 rai or 70,000 ha) is also used for the production of second rice, i.e., dry-season rice under irrigation.

However, rice together with cassava, coffee, and pepper are included in the Government's Agricultural Restructuring Program, which aims at reducing unsuitable areas under these crops. Under this program, rice farmers receive some incentives in the form of grants and concessionary credits if they agree to reduce the rice area and produce high-value crops such as fruit and vegetables. The Government's program is still ongoing and there is no formal assessment and evaluation of the program yet. The program is likely to be extended beyond its initial expiration date of 1997. A few revisions in the implementation procedure of the program are being implemented. Thus, it is premature to propose a new program to address the same issue while there is no evaluation of the ongoing program.

Nevertheless, it is very likely that the production of rice will lose its comparative advantage to other crops and activities as the cost of land, labor and water (if the Government decides to charge) will increase relatively faster in the WSB region than in other regions. Attention should be focused initially on the irrigated area, as it is comparatively easy to diversify to other high value-crops. However, conversion of irrigated rice to other crops might require some initial investment as most irrigation schemes in the area were designed for rice production. The present system of rice production under irrigation might not be economic if the economic cost of water is included in the cost calculation.

The reduction in rice production area is projected to be gradual and slow. The speed of this reduction would depend on: (i) the pricing policy of water, (ii) the initial investment required to modify farmland to suit the production of other crops, and (iii) the technical capacity of farmers to adopt new crops. As a general rule, less advanced farmers tend to continue producing rice as it is a traditional crop very well known in Thailand. Any new program to support the shifting of rice cultivation to other crops should be suspended until the ongoing program can be assessed and the lessons fully understood. A program to support this transition would include, as in the case of sugar cane, incentives in terms of concessionary credits and technical support for the production of fruit and vegetables that are not familiar to most rice farmers.

In the selection of new crops to be supported and promoted in the sugar cane and rice areas, particular attention should be paid to the production of crops that produce by-products that will be used eventually to feed meat and dairy cattle. An example of this activity is the production of sweet corn and baby corn.

Promotion of Special Crops and Flowers for Niche Markets

With its population of about 10 million people, the Bangkok Metropolitan Area (BMA) provides substantial demand for general as well as exotic fruits, vegetables, and cut flowers. Large department stores, market operators, and restaurants in Bangkok have been promoting good quality, exotic, and chemical-free products for their consumers in Bangkok. Contract farming between companies in Bangkok and farmers' groups has been promoted for the production of high-value vegetables such as asparagus.

This type of contract farming for the production of high-value crops should be promoted, and the Upper WSB is well placed to undertake this activity due to its proximity to Bangkok and its availability of resources. The future demand for high-value crops is promising as per capita income is increasing. And as awareness of the quality of life and health become widespread, the demand for organic or chemical-free products is expected to grow.

Promotion of Cattle Fattening

Due to high prices, Thailand has been for decades the major market for live animals, particularly cattle, from neighboring countries. Although the import of live animal is still regarded as illegal trade or smuggling, this activity has been widespread for a long time. Since it is smuggling, there are no statistics on the number of animals brought into Thailand, but the best estimates suggest that about half a million head of cattle is brought into Thai markets each year.

Animals imported into the WSB region mainly come from Myanmar. Although there is no thorough study of the source of these animals, reliable evidence suggests that some animals are brought in from as far away as Bangladesh and India. By the time these animals reach Thailand, they are weak and thin, and thus not suitable for immediate slaughtering.

Animals are kept for fattening for about three months until they are fat enough for slaughtering, and to sell to provincial markets or markets in Bangkok. The border price is estimated at about 2,000 to 3,000 Baht per head. After three months fattening, the price of each animal may reach as high as 8,000 to 10,000 Baht. Cattle fattening has been quite a popular income generating activity among people living in provinces bordering on Myanmar. Considering the high income elasticity of demand for meat, it is projected that the demand for meat in Thailand will increase.

There are a number of constraints on promoting cattle fattening activity: (i) the need for new participants for initial investment costs to establish a facility and buy animals, (ii) a lack of expertise, and (iii) a shortage of fodder in some area. One of the major issues relating to the smuggling-fattening activity is that it will continue to make it difficult for the Government to control diseases such as the foot-and-mouth disease (FMD) brought in with the animals.

Promotion of Dairy Production

The demand for milk and other dairy products will also increase with the rise in per capita income. Milk and dairy production have been promoted in Thailand for quite sometime, and in the WSB area a few dairy co-operatives that successfully manage their businesses have emerged. As in the case of cattle fattening, dairy production is a very important activity since it provides additional income to rural farmers.

However, encouragement of dairy production cannot be promoted without dairy factories as marketing outlets have to be secured. The successful experience with Nongpho Dairy Co-operative and the DPO should be carefully studied and replicated in other areas where the potential is high in terms of ample feed supply and the existence of enthusiastic farmers.

One of the common constraints on dairy production and cattle fattening is the limited supply of animal feed. Although concentrate is generally used partly to feed the animals, natural feed is still required to supplement the concentrate. The supply of natural feed is becoming a problem in some areas as the price of land is high, and thus there is no adequate incentive for farmers to produce hay for animals.

Promotion of Integrated Farming System

The promotion of an integrated farming system is necessary to use land resources efficiently and thus increase farmers' incomes. Introduction of fodder trees in the farming system is deemed useful to meet to the increasing demand for fodder for livestock activities. Integrated farming could be defined as a farming system that combines various crops or various crops together with the introduction of milk and meat cattle. The introduction of such an integrated farming system is likely to be more feasible with small farmers than with commercial and large-scale farmers. As it is an integrated system, it requires more labor; this requirement may not be popular with commercial-oriented farmers, as labor costs are increasing.

Promotion of Agro-Processing

In order to provide dynamism in rural areas and to increase farm incomes, agro-processing should be encouraged wherever feasible. As the production of various fruits and vegetables is expected to increase, agro-processing capacity should at the same time be upgraded to respond to the extra supply. The canning of fruits and vegetable, and the production of fruit juice should be encouraged.

Encouragement of agro-processing would not be limited to the processing of agricultural products produced in Thailand. The WSB is very close to Myanmar, and subregional transport and communication will be improved in the future. Furthermore, the area in Myanmar opposite the WSB has high potential to produce crops similar to those presently produced in Thailand. However, development in Myanmar is not advanced, and the quality of agricultural produces is obviously inferior. Thus, the area around Kanchanaburi is an ideal location to tap the opportunity for processing of agricultural supplies from Myanmar in the future.

Economizing on the Use of Water Resources

At present as water is being distributed to farmers free of charge, it is very hard to envisage any farmers' initiative to economize on water use, e.g., optimizing water use by shifting cropping patterns toward one that requires less water. Water shortages are prevalent in Thailand, and thus there is severe competition for water from other sectors in some areas. It is projected that the demand for water will surely increase with the expansion of economic activity, but at the same time the increase in water supply will be less promising. Policies and measures should be implemented to preempt water

shortages, which appear very likely in the future. The promotion of the use of pipe, sprinklers, and dripping systems should be encouraged.

1.4.3 Central WSB Agricultural Development Plan

The Central WSB area is defined broadly as the area that covers Cha Am, Hua Hin, and the northern part and part of the southern part of Prachuap Khirikhan province. The area is basically low in rainfall, and the northern part of the Central WSB is covered with two major irrigation schemes supplied by Kaeng Krachan and Pran Buri reservoirs.

(1) Main Features

(i) The area of Cha Am and Hua Hin has been designated as a site for the development of tourism, an educational and convention center, and a Science City.

(ii) There is no major concentration of population in the area, and thus its absorptive capacity for agricultural products is rather limited.

(iii) A large part of the agricultural land in the area, particularly in the lowland, is used to produce pineapple and sugar cane. The production of various kinds of fruit is carried out in upland areas.

(iv) A large number of fruit-processing factories is concentrated in the area.

(2) Strategy and Policy

The following strategy is deemed appropriate for the development of the area:

(i) On irrigated land, the production of high-quality fruit and vegetables should be encouraged for the tourist and domestic markets. Agro-processing factories such as that of the Dole company demands other fruits such as banana, guava, and papaya for the canning of fruit salad mixed with pineapple. Tamarind appears to be in high demand for juice, and it grows well in the area.

(ii) The production of pineapple will continue to stay around the present level, but the production of sugar cane will be reduced. Thus, alternative

crops will have to be proposed on the land previously used for sugar cane.

(iii) As this area is designated as a tourism and educational center, adequate attention must be paid to the amenity aspect. Thus, preservation of environment and reforestation should be encouraged. At the same time, further location of agro-processing factories should be screened and guided away from the tourist areas.

(iv) Livestock production should be explored and encouraged to fully utilize pineapple waste discharged from pineapple factories and other agricultural by-products. Similarly, in developing this activity adequate attention should be paid to the amenities of the tourist area and Science City.

(v) Considering the limited supply of water together with increased demand for water in the future, it is imperative that water-saving measures be promoted. These measures should not be restricted only to the Central WSB. Utilization of water-saving equipment such as dripping and sprinklers should be encouraged.

(3) Outline of Agricultural Development Projects and Programs

Rice Area and Alternative Uses

Rice still occupies about 50 per cent of the agricultural land in Petchaburi province. Dry-season rice is generally practiced in irrigation schemes. As in the case of rice in the Upper WSB, rice in irrigated areas should be reduced gradually so that the production of high-value crops can be increased. In fact, this process has been taking place at the farm level at a slower pace. At the field level, advanced farmers are converting rice area into the production of fruit crops such as banana, papaya, guava, which produce fruit year round and find outlets in local markets as well as in local agro-processing factories. As the harvesting season of these fruits is not concentrated in any particular time as in the case of traditional fruits, they are less likely to face major marketing constraints and sudden drops in prices.

Sugar Area and Alternative Uses

The economics of sugar production in the Central WSB is similar to that in the Upper WSB. The yield of sugar cane is low and decreasing, and sugar cane must be transported a long distance to the nearest sugar mill as many have been relocated to the northern part of Thailand. Sugar cane production in irrigated areas is very likely to be converted quite smoothly to other high-value crops. However, it would be more difficult for sugar cane production under a rainfed system to find alternative crops that can be produced with limited water supply.

Reforestation and Improvement of the Amenity

In line with the Government's overall policy to develop and promote the Cha Am and Hua Hin area into an educational as well as tourist center, it is imperative that environments and amenity value in the area be preserved and upgraded to an acceptable standard. To achieve this overall objective, reforestation of the surrounding area should be promoted and protection of sensitive areas should be strengthened. Although specific types of trees should be decided based on specific area study, eucalyptus, tamarind, and cashew nut appear promising based on preliminary indications.

Promotion of Meat and Dairy Cattle

To fully utilize pineapple waste and other agricultural by-products readily available in this area, the raising of meat and dairy cattle should be promoted on a smaller scale. Milk production will find an outlet in the DPO dairy plant in Pran Buri. As in the case of the Upper WSB, crops such as baby corn that also can be used for animal feed should be encouraged. Furthermore, as land prices are still relatively cheaper in the Central WSB than in the northern part, the Central WSB has a comparative advantage over the north in the production of hay for animals. Meat production can find outlets mainly in the tourist and educational areas around Cha Am and Hua Hin. However, livestock production should not be promoted in the Cha Am and Hua Hin area at the cost of environmental and amenity values.

1.4.4 Lower WSB Agricultural Development Plan

The Lower WSB area is defined to encompass the southern part of Prachuap Khirikhan and the whole of Chumphon province. Due to its agro-climatic condition and limited water supply in the dry season, this area will continue to be the base of commercial

plantation of coconut, coffee, palm oil, rubber, and various tropical fruit trees. Production of grain and vegetables is not expected to go beyond the quantity that can be absorbed by local community. More export opportunities for agricultural product, particularly for tropical fruit, will be open following the construction of the deep-sea port at Bang Saphan and the new airport at Pathiu. The marketing system will also be strengthened with the improvement of infrastructure to cope with the new opportunities.

(1) Main Features

The main features of the Lower WSB are:

(i) its remoteness from major consumption centers such as Bangkok;
(ii) the concentration of the production of tropical fruit and tree crops in this area;
(iii) extremely small area under rice and field crops compared with the area planted with fruit,
(iv) the high rainfall in the area during the rainy season, although water is rather scarce in the dry season; and
(v) the new development of a port at Bang Saphan and an airport at Pathiu.

(2) Strategy and Policy

To maximize the use of natural resources and the new infrastructure in this area, the following strategy is deemed appropriate:

(i) As this is mainly a fruit and tree crop area, the strategic emphasis should be focused on these crops. There are some concerns about the economics and competitiveness of the oil palm production as it must face competition from other countries in the region, particularly from Malaysia after AFTA. However, it will likely take sometime until the impact is felt, perhaps beyond this study period. Besides, the conversion from the production of perennial crops such as oil palm to other crops would incur substantial costs to farmers as well as the national economy. Thailand is a major producer of rubber, and this subsector appears to operate quite well. The Government is encouraging the reduction of coffee on unsuitable and less productive land.

(ii) At the field level, farmers have been converting paddy land into the production of oil palm. Taking into account the prospects of oil palm in the future, it is reasonable to limit the increase in oil palm area unless productivity can be improved to assure the economics of oil palm production.

(iii) A large area is planted with fruit trees, including durian, rambutan, mangosteen, and long kong. To maximize the use of natural resources in the area, tropical fruit production should be encouraged The Government is encouraging the reduction of coffee production in favor of other fruit crops. As it appears difficult to develop new agricultural land, expansion of the plantation with tropical fruits is likely to be achieved by restructuring the fruit and tree crops area.

(iv) Increased production and exports of tropical fruit should be encouraged. To achieve this objective, upgrading fruit quality and improving the marketing system is required.

(v) The deep-sea port at Bang Saphan and the new airport at Pathiu will certainly facilitate the expansion and export of tropical fruit. However, there is no major fruit market in the Lower WSB. Establishing a fruit market in this area is considered crucial for promoting fruit exports.

(vi) Coconut plantation occupies a large share of agricultural land in the region. However, coconut plantation itself should be regarded not only from the viewpoint of financial criteria as it gives a special characteristic and flavor to the area, and consequently supports amenity values and tourism. Also, the generally sandy soil in the coconut areas would make it very difficult to find other crops to replace coconut. However, old coconut plantations should be replaced and coconut wood utilized.

(vii) To maximize the use of agricultural by-products and to meet market demand in the future, meat and dairy production should be promoted in this area. A FAO study in the Asia and Pacific region indicates that there are possibilities to raise cattle under tree crops, particularly coconut. As a matter of fact, livestock activities have already been started and are operating in the region.

(viii) Since the Lower WSB is a major tropical fruit producing area, agro-processing, particularly the production of canned fruit and juice, should receive special emphasis in this area. A number of factories, including that of the Dole company, are operating in the area. These activities should be strengthened further. In the future, it is expected that part of the raw materials processed in these factories would be supplied from the adjacent area in Myanmar with transport via the coastal port at Ranong.

(ix) Although the Lower WSB receives high rainfall, the area under irrigation is rather limited and the Government is planning the development of a number of new reservoirs. Water shortages appear critical during the dry season, a situation that hampers the production of good quality fruit. Measures should be taken to economize on water use by promoting sprinkler and drip irrigation, and to improve the irrigation system in orchard areas.

(3) Outline of Agricultural Development Projects and Programs

In line with the proposed strategy discussed in the foregoing section, the following projects and programs are considered appropriate for the Lower WSB.

Expansion and Quality Improvement of Tropical Fruits

A program is required to facilitate the expansion of area planted with tropical fruit and the improvement of fruit quality for domestic as well as for export markets. The Government has been implementing a program to convert rice, cassava, pepper, and coffee to other high-value crops. The program conceived here partly overlaps with the Government program. At present, as it is difficult to really expand the area planted under fruit in the new area, the only possibility is to restructure the "fruit and tree" subsector, and expand the area under tropical fruit required by new market opportunities. Therefore, the proposed program should focus only on the expansion of fruit production and the improvement of fruits quality.

The expansion of tropical fruit production cannot be promoted without promoting marketing in order to expand outlets. Markets conceived here are domestic as well as export. With the increase of per capita income in the world, particularly in Asia, the demand for tropical fruit is expected to increase as fruit has a high income elasticity of demand. Historically, only Japan, the United States and Europe imported tropical fruit.

Now in Asia, countries such as Singapore, Taiwan, and Korea import tropical fruit. In the future, it is expected that huge demand from the People's Republic of China will add to the international demand. The deep-sea port in Bang Saphan and the new airport at Pathiu will facilitate transport to these markets. It is therefore proposed that a new fruit market be established in the Lower WSB area, and the fruit marketing system be upgraded.

Restructuring of Coconut Plantation

Coconut plantation dominates a large area in the region, and in Chumphon province alone the coconut area was estimated at about 402,000 rai (about 64,000 ha) in 1994, making coconut the most widely planted crop in the province. As discussed in the previous section, coconut plantation should be maintained because: (i) it promotes amenity values and thus attracts tourism; and (ii) there is technical limitation as the area under coconut is generally sandy and poor. Therefore, it is considered reasonable to renew the old plantation, and keep this plantation at a more balanced composition in terms of age. In some areas, coconut is intercropped with other field crops such as pineapple and coffee. Coconut plantation would offer a good grazing ground for cattle. It is reported that there is substantial demand for credit requested by coconut growers in order to replant their plantations.

Promoting Livestock Production

Raising cattle for meat and dairy is another promising activity in the future as it provides high income to farmers, and the demand for meat and dairy products will increase. As in the case of the Upper WSB, raising cattle for meat consists mainly of the fattening of imported cattle from neighboring countries. Cattle can be raised in a tree crop area, particularly coconut, and agricultural by-products such as oil palm and pineapple residues can be used to feed animals in addition to the concentrate required. At the same time, milk and dairy products should be promoted as industrialization in the Bang Saphan area as well as the new airport will provide additional demand for these products. A milk processing factory will be necessary in this area in the future.

Encouraging Agro-Processing

The development of agro-processing proposed here should be conceived broadly. Firstly, it should follow the traditional path of agro-processing, which mainly involves the processing of raw materials available in the area. Secondly, however, this activity will

have to somehow modify its operation in order to respond to the new requirements and opportunities. These include the increases in wages, the limited supply of some raw materials, and regionalization of the area. In the future, agricultural products can be produced on the Myanmar side of the WSB, and then shipped to Ranong for final use in processing factories in the Lower WSB area. Discussions with managers of agro-processing factories in the area indicate that presently they are increasingly facing difficulties due to wage increases and a limited labor supply. Also they are looking for possibilities to secure supply from Myanmar as discussed above.

Economizing on Water and Improving the Watering of Fruit Trees

In parallel with a Government plan to develop new water sources by constructing new reservoirs, a program should be formulated to promote water-saving, particularly during the dry season. As this water-saving promotion activity mainly involves the private sector, the Government intervention could include incentives in the form of cheap credits and favorable tax incentives to promote this activity. Promoting the use of drip and sprinkler irrigation should be included in this program. In addition to the financial issue of making funds and equipment available to operators, a technical issue is the improvement of the watering system for fruit trees in order to improve fruit quality as well as save water.

1.4.5 Entire WSB Agricultural Development Plan

In addition to projects and programs for each area, a human resource development program will cover the whole WSB.

Lifetime Training

As discussed in the foregoing section, the future demand for agricultural production will be more diversified and less predictable than before. Consumers will demand many products, and at the same time this demand will always be changing. Therefore, it is very crucial that farmers be prepared themselves to adjust to the market demand, and their knowledge and technology be upgraded to swiftly address new opportunities. In a sense, Thailand should prepare itself for entrance to the next stage of its economic development.

In addition to technical and vocational training, lifetime training of farmers should be promoted. As a first step in this direction, a training facility should be established and

opened to the general public. The Rajabhat Institute in Petchaburi, which has an Agricultural Department and an experimentation farm, should be mobilized and used as a pilot case for this endeavor. This Institute has already initiated some courses for the general public during weekends. In addition to its own experimental farm, the Institute could coordinate efforts with the Horticulture Research Center and other agricultural institutions in the area, and use their facilities to demonstrate technologies to the students and general public. This lifetime training program should not be confined only to the Central WSB, but it should be designed for the whole WSB. Kasetsart University should play the same role for the Upper WSB, while Chumphon Agricultural College should be the focal point for the Lower WSB.