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# Agricultural Development Planning in Thailand: Some Supporting Analysis

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AGRICULTURAL DEVELOPMENT PLANNING IN THAILAND:  
SOME SUPPORTING ANALYSIS

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## FOREWORD

This report summarizes several alternatives analyzed relative to Thailand's Fourth Five-Year Development Plan. The alternatives are analyzed relative to the agricultural sector.

The research summarized has been conducted in the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government under Director Somnuk Sriplung. It is a cooperative project on agricultural sector planning between the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, and the Center for Agricultural and Rural Development of Iowa State University. Earl O. Heady serves as project director for Iowa State University. The cooperative project is financed by the Agency for International Development and the Royal Thai Government.

The report summarizes the alternatives analyzed and the results forthcoming from them for the year BE 2524 (1981). It does not provide documentation of the national and interregional linear programming model used in the analysis since the latter is being detailed in a separate publication. The national programming model, being used for various sector planning projects and policy analyses, is under continuing development.

This manuscript is written in cooperation with the following staff members of the Division of Agricultural Economics, Ministry of

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## I. INTRODUCTION

Seventy-eight percent of Thailand's economically active population<sup>1</sup> and a corresponding proportion of the country's total population depends on the agricultural sector for their livelihood. With such great importance attached to agriculture, the Thai government places emphasis on agricultural sector planning. Planning activities are being implemented through a set of sector models being developed in the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives. The sector project is conducted cooperatively with Iowa State University and is financed by the United States Agency for International Development.

Planning activities and sector models include those for regional and national development. Several models have been quantified, made operational and are being put to use in planning. Models completed to date include a national and interregional linear programming model of agriculture, a macro model of the entire economy and numerous regional models. This modeling work and related analytical research serves as one foundation for developmental planning in Thailand. More specifically, the national and interregional programming model has been used for the analysis which follows.

### Purpose

While the agricultural sector analysis modeling work has not yet been completed and preparation of a more complete manuscript containing a

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<sup>1</sup>National Statistical Office, Royal Thai Government, 1970 Population and Housing Census. Office of the Prime Minister, Royal Thai Government, Bangkok, 1973. Table 16.

description of the model is still underway, the model has already been used extensively.

The most extensive use has been in applied agricultural economics research conducted to support development of Thailand's Fourth Five-Year Development Plan for the period BE2520-24. The purpose of this document is to report the results of that research work, together with a description of current agricultural conditions, issues affecting agricultural planning research, and the research approach taken. This report includes the following eight sections: (1) the introduction; (2) summary description of current conditions in and related to Thailand's agriculture; (3) brief summarization of the existing issues affecting agricultural development in Thailand; (4) a statement of the research objective; (5) description of the research strategy employed; (6) description of development alternatives considered in the analyses conducted; (7) discussion of the results of alternatives analyzed; and (8) supporting appendices.

The analyses supporting development planning in Thailand were specific to each of the 19 agricultural zones used to divide Thailand into relatively homogenous production regions. For purposes of brevity and clarity of presentation, analytical results are presented for Thailand as a whole and for each of Thailand's four major agricultural regions. Regional results are produced by aggregating agricultural zone data. The four regions are the North, Northeast, Coastal Plains, and South regions. The area of Thailand included in each region and the zones each region contains are shown in Figure 1. The programming model is built

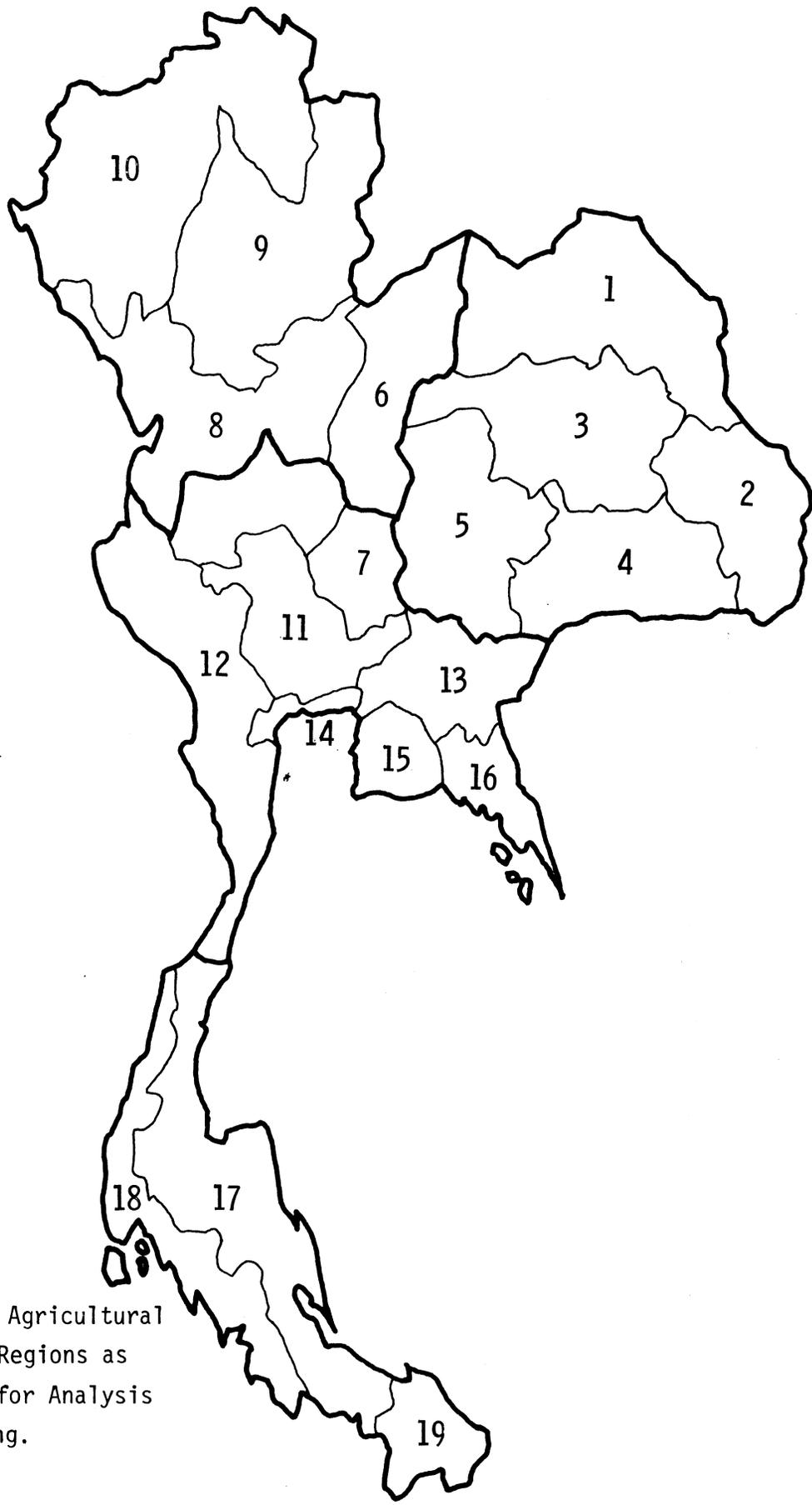


Figure 1. Thailand's Agricultural Zones and Regions as Specified for Analysis and Planning.

around the 19 zones, with data then aggregated to the regional level. Labor, land, capital and other restraints are defined for the 19 zones and land types within the zones.

The analyses conducted as the basis for development planning were highly disaggregated. In order to highlight the key dimensions of the agricultural industry and results of its analysis, presentation of results is based on some reaggregation of data. The commodities and commodity groups used throughout the document are as shown in Table 1.

Table 1. Commodities and Commodity Groups Explicitly Identified, Analyzed and Reported Throughout the Text.

Crop Commodities	Livestock Commodities
Rice (glutinous)	Water Buffalo
Rice (nonglutinous)	Beef Cattle
Maize	Hogs
Sugar Cane	Dairy
Cassava	Poultry
Kenaf and Jute	Other Livestock
Rubber	
Other Crops	

## II. THE PRESENT SITUATION

Agricultural development planning research for Thailand must proceed from and be based on current conditions. The purpose of this chapter is to present a description of current conditions. The summary describes the population and labor force; the land resources available for use in development; the capital stock or infrastructure represented in the form of livestock, machinery and equipment; the current productivity of agriculture as reflected in crop and livestock production and Thailand's export-import situation; and the current income and employment in and generated by agriculture.

### Thailand's Population

The total population of Thailand in BE 2513, the year of the most recent census, was 34.4 million people. The regional and rural-urban distribution of the population at that time is shown in Figure 2. Table 2 contains corresponding information and related labor force statistics.

Study of the information contained in Figure 2 and Table 2 illustrates the features which characterize Thailand's population. With the exception of the Central Plain the population is mainly agricultural and the majority of the labor force an agricultural labor force. The farm population and labor force account for at least 57 percent of their respective totals in all regions except the Central Plain.

The nature of Thailand's population distribution is also significant. Some 34 percent of the total population lives in the Northeast. Only two urban locations, Chiang Mai and Bangkok have populations larger than 100,000 people.

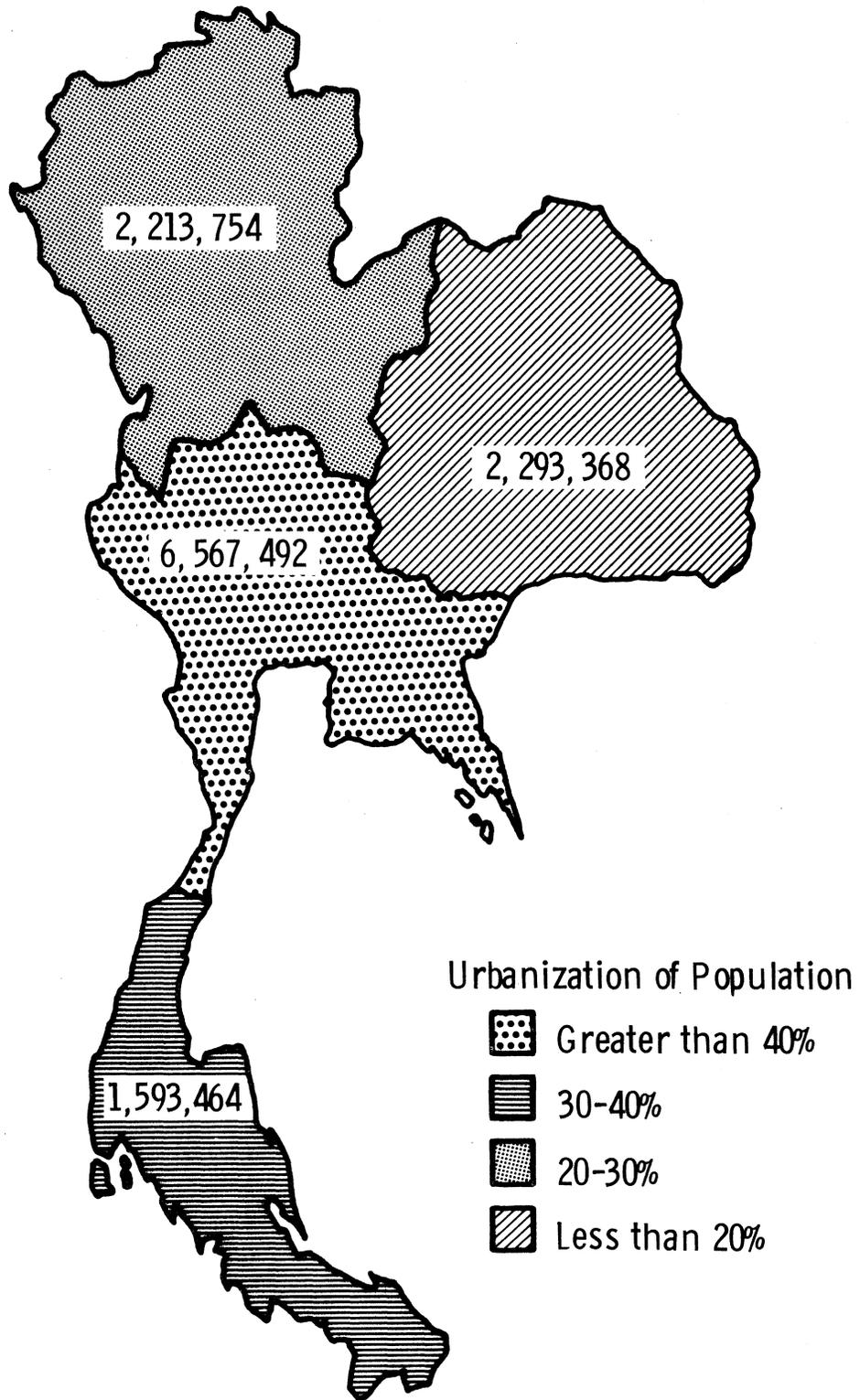


Figure 2. The Regional Distribution and Levels of Urbanization of Population in Thailand.

Table 2. Characteristic Features of Thailand's Population and Labor Force by Region in 1970.

Region	Total Population	Agricultural Population <sup>1</sup>	Economically Active Population (15-64 years of age)	
			Total <sup>2</sup>	Employed only in Agriculture <sup>3</sup>
North <sup>4</sup>	7,813,000	5,599,613	3,402,233	1,925,664
Northeast <sup>5</sup>	11,700,000	9,407,088	5,268,192	3,145,111
Central Plain	10,612,000	4,044,385	4,251,424	2,300,020
South	4,272,000	2,678,210	1,753,951	997,325
Thailand	34,397,000	21,729,296	14,680,800	8,368,120

<sup>1</sup>Population and Housing Census National Statistical Office, Office of the Prime Minister, 1973 table 1 and table 2.

<sup>2</sup>Population and Housing Census, National Statistical Office, Office of the Prime Minister, Royal Thai Government, Bangkok, Thailand, 1973, table 19.

<sup>3</sup>Estimated by using proportion from 1973 General Survey, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives.

<sup>4</sup>North - includes changwat Loei.

<sup>5</sup>Northeast - excludes changwat Loei.

#### Land for Agriculture

Thailand has a total land area of 321 million rai. The land classes and area of each are indicated in Table 3.

Agricultural production in Thailand takes place mainly on land classified as agricultural. While some agricultural production takes place on nonagricultural lands, this production, based on slash and burn techniques, is detrimental to preservation of water sheds and maintenance of annual forest product supplies. Therefore, the intent of the government is to restrict such practices. Thus agricultural planning is limited to those lands classified as agricultural and limited additional areas identified as suitable for agricultural use.

Table 3. Thailand's Land Area by Class of Land and Region in BE 2516.

Region	Land Area by Class (Rai)		
	Farm Holdings <sup>1</sup>	Forest	Other
North	24,035,568	63,108,750	25,944,435
Northeast	47,802,248	31,865,625	19,888,377
Central Plain	26,087,356	24,378,750	14,270,769
South	11,481,234	15,208,125	17,178,766
Thailand	109,406,406	134,561,250	77,282,347

<sup>1</sup>The Center for Agricultural Statistics, Division of Agricultural Economics; Ministry of Agriculture and Cooperatives, Royal Thai Government.

<sup>2</sup>Royal Forestry Department, Royal Thai Government, Bangkok, Thailand, BE 2517.

The agricultural land area of Thailand consists of four types of land. Land Type I is continuously flooded and hence is suited only to production of floating rice. Land Type II is land where controlled irrigation practices can be employed. Land Type III is land area which permits only rainfed paddy production. Land Type IV is that land area in Thailand which can produce only upland crops. These four types form the land base for current and future agricultural production in Thailand. The quantities of each type of land are shown in Table 4 by region. Agricultural development planning refers to this land base.

The effectiveness with which this land base can be used depends to a large degree on the supply and prices of secondary inputs and capital available for use in agricultural production. These factors of production include production skills reflected in education levels achieved by farmers, breeding stock or farms, and capital investment. A summary description of these factors is included in the following section.

Table 4. Thailand's Agricultural Land Area by Class and Region in BE 2516-2517.

Region	Land Area by Type (Rai)				Total
	Type I	Type II	Type III	Type IV	
North	2,591,000	3,821,000	8,670,000	7,145,000	22,227,000
Northeast	-	2,333,000	33,623,000	7,690,000	43,646,000
Central Plain	336,000	11,670,000	3,963,000	6,274,000	22,240,000
South	-	1,544,000	3,015,000	7,764,000	12,323,000
Thailand	2,927,000	19,365,000	49,271,000	28,873,000	100,436,000 <sup>1</sup>

<sup>1</sup>Total agricultural land in Table 4 differs from that indicated in Table 3 because land in farms used for roadways and farmsteads is included in Table 3.

#### Agricultural Resource Development

Data in Table 5 express certain development characteristics of Thai farms. Thai farmers have had limited opportunity to attend school. The resulting low level of education among farmers causes reluctance to try new techniques and hence restricts adoption of new technology. The limited number of breeding stock on farms and low level of capital investment are indicative of the traditional nature of production techniques. These conditions have very positive implications. The potential to markedly increase Thailand's agricultural output through provision of agricultural training programs and programs to stimulate adoption of new technologies is indeed great.

#### Agricultural Production

The types and amounts of agricultural commodities produced indicate the use and productivity of Thailand's agricultural resources. In BE 2516-17 Thai farmers used labor, land and capital resources to produce the per rai and total production levels shown in Tables 6 and 7.

Table 5. Indicators of Thailand's Average Agricultural Resource Development by Region, BE 2517.

Region	Average Number of Livestock Per Farm <sup>1</sup>		Indicators of Average Farm Capital Investment Per Rai <sup>1</sup>			
	Cattle (Number)	Buffaloes (Number)	Value of Land (Baht per rai)		BE 2517 Purchased Inputs Excluding Hired Labor (Baht per rai)	
North	.96	1.21	1,331		9	
Northeast	.91	1.89	1,731		14	
Central Plain	.78	.94	2,993		24	
South	1.38	.43	2,760		11	
Thailand	.96	1.33	1,962		14	

Region	Level of Education of Farm Family Heads BE 2506 <sup>2</sup>							
	No Education		Grade 1-4		Grade 4-12		Other <sup>3</sup>	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
North	308,732	39.7	157,673	20.3	290,035	37.3	21,202	2.7
Northeast	392,998	32.2	210,158	17.2	591,938	48.5	25,692	2.1
Central Plain	255,135	35.3	139,398	19.3	299,898	41.5	28,540	3.9
South	206,815	41.9	87,481	17.7	172,522	35.0	26,188	5.3
Thailand	1,163,680	36.2	594,710	18.5	1,354,393	42.1	101,622	3.2

	Current Education Level of Farm Family Children Who Have Education Beyond Prathom <sup>4</sup>				
	NE	North	Central	South	Kingdom
MS 1	13,333	7,025	6,197	3,296	29,851
MS 2	55,180	24,901	26,211	32,536	138,828
MS 3	75,563	40,712	34,654	33,000	183,920
MS 4	10,766	6,074	6,675	10,015	33,530
MS 5	6,707	4,006	7,049	8,452	26,214
MS 6	5,252	2,191	7,768	4,484	19,695
VOCATIONAL	18,346	7,222	15,786	17,588	58,942
UNIVERSITY	13,035	3,911	13,757	10,996	41,699
TOTAL	198,182	96,042	118,088	120,367	537,679

<sup>1</sup>Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>2</sup>National Statistical Office, Census of Agriculture BE 2506 Royal Thai Government, Bangkok, Thailand, 1965.

<sup>3</sup>Includes persons who attended special or foreign schools for whom it was not possible to determine the equivalent of grades completed in the standard system.

<sup>4</sup>These data summarize the educational status of the children of farm family heads farming in BE 2516 for those children who have completed education beyond prathom seven.

Table 6. Agricultural Production of Major Crops in Thailand BE 2516-2517 by Region Unit - 1,000 Tons.

Commodity	Region				
	North	Northeast	Central Plain	South	Thailand
Rice (NG) <sup>1</sup>	2,306	1,512	4,445	747	9,009
Rice (G)	1,674	3,018	10	41	4,744
Corn (BE) <sup>2</sup>	1,270	344	729	-	2,343
Sugarcane <sup>3</sup>	1,007	453	11,180	-	12,640
Kenaf <sup>1</sup>	27	570	18	-	615
Cassava	491	1,225	4,463	237	6,416
Rubber	-	-	18	350	368

Average Production Per Rai-Kilograms

Commodity	Region				
	North	Northeast	Central Plain	South	Thailand
Rice (NG) <sup>1</sup>	299	119	329	258	284
Rice (G)	434	208	177	374	256
Corn <sup>2</sup>	345	345	337	-	343
Sugarcane <sup>3</sup>	7,000	5,000	8,100	-	7,800
Kenaf <sup>1</sup>	225	184	167	-	185
Cassava	2,755	2,317	2,410	2,056	2,400
Rubber	-	-	38	67	65

<sup>1</sup>BE 2517 Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>2</sup>Board of Trade and Department of Extension, Royal Thai Government, Bangkok, Thailand.

<sup>3</sup>Sugar Institute, Ministry of Industry, Royal Thai Government, Bangkok, Thailand.

Performance of Thai Agriculture

The data of Tables 6 and 7 indicate relatively large production by Thai farmers, but at the same time reflect substantial potential for improvements. For example average nonglutinous (NG) rice yield of 284 kilos per rai is low by international standards as is corn yield of 343 kilos per rai. Cattle calving rates and average piglets per mature female of .3 and 7.0

Table 7. Agricultural Productivity<sup>1</sup> of Major Livestock Types in Thailand BE 2516-17 by Region.

Livestock Types	Region				
	North	Northeast	Central	South	Thailand
	Production (head)				
Buffaloes	1,293,846	3,608,379	809,356	230,102	5,941,683
Cattle	1,078,865	1,983,523	832,999	834,104	4,729,491
Hogs	1,035,048	1,352,344	1,324,883	557,581	4,269,856
Poultry	16,578,630	28,739,178	19,131,640	7,928,643	72,378,102
	Marketing (1,000 head)				
Buffaloes	122	545	72	38	779
Cattle	149	372	75	141	738
Hogs	812	1,336	1,931	380	4,460
Poultry	4,383	8,992	15,281	2,847	31,504
	Average Number of Births Per Mature Female Per Annum				
Buffaloes	.26	.23	.22	.19	.23
Cattle	.32	.29	.37	.22	.29
Hogs	6.81	5.39	7.62	6.51	6.96

Source: Division of Agricultural Economics, Office of the Under Secretary of State, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>1</sup>Productivity refers to the efficiency of a producing unit or the commodity output realized from a given input level.

per annum respectively also suggest a significant potential for improvement of livestock production efficiency. Under experimental conditions annual calving rates of 80 to 90 percent per mature female and average litter sizes of 9 piglets, which assuming 2 litters per year is 18 piglets per mature female, have been achieved in Thailand.

One measure of Thai agricultural performance is its ability to satisfy domestic needs and contribute to foreign exchange earnings through exports. The production and export-import situation for selected products

in the years BE 2513 and BE 2516 is presented in Table 8. Appendix Table 1 contains a more complete listing of Thailand's agricultural import-export situation.

Table 8. Thailand's Agricultural Import-Export Situation for Selected Commodities BE 2513 and BE 2516.

Commodity or Commodity Group	Quantity (Q) Value (V)	Units-1,000 Tons and 1,000,000 Baht			
		BE 2513		BE 2516	
		Export	Import	Export	Import
Rice (NG, white)	Q	977.0	0	822	0
	V	2,347.0	0	4,594.3	0
Rice (G, white)	Q	92.4	0	27.0	0
	V	180.2	0	126.2	0
Maize	Q	1,520.0	.1	1,456.0	1.0
	V	1,856.9	.5	2,861.2	1.0
Sugar	Q	168.0	0	276.0	0
	V	139.5	0	1,155.6	0
Rubber	Q	278.0	0	391.0	0
	V	2,249.7	207.9	4,572.6	142.4
Cassava Products	Q	1,327.0	0	1,836.0	0
	V	1,227.2	0	2,536.6	0
Buffalo, Bullocks, and Cows	Q	35.0	.2	46.0	2.4
	V	72.8	3.4	138.6	.7
Swine	Q	16.0	.3	11.0	.6
	V	10.8	.4	8.3	2.4
Dairy Products	Q	0	46.0	0	40.0
	V	0	397.3	0	511.2
All Agricultural Products	V	10,977.7	3,884.50	22,150.9	5,519.7
Agricultural Trade Balance Exports-Imports	V	7,093.3		16,631.1	

Source: See Appendix Table 1.

As indicated in Table 8 agricultural production in Thailand has met most domestic requirements and made a significant contribution to Thailand's balance of payments. Net foreign exchange earnings from agricultural trade totaled 28.4 million Baht in BE 2517.

Providing food for Thai citizens at reasonable prices and contributing to Thailand's balance of trade are important contributions of agriculture. However, the industry's provision of income and employment for 80 percent of Thailand's people also is very important. Cash income and income in kind received from agriculture and family income generated by the agricultural sector are shown in Figure 3 and Table 9. Agriculture's contribution to the income objectives of Thailand is large and important (Table 10).

Table 9. Regional Average Farm Family Income by Source and Total Family Income Generated in Nonagricultural Sectors by Agriculture in BE 2513 (Baht).

Region	Farm Income			Total Family Income Generated in Nonagricultural Sectors by Agriculture BE 2516
	Income from Farm Sources Less Operating Expenses <sup>1</sup>	Income from Off-farm Work	Farm Family Disposable Income	
North	2,187	1,602	3,789	
Northeast	952	1,064	2,015	
Central Plain	1,343	4,585	5,928	
South	1,784	2,170	3,954	
Thailand	1,486	2,044	3,530	44,325 million

Source: Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government Farm Income and Expenditures in Thailand- BE 2513 Bangkok, Thailand.

<sup>1</sup>Includes value of rice grown and consumed by the family.

The production and trade data of Table 8 indicate that Thai farmers are very successful in meeting domestic food requirements and generating substantial foreign exchange earnings. Success of Thai farmers in achieving their income and employment objectives has been much more limited, however. Average farm family disposable income of 3482 Baht and unemployment and

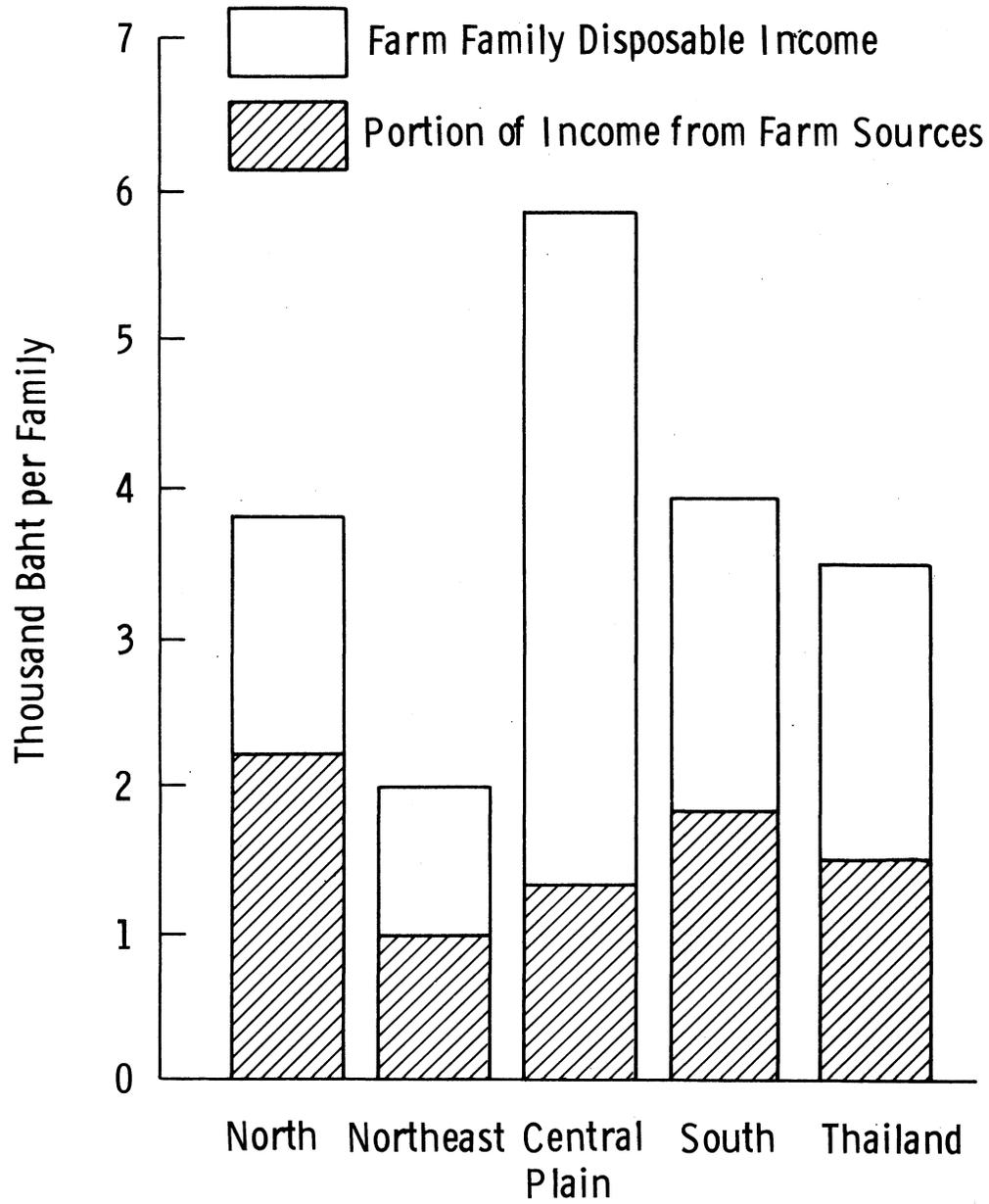


Figure 3. Average Income per Farm Family by Source BE 2513.

Table 10. Labor Force and Employment in Thailand for Agriculture and Nonagricultural Sectors by Region BE 2513 (1,000).

Region	Total population 11 Years of Age <sup>1</sup> and Over <sup>1</sup>	Economically Active Population		Economically Active Popula- tion Employed only in Agriculture 15-64 <sup>3</sup>	Economically Active Population by Occupation <sup>2</sup>	
		11-14	15-64 and over		Agriculture 15-64	Nonagriculture 15-64
North <sup>4</sup>	5,166	395	3,402	1,926	2,891	511
Northeast <sup>5</sup>	7,327	734	5,268	3,145	4,788	480
Central Plain	7,193	379	4,251	2,300	2,312	1,940
South	2,776	132	1,759	997	1,428	331
Thailand	22,462	1,640	14,681	8,368	11,419	3,262

<sup>1</sup>Table 16, 1970 Population and Housing Census, National Statistical Office, Office of the Prime Minister, 1973 Bangkok, Thailand.

<sup>2</sup>Table 19, 1970 Population and Housing Census, National Statistical Office, Office of the Prime Ministry, 1973 Bangkok, Thailand.

<sup>3</sup>Estimated by using proportion from 1973 General Survey, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok, Thailand.

<sup>4</sup>North - including changwat Loei.

<sup>5</sup>Northeast - excluding changwat Loei.

underemployment of 6.2 million man years indicate the presence of factors severely limiting the ability of Thailand to achieve agricultural income and employment objectives. Average farm family disposable income for the nation was only 3482 Baht in BE 2513. Underemployment in combination with unemployment encompassed 42 percent of the nation's work force. Income and employment also vary considerably by region. In BE 2513, per farm family disposable income was only 2015 Baht while unemployment alone was 33 percent in the Northeast region (Table 11).

Table 11. BE 2513 and Projected BE 2524 Population Statistics Under Alternative Population Growth Assumptions by Region (1000).

	North	Northeast	Central Plain	South	Thailand
Growth Rate of 2.1 Percent					
Population BE 2513 <sup>1</sup>	7,813	11,700	10,612	4,272	34,397
Projected Population BE 2524 <sup>2</sup>	10,946	16,386	14,863	5,984	48,179
Projected Increase	3,133	4,686	4,251	1,712	13,782
Economically Active Population BE 2513	3,402	5,268	4,251	1,759	14,680
Project Economically Active Population BE 2524	4,019	7,730	8,087	2,554	22,390
Projected Increase	617	2,462	3,836	795	7,710
Growth Rate of 2.5 Percent					
Population BE 2513 <sup>1</sup>	7,813	11,700	10,612	4,272	34,397
Projected Population BE 2524 <sup>2</sup>	11,110	16,630	15,085	6,073	48,898
Projected Increase	3,297	4,930	4,473	1,801	14,501
Economically Active Population BE 2513	3,402	5,268	4,251	1,759	14,680
Projected Economically Active Population BE 2524	4,019	7,730	8,087	2,554	22,390
Projected Increase	617	2,462	3,836	795	7,710
Growth Rate of 2.8 Percent					
Population BE 2513 <sup>1</sup>	7,813	11,700	10,612	4,272	34,397
Projected Population BE 2524 <sup>2</sup>	11,254	16,847	15,281	6,152	49,534
Projected Increase	3,441	5,147	4,669	1,880	15,137
Economically Active Population BE 2513	3,402	5,268	4,251	1,759	14,680
Projected Economically Active Population BE 2524	4,019	7,730	8,087	2,534	22,390
Project Increase	617	2,462	3,836	795	7,710

<sup>1</sup>1970 Population Housing Census, National Statistics Office, Office of The Prime Minister, 1973, Bangkok, Thailand. Table 1.

<sup>2</sup>Projected from 1970 Population & Housing Census, National Statistic Office, Office of The Prime Minister, 1973, Bangkok, Thailand, Tables 4,16, and 19. The projections were made by the Institute of Population Studies, Chulalongkorn University, Bangkok, Thailand.

## III. ISSUES AFFECTING PLANNING RESEARCH

## Population Growth

Effective agricultural planning in Thailand requires consideration of several specific issues. Paramount among these issues is population growth. Planning is done to meet the objectives of the people. The size of the future population determines the number of people with food needs and income and employment aspirations; that is, the number of people with objectives to be met.

Estimates of Thailand's annual population growth rate by the end of the Fourth Five-Year Plan period, BE 2524, range from a low of 2.1 percent to a high of 2.8 percent. If the lower of the two rates prevails, the population of Thailand will be 1,355,000 persons less than if the higher rate prevails. Similarly, the number of economically active Thai people, those wanting jobs, will be much larger in the future if the high rate is the actual rate of population growth. The uncertainty as to the actual growth rate requires that implications of alternate rates be analyzed.

The levels of total and economically active population if alternative population growth rates prevail are presented in Table 11.

Surplus production available for export is important for Thailand's future development. Agricultural exports traditionally have been very important earners of foreign exchange. Foreign exchange earnings are critical for the capital investments necessary for future development. Self sufficiency of agricultural production and the presence of a surplus for export depend on three factors: population which determines domestic

requirements, land area in agriculture, and productivity of agricultural inputs interact to determine the domestic food situation. Land area and agricultural input productivity are discussed later. Our emphasis here is that if population and domestic food requirements increase at a rapid rate and land area and productivity increase only at past trends, Thailand could soon become a net rice importer. The issue is can Thailand influence population growth and agricultural production so that self sufficiency of food production can continue and specified export targets be achieved.

#### Income Levels and Distribution

Review of the current income conditions presented in Figure 3 and Table 9 and comparison of farm and nonfarm family income statistics for Thailand indicates three issues with respect to income levels in Thailand.<sup>1</sup> Those issues are that the level of incomes in agriculture is low, that the level of incomes in agriculture is low relative to income levels in Bangkok, and that a highly unequal distribution of income prevails among farmers within between regions.

As shown in Figure 3 and Table 9 the average disposable income of farm families in Thailand was 3482 Baht per family in BE 2513. Some 1000 Baht or 29 percent of that amount is rice grown on the farm and consumed by the family. Average income per family living in Bangkok in BE 2513 was 32,220 Baht.

Income varies among regions due to land productivity, size of farm, and availability of off-farm work. As shown in Figure 3 income of farm

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<sup>1</sup>National Statistical Office, Report Socio-Economic Survey BE 2511-2512, Office of the Prime Minister, Royal Thai Government, Bangkok, Thailand.

families is highest, 5,928 Baht per family, in the Central Plain. Farmers in this region have more productive land and a greater opportunity for off-farm work. Average farm size in the low income Northeast regions is not enough larger than in the Central Plain to compensate for differences in land quality and productivity.

#### Employment Levels and Distribution

Next to land, Thailand's people and the labor they supply are the nation's richest resource. However, the labor resource is effective only if it can be employed productively. Whether or not it can be so employed and where it can be employed are important issues for development planning.

As shown in Figure 4 and Table 10, annual unemployment currently is high. If current unemployment rates continue under population growth, underemployment and unemployment could encompass 13.9 man years by BE 2524.

Two propositions prevail relative to where the otherwise unused labor can be employed. Some persons believe that the major portion of available labor can be absorbed by agriculture. Others suggest that agriculture can not absorb growth in the labor supply and that industrialization must be stepped up accordingly. Labor requirements in agriculture are seasonal and, as shown in Figure 5, labor is in short supply in periods of peak use. This situation coupled with increased use of labor intensive technology could result in greater labor utilization in agriculture. However, this increased use will not be sufficient to provide employment for all unused labor available annually.<sup>1</sup> If increased employment and income

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<sup>1</sup>See Figure 6.

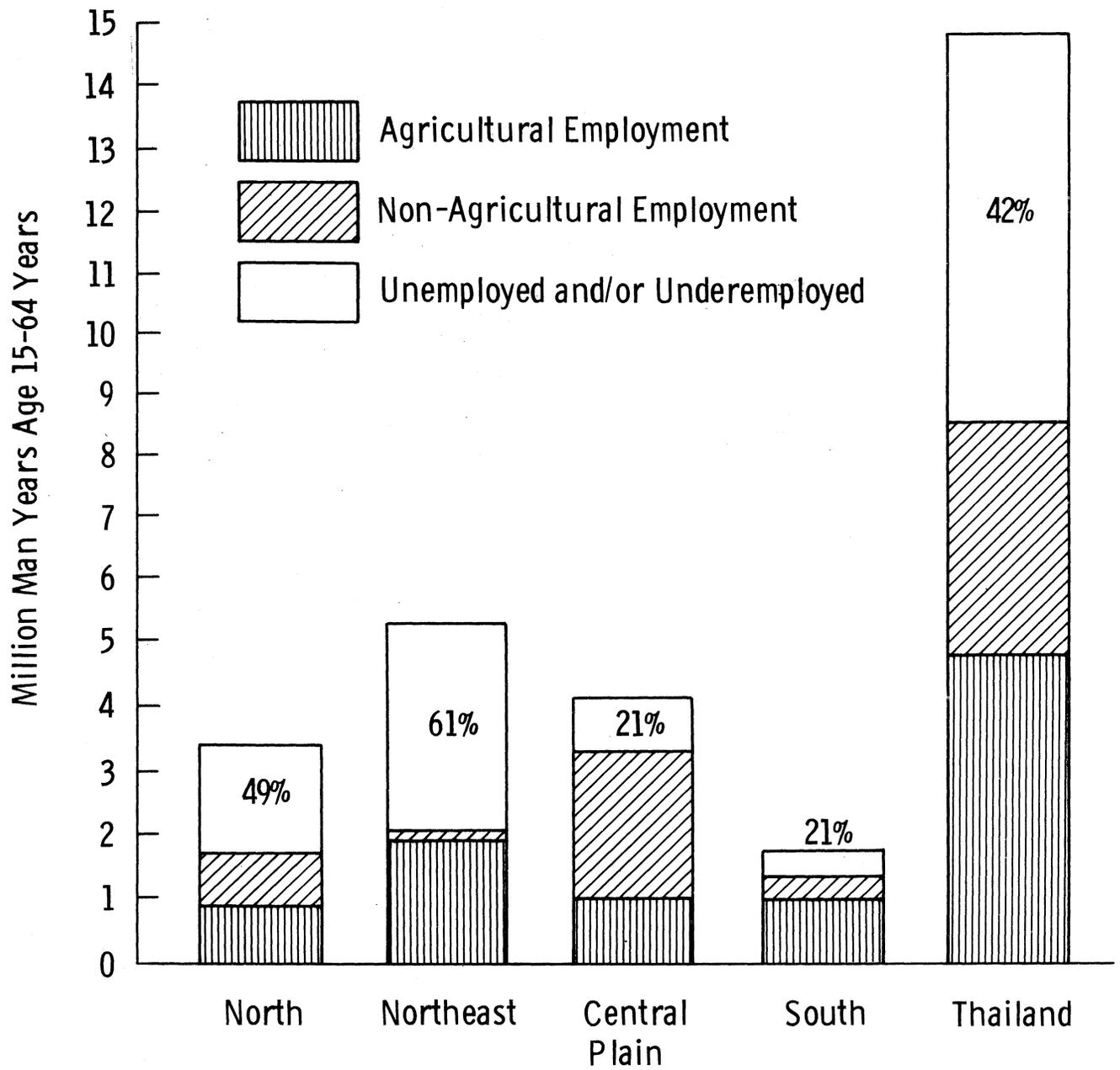


Figure 4. Employment in Thailand by Region for Agriculture and Nonagricultural Sectors BE 2513

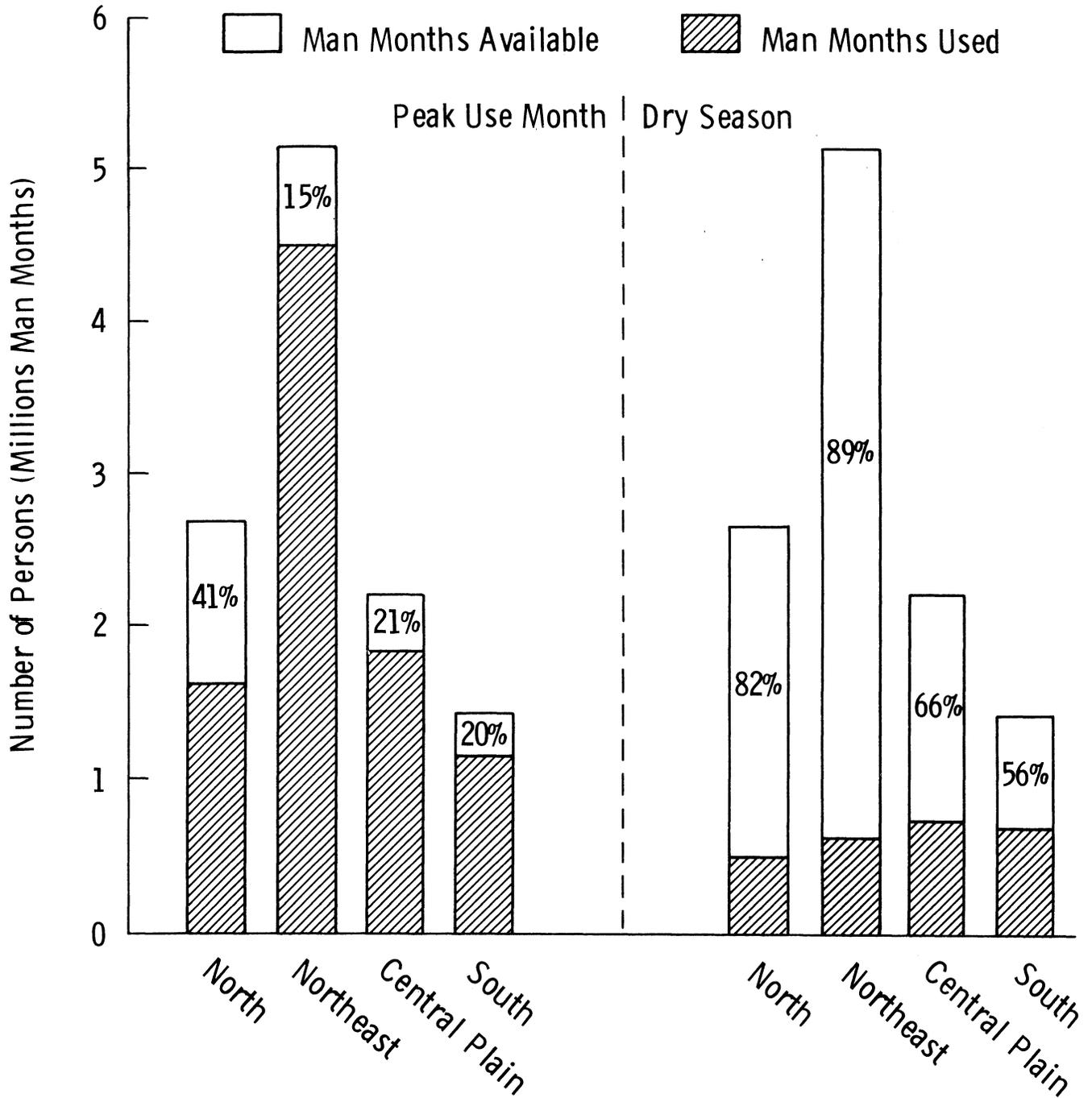


Figure 5. BE 2516 Agricultural Labor Available and Employed in Agriculture in Thailand's Agricultural Regions During the Peak Use Month and in the Dry Season When Agricultural Labor Requirements are Lowest. (Numbers in Bars Indicate Percent of Labor not Used.)

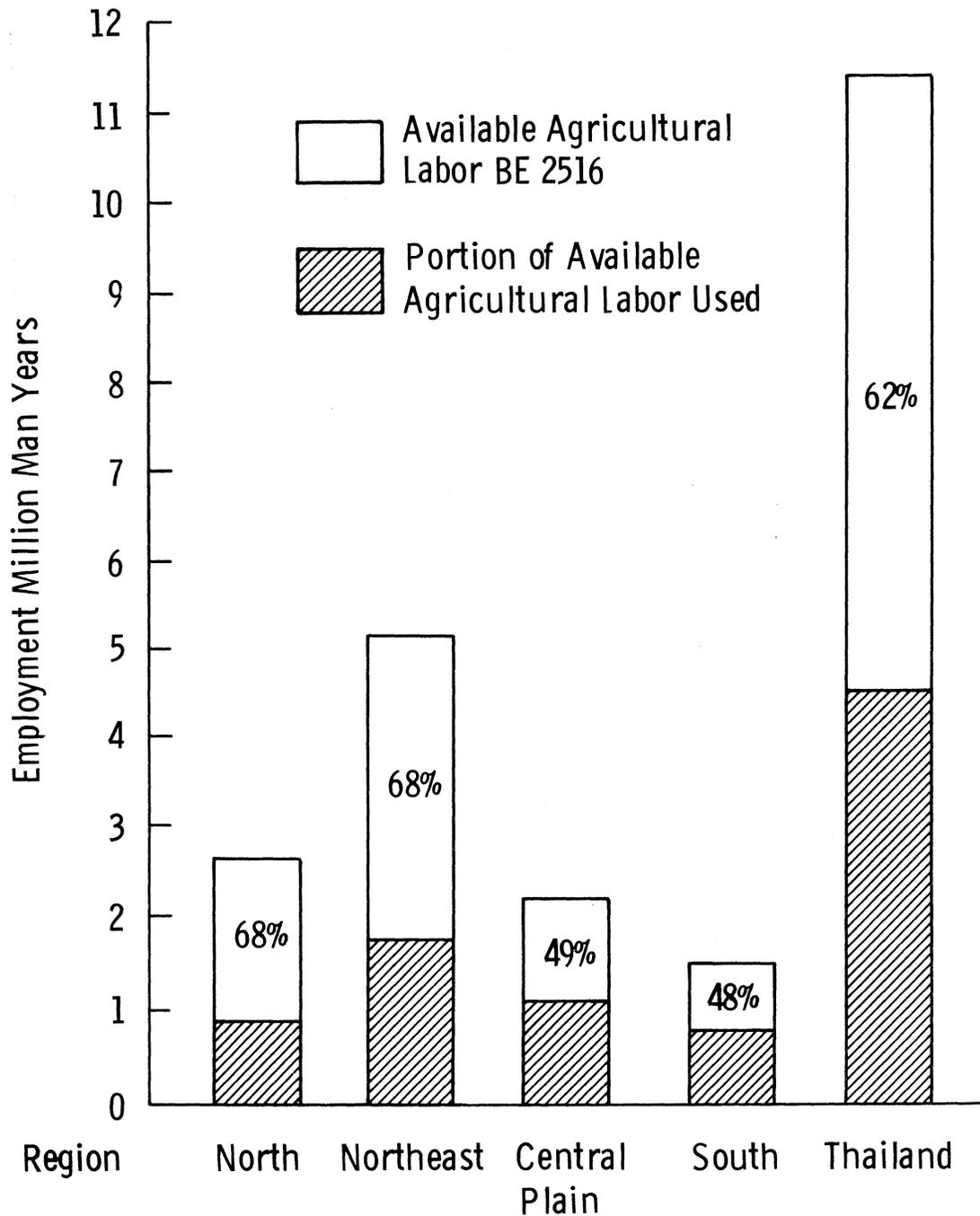


Figure 6. BE 2516 Levels of Total Employment in Agriculture. (Numbers in Bars are Percent of Labor Not Used.)

Source: Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government.

opportunities are to be provided, more off-farm jobs must become available. To have greatest impact on agriculture, some of the off-farm jobs must provide employment opportunities during those periods of the year when agricultural labor requirements are at low levels shown in Figure 7.

#### Land Reform and the Right to Land Ownership

The ownership of land also is an important issue in development planning. There is need for security in the ownership of land. A farmer who owns his land, or owns the rights to its use, is secure in the knowledge that he will be able to produce food for his family and have a place to live. Depending on the size of his land-holding, he also has ability to earn money income from the use of his land. The ownership or right to use land and to realize the product it generates directly affects the ability of farmers to produce food for themselves and market income.

As shown in Table 12, the quantity of farm land owned varies among farmers in Thailand. Two questions must be answered if land reform is to be considered as an instrument. Two questions must be answered if land reform is to be considered as an instrument to improve the distribution of income in rural Thailand. Those questions are: (a) what income level is "adequate" for Thailand's farmers, and (b) given differences in land quality and planned production and product prices, how large must farms be in each region of Thailand if they are to provide an "adequate" income?

#### Area of Land Classified by Type and Actual Land Use<sup>1</sup>

The Division of Agricultural Economics' BE 2516 survey of Thailand estimated an agricultural land area of 100,436,000 rai. The distribution

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<sup>1</sup>The definition of Land Types is as follows: Land Type I suitable only for production of floating rice; Land Type II suitable for production of crops under controlled irrigation; Land Type III suitable for rainfed irrigation crop production; Land Type IV suitable only for upland crops.

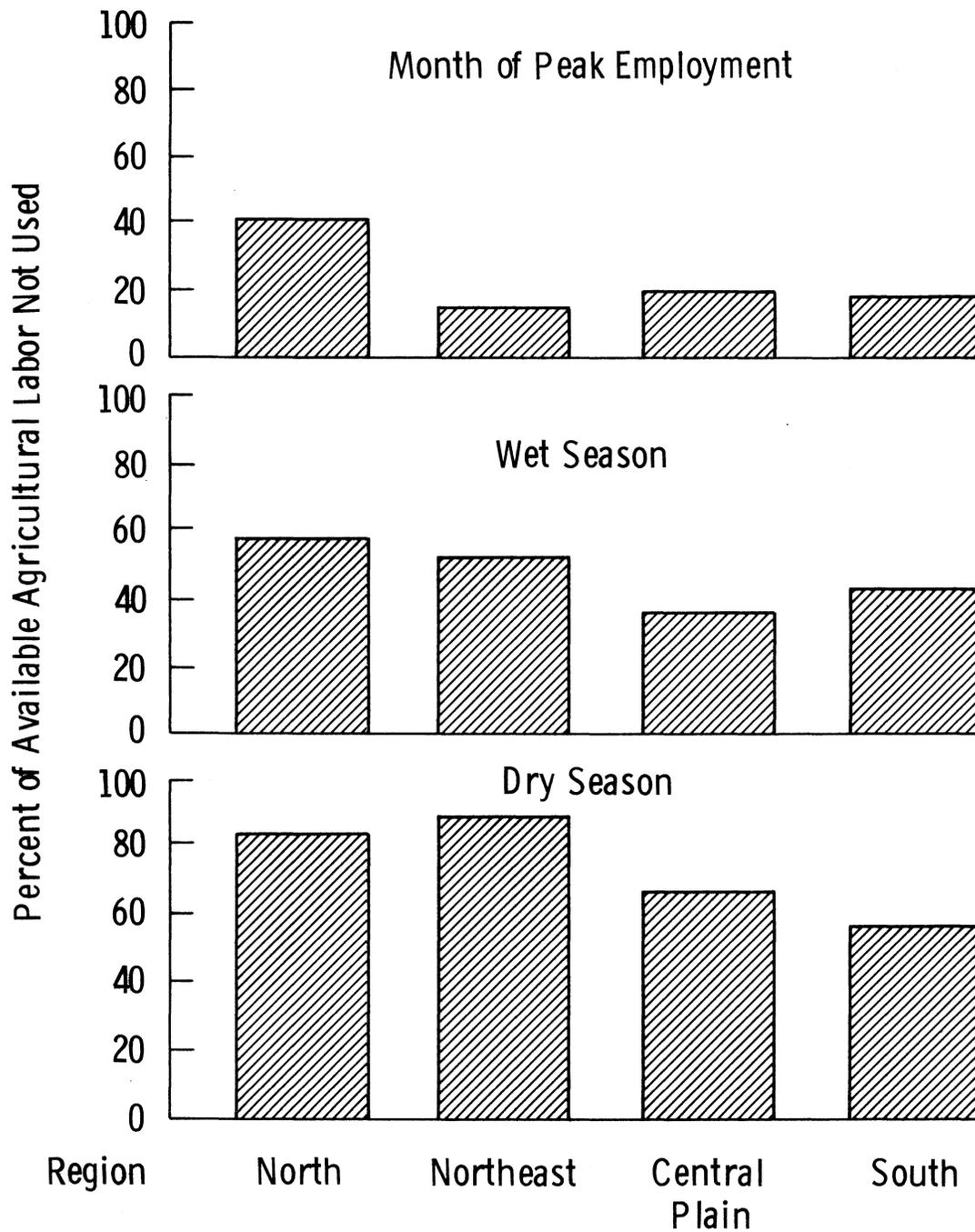


Figure 7. BE 2516 Agricultural Employment Situation by Region in the Month of Peak Employment, the Dry Season and the Wet Season.  
 Source: Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government.

Table 12. The Distribution of Farms by Size and Land Area by Tenure Class and Region, BE 2517.<sup>1</sup>

Region	Number of Farms by Size Class in Rai						Total
	0-10	11-20	21-30	31-40	41-50	More Than 50	
All Farms							
Northeast	170,837	359,162	344,656	234,765	142,039	250,798	1,502,257
North	252,682	202,578	106,367	74,806	60,886	157,275	854,594
Central	111,851	128,470	131,368	87,211	72,225	161,829	693,017
South	113,110	160,868	90,310	46,989	28,833	40,880	480,990
Kingdom	648,480	851,078	672,701	443,771	303,983	610,782	3,530,795 <sup>a</sup>
Average Farm Size (Rai)	6.03	14.77	24.60	34.55	44.65	77.65	30.97
Total Land Area (Rai)	3,910,334	12,570,422	16,548,445	15,332,288	13,572,841	47,427,222	109,348,721
Owned Farm							
Northeast	109,393	256,965	260,802	191,512	115,260	270,800	1,204,732
North	159,130	112,273	59,163	44,941	37,629	93,292	506,428
Central	15,478	67,811	60,929	36,530	32,655	80,198	353,601
South	13,001	111,951	66,295	36,614	24,417	36,178	348,456
Kingdom	417,002	549,001	447,189	309,597	209,962	417,469	2,350,220
Average Farm Size (Rai)	5.89	14.80	24.60	34.61	44.66	77.52	26.94
Total Land Area (Rai)	2,456,142	8,125,215	11,000,849	10,715,152	9,376,903	32,362,197	74,036,458
Part Owned and Part Rented							
Northeast	10,513	26,695	23,853	14,077	12,975	16,104	104,217
North	39,645	38,905	17,637	13,777	13,373	37,500	160,837
Central	9,744	24,196	36,327	28,014	21,467	51,879	171,627
South	22,902	31,729	13,583	5,728	1,800	2,194	77,936
Kingdom	82,804	121,525	91,400	61,596	49,615	107,677	514,617
Average Farm Size (Rai)	8.08	14.80	24.60	34.66	44.69	78.86	34.12
Total Land Area (Rai)	669,056	1,798,570	2,248,440	2,134,917	2,217,294	8,491,408	17,558,732
Rented							
Northeast	679	300	663	157	0	382	2,181
North	1,088	1,631	3,326	1,252	217	485	7,999
Central	11,014	12,254	12,549	6,679	6,535	10,324	59,355
South	56	79	0	0	156	0	291
Kingdom	12,836	14,264	16,538	8,089	6,908	11,191	69,826
Average Farm size (Rai)	5.36	15.81	26.17	36.07	47.31	74.03	31.14
Total Land Area (Rai)	68,801	225,514	432,799	291,770	326,817	828,470	2,174,382

Source: Division of Agricultural Economics, Office of the Under Secretary, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>1</sup>The information on land tenure presented does not cover all farmers. Information for those who, for example, are given free use of public land or farm institutional land are not included.

by land type was as follows: Land Type I-2,927,000 rai; Land Type II-19,365,000 rai; Land Type III-49,271,000 rai; and Land Type IV-28,873,000 rai. Area seeded to paddy in BE 2516 totaled 52,270,000 rai while the area seeded to upland crops was 29,621,000 rai. The total area seeded to crops was 81,891,000 rai or 81.5 percent of Thailand's land area classified as agricultural.

Production of paddy rice occurs on Land Types I, II and III. There are 71,563,000 rai of land classified as Type I, II or III. Only 73 percent of this area or 52,270,000 rai was seeded to paddy in the wet season. An important question is whether the remaining 19,293,000 rai or 27 percent was used for crops. If it was not used the reasons should be studied. If climatic and topographical conditions make it impossible to grow crops on the remaining area under normal conditions alternative uses of this area should be considered. Potentially, farm income can be improved in some regions through appropriately planned use of this area of Type I, II and III land.

#### Agricultural Productivity and Technology Adoption

Thailand's agriculture historically has provided ample food for the nation's people and has been a major earner of foreign exchange essential for development. To maintain these accomplishments and pursue development objectives such as income improvement and increased employment new approaches must be taken. In the past new land could be brought into cultivation. Production then could be increased without improving yield per rai. The data in Table 13 indicate increased land area as the main source of greater production. The fact that average yield levels were

maintained while new land areas of lower quality were added indicates that some yield increases were realized. However, potential yield increases much larger than those now realized are possible. Under experimental conditions RD variety rice yields averaging some 750 kilograms per rai have been produced in Thailand.

Table 13. Land Area, Yield and Production of Rice in Thailand BE 2498-2518.

Year	Land Area Planted to Paddy (1,000 Rai)	Yield Per Rai (Kgs of Paddy Rice)	Total Production (1,000 Metric Tons of Paddy Rice)
2498	36,060	247	8,907
2499	37,648	264	9,939
2500	31,726	220	6,980
2501	35,887	240	8,613
2502	37,909	223	8,454
2503	37,012	256	9,475
2504	38,619	256	9,886
2505	41,168	267	10,992
2506	41,299	281	11,585
2507	40,872	278	11,362
2508	40,961	268	10,978
2509	46,454	257	11,947
2510	41,612	231	9,625
2511	45,173	229	10,348
2512	47,400	283	13,410
2513	46,840	290	13,570
2514	47,043	292	13,744
2515	45,931	270	12,413
2516	52,270	285	14,898
2517	49,889	268	13,486
2518 <sup>1</sup>	53,243	265	14,091

Source: The Center for Agricultural Statistics, Division of Agricultural Economics, Ministry of Agricultural and Cooperatives, Royal Thai Government, Bangkok, Thailand, 1975.

<sup>1</sup>Second crop production not included.

Most of Thailand's land area suited to agriculture is now in use. Further clearing of virgin land could destroy essential watersheds and not provide land suited to crops. Therefore, further production increases must come mainly from more intensive use of the land currently in agriculture. More double cropping through use of irrigation potential, increased use of pesticides, fertilizers and new varieties and more effective use of improved technology must be considered as means to increase output per rai.

## IV. OBJECTIVES

Development planning in Thailand is based on plans for concurrent five-year periods. Three concurrent plans have been developed to date. The Third National Economic and Social Development Plan (1972-1976)<sup>1</sup> provides for development planning through the year VE 2519.

To facilitate development of a Fourth Five-Year Plan for Agriculture the Ministry of Agriculture and Cooperatives, Royal Thai Government, charged its Division of Agricultural Economics with responsibility for development of Thailand's Fourth Five-Year Agricultural Development Plan BE 2524-Guidelines.<sup>2</sup> In order to complete the task of developing guidelines for the Fourth Five Year Plan for the agricultural sector a program of research with the following objectives was specified: (1) to discern the general objectives the Royal Thai Government wishes to pursue during the period of The Fourth Five-Year Plan; (2) to identify alternative ways of pursuing those objectives through agriculture; (3) to specify potential Alternative Plans consisting of specific levels of (a) government objectives and (b) means for achieving those objectives; (4) to conduct analyses of each specified Alternative Plan to determine its feasibility implications, and impact on government objectives.

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<sup>1</sup>Government of Thailand, The Third National Economic and Social Development Plan (1972-1976) Economic and Social Development Board, Office of The Prime Minister, Bangkok, Thailand. 1973.

<sup>2</sup>Division of Agricultural Economics, Thailand's Fourth Five-Year Agricultural Development Plan BE 2524 - Guidelines. Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand. June, 1976. (Mimeo-Publication Pending)

## V. THE APPROACH TAKEN

The purpose of this chapter is to present a description of the approach taken to specify the agricultural development plan alternatives analyzed and to estimate the impact of each on identified objectives.

The general objectives discerned as those the Royal Thai Government wishes to pursue during the period of the Fourth Five-Year Plan are: (1) to raise the levels of income in Thailand and improve the distribution of income of Thailand's farm and nonfarm people; (2) to increase employment opportunities for Thailand's people; (3) to produce adequate food supplies for all people at reasonable prices; (4) to improve national security and unity; (5) to increase the level of foreign exchange earnings; and (6) to provide the right of individual farmers to own land.

Two of the above objectives were not directly considered in the analyses conducted. One of these, improved national security and unity, was assumed to follow from achievement of income and employment objectives. If people have jobs and improving income situations they were assumed to be able to satisfy their life goals better and as a result take more pride in their country and have less reason to seek or be responsive to alternative non-Thai leaders and or forms of government.

The other objective not analyzed was the right of individual farmers to own land. While land ownership and its distribution can profoundly affect income distribution and may affect productivity it was assumed to be a means of income redistribution which does not significantly affect production and productivity.

Analyses of Alternative Plans were conducted in terms of the remaining four objectives; namely, income, employment, production, and exports with production and export results reflecting self sufficiency of food production and the level of foreign exchange earnings.

The purpose of this chapter is to describe the approach taken to specify the Alternative Plans analyzed.

The factors affecting achievement of identified objectives can be classified into two groups. Namely, those affecting the demand for agricultural products and those affecting the supply of agricultural products. Table 14 contains a listing of both types of factors. These factors are subject to variation. Variation in any factor or combination of factors affects the achievement of identified government objectives. Therefore, research to support plan formulation must include analysis of the extent to which government objectives can be achieved under specified conditions concerning all factors. Each specification is one "Alternative Plan".

Table 14. Factors Affecting Achievement of Agricultural Development Planning Objectives.

Factors Affecting Product Demand	Factors Affecting Product Supply
Population Income Exports Commodity Prices	Agricultural Land Area and Use Irrigation Technology Adoption Commodity Prices Input Costs Climatic Conditions

In order to specify alternative plans it was necessary to consider the conditions affecting each factor and the extent to which they may be

modified through government programs implemented in the Fourth Five-Year Plan period. Conditions surrounding these factors are discussed in following sections of this chapter.

### Population Levels and Rate of Population Growth<sup>1</sup>

Analysis of past population growth rates and factors affecting fertilizer and mortality suggest that future population growth may range from a low of 2.1 percent per year to a high of 2.8 percent per year by the year BE 2524. The resulting projected population by region and for the nation under the low growth rate of 2.1 percent, the high growth rate of 2.8 percent and a medium growth rate are shown for Thailand by region in Table 15.

Table 15. Projected BE 2524 Regional and National Population Levels for Thailand Under Alternative Population Growth Rates (1,000 Persons).

	Region <sup>1</sup>				
	North	Northeast	Central	South	Nation
Population BE 2513 (Census Count) <sup>2</sup>	7,813	11,700	10,612	4,272	34,397
Revised BE 2513 Census Population					36,370
Projected Population BE 2524					
Low Growth Rate (2.1%)	10,946	16,386	14,863	5,984	48,179
Medium Growth Rate (2.5%)	11,110	16,630	15,085	6,073	48,898
High Growth Rate (2.8%)	11,254	16,847	15,281	6,152	49,534

<sup>1</sup>Regional disaggregation is based on data from the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>2</sup>National Statistical Office, Office of the Prime Minister, Thailand: Population and Housing Census BE 2513.

<sup>3</sup>Private communication. Institute of Population Studies, Chulalongkorn University.

<sup>1</sup>Population censuses were taken in Thailand in BE 2503 and BE 2513. The BE 2503 census count of Thailand's population was 26,257,916 people; the BE 2513 count was 34,397,000 people. Problems of under-enumeration have made subsequent upward adjustment in the census counts necessary. The result of those adjustments is a population of 36,370,000 people in the year of the most recent census, BE 2513.

### Income Growth

Review of past income growth rate trends and consideration of likely future income growth trends indicates that Thailand's income growth will vary only slightly relative to growth experienced since the beginning of the second five-year plan period. Growth since then has averaged approximately 2.2 percent per annum. Suppose the rate varied 1 percentage point from the 2.2 percent rate. The effect on total demand for a product whose consumption changed 0.4 percent for a 1 percent income increase would be only 2.00 percent.<sup>1</sup> A total difference of such a small magnitude relative to differences caused by variation in other factors such as population is relatively small.

### Exports

Agricultural product exports are subject to wide variation. The extent of the variation is illustrated in Table 8, Chapter II. During the period BE 2512-13 to BE 2517-18 nonglutinous rice exports ranged from a low of 82,000 tons in BE 2516 to a high of 1,487,000 tons in BE 2514.<sup>2</sup> During the same period, kenaf and jute exports varied by some 24,000 tons and rubber exported ranged between levels of 298,000 and 391,000 tons. Table 16 indicates the effect of a 1 percent income increase on the domestic demand for major type of food produced in Thailand.

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<sup>1</sup>A product with an income elasticity of demand equal to .4.

<sup>2</sup>See Appendix Table 1.

Table 16. Percentage Increase in Domestic Demand for Selected Major Thailand Agricultural Products Given a One Percent Increase in Disposable Income, 1972-73.

Crop	Percent Increase	Percent Change Over a 5 Year Period for a 1 Percent Change in Income Growth Rate
Rice: Glutinous	.047	.235
Rice: Nonglutinous	.047	.235
Cassava	.388	1.955
Sugarcane	.337	1.696
Beans and Oilseeds	.338	1.701
Vegetables	.216	1.085
Beef	.142	.712
Pork	.386	1.945

Source: Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

#### Commodity Prices

Commodity prices affect both the demand for and supply of agricultural products. When the price of a product is high farmers increase production of that product to improve their income. When it is low they decrease production of it. From these conditions it follows that supply stability and price stability must be considered together if policies concerning price and or supply stabilization are to be effective.

Historically, prices of agricultural products and levels of production have fluctuated considerably except in instances where controls have been used. Table 17 illustrates the nature of price and production relationships for selected commodities.

Because of insufficient demand analysis research to estimate price changes and in order to keep the number of alternatives analyzed manageable,

commodity prices stable at current levels were assumed for all products except sugarcane and rice in all analyses conducted. Sugarcane prices were set at the government-specified level. Rice prices, given the high level of uncertainty as to what they would be, were set at a farm level price of 2,500 and 2,600 Baht, respectively, for glutinous and nonglutinous paddy rice. The impact of these assumed rice prices and alternative price conditions is discussed in detail in Chapter VII.

Table 17. Price, Production and Export Levels for Selected Thai Agricultural Products.

Product	Date	Price <sup>1</sup>		Production	Level of Exports (metric tons)
		Domestic (Baht/ton)	Export FOB (Baht/ton)	Level (metric tons)	
Mixed Rubber	BE 2513	6,740	8,097	287,200	278,060
	BE 2514	5,500	6,192	316,300	308,069
	BE 2515	5,390	5,868	336,900	317,665
	BE 2516	9,910	11,734	367,700	390,649
	BE 2517	9,780	13,924	382,100	362,865
Kenaf and Jute	BE 2513	2,680	2,792	380,900 <sup>2</sup>	257,663
	BE 2514	3,163	3,449	419,100	270,676
	BE 2515	4,460	4,269	427,900	255,093
	BE 2516	3,430	3,992	468,900	264,684
	BE 2517	3,020	3,431	384,100	246,007
White Rice (No. 1)	BE 2513	2,096	3,140	13,570,000	1,063,616
	BE 2514	1,940	2,563	13,744,000	1,591,384
	BE 2515	1,979	2,690	12,413,000	2,112,114
	BE 2516	3,007	5,174	14,898 000	848,717
	BE 2517	3,918	10,369	13,386,000	1,015,620

Source: Division of Agricultural Economics, Annual Agricultural Price Statistics, Agricultural Marketing Branch, Division of Agricultural Economics, 2514, 2516, 2518.

<sup>1</sup>Bangkok wholesale price.

<sup>2</sup>Kenaf.

### Agricultural Land Area and Use and Technology Adoption

Land area classified as upland and paddy land and land area actually used for upland and paddy crops are quite different. The low use level relative to land available and the adoption of technology for application in production were both discussed in Chapter III. Levels of use and technological adoption rate alternatives must be considered in analyses to support development of a Fourth Five-Year Plan for agriculture.

### Irrigation

One very important factor restricting the intensity of land use in Thailand is the use of irrigation water and its availability. Table 18 indicates the area of land which could be irrigated in each season, given water available from dams scheduled for completion by BE 2524. From analysis of the material presented in Table 18 it can be readily seen that potentially irrigable area will be much greater than that actually irrigated in BE 2524 unless use levels increase dramatically. Irrigable area available in BE 2524 in the wet season would permit almost a doubling of irrigated area and doubling of dry season irrigated area would still leave some 848 thousand rai of irrigable area unirrigated.

### Analysis of Livestock Production

Since analytical models suitable for detailed analysis of livestock production have not yet been completed for Thailand, it was necessary to limit the scope of analysis of livestock production. The analysis conducted involved the following steps: (1) estimation of the BE 2524 food and non-food demand for livestock-cattle, buffaloes, poultry, and pigs; (2) estimation of labor required to produce estimated BE 2524 livestock demand;

Table 18. Actual BE 2518 Irrigable Area Planted to Paddy and Potentially Irrigable Paddy Area by Season Given Completion of Dams and Reservoirs Under Construction and Scheduled for Completion by BE 2524.

Region and Zone	Wet Season		Dry Season <sup>1</sup>	
	Irrigated (Rai)	Irrigable (Rai)	Irrigated (Rai)	Irrigable (Rai)
Zone 1	317,324	518,965	7,048	111,154
Zone 2	27,644	182,070	-	46,486
Zone 3	471,645	1,067,720	5,608	379,625
Zone 4	64,406	153,334	-	21,777
Zone 5	303,448	415,248	20,634	147,426
Northeast Region	1,184,467	2,337,337	33,290	706,468
Zone 6	300,748	1,099,242	5,026	96,856
Zone 8	283,480	1,173,812	7,000	296,132
Zone 9	294,220	570,650	72,501	162,943
Zone 10	475,077	1,191,000	191,351	471,133
North Region	1,353,525	4,034,704	275,878	1,027,064
Zone 7	383,445 <sup>2</sup>	676,638	23,392	38,907
Zone 11	5,345,427 <sup>2</sup>	6,858,923	1,316,399	2,309,071
Zone 12	621,953 <sup>2</sup>	1,266,816	149,735	245,813
Zone 13	539,500 <sup>2</sup>	1,905,213	94,445	147,409
Zone 14	153,125 <sup>2</sup>	798,578	32,180	170,304
Zone 15	137,602 <sup>2</sup>	183,760	6,259	4,156
Zone 16	17,200	36,500	1,330	3,456
Central Plains	7,198,252	11,726,428	1,623,740	2,919,116
Zone 17	393,006	958,800	31,167	116,021
Zone 18	65,398	219,100	82	7,849
Zone 19	46,670	529,000	-	-
South Region	505,074	1,706,900	31,249	123,870
Thailand	10,241,318	19,805,369	1,964,157	4,776,518

Source: Irrigation Department, Ministry of Agriculture and Cooperatives, Royal Thai Government, Bangkok, Thailand.

<sup>1</sup>Estimated using the following procedure to allocate dry season irrigable area for projects without dry season data. In those cases Dry Season Irrigable Area for Projects without Dry Season Data = (Dry Season Irrigable Area for Project with Data Available/Wet Season Irrigable Area for Projects with Dry Season Data Available) (Wet Season Irrigable Area for Project with no Dry Season Data). Such estimates were required for 38 percent of the total area or 1.8 million rai.

<sup>2</sup>The distribution of project areas was estimated using the following procedure to allocate project area where projects involved are in more than one zone and changwat:

Project Area in Changwat = (Total Irrigated Area in Projects/Total Planted Area in Project Changwats) (Planted Area in Changwat).

(3) reduction of available crop labor by the estimated livestock labor requirement and allocation of that quantity of total labor available to livestock production; (4) estimation of livestock feed required to produce estimated BE 2524 livestock demand; and (5) addition of the feed required for livestock to the total demand for the identified feed crops.

Low, medium and high export assumptions for livestock corresponding to those for crops were used in estimation of total agricultural exports in the analyses conducted. The actual levels of domestic and export livestock demands used are shown in Table 19. The resulting domestic, export, and total livestock product demands also are presented in Tables 19a through 19f. Appendix Tables 2 and 3 contain the estimated labor and feed required for livestock.

#### Alternatives Identified for Analysis

On the basis of consideration of the demand and supply factors presented and discussed here together with the related issues discussed in chapter III a specific analytical approach was established. That approach was:

(1) to identify three principal alternatives for analysis; (2) to identify four complementary illustrative alternatives designed to illustrate the impact of specified conditions concerning selected individual factors; and (3) to estimate the impact of each principal and illustrative alternative on specified objectives. The three principal and four complementary illustrative alternatives identified and analyzed are presented in Table 20.

Table 19a. Estimated BE 2524 Domestic, Export and Total Livestock Product Demands by Region.<sup>1</sup> Low Assumed Population Growth Rate and Low Exports.<sup>2</sup>

Region and Commodity	Unit	Domestic Demand
North	Cattle	1,000 Head 223
	Buffalo	1,000 Head 23
	Swine	1,000 Head 978
	Chickens & Ducks	1,000 Birds 26,440
	Eggs (Hen & Duck)	Tons 417
Northeast	Cattle	1,000 Head 78
	Buffalo	1,000 Head 7.3
	Swine	1,000 Head 592
	Chickens & Ducks	1,000 Birds 60,190
	Eggs (Hen & Duck)	Tons 920
Central Plain	Cattle	1,000 Head 382
	Buffalo	1,000 Head 216
	Swine	1,000 Head 3,595
	Chickens & Ducks	1,000 Birds 50,820
	Eggs (Hen & Duck)	Tons 1,736
South	Cattle	1,000 Head 90
	Buffalo	1,000 Head 12.7
	Swine	1,000 Head 1,035
	Chickens & Ducks	1,000 Birds 24,660
	Eggs (Hen & Duck)	Tons 439

<sup>1</sup>Export demands were estimated only at the Kingdom level and assumed to be distributed among regions according to efficiency and/or government policy criteria.

<sup>2</sup>Conditions assumed in Alternative D to be discussed later.

Table 19b. Estimated BE 2524 Livestock Total Demands for Thailand with Low Assumed Population Growth and Low Exports.

Commodity	Unit	Domestic Demand	Export Demand	Total Demand
Thailand Cattle	1,000 Head	773	20	793
Buffalo	1,000 Head	266	5	271
Swine	1,000 Head	6,200	8	6,208
Chickens & Ducks	1,000 Birds	162,110	3,500	165,610
Eggs (Hen & Duck)	Tons	3,512	3,000	6,512

Table 19c. Estimated BE 2524 Domestic, Export and Total Livestock Product Demands by Region. Medium Assumed Population Growth Rate and Medium Exports.<sup>1</sup>

Region and Commodity		Unit	Domestic Demand
North	Cattle	1,000 Head	226
	Buffalo	1,000 Head	23.4
	Swine	1,000 Head	994
	Chickens & Ducks	1,000 Birds	26,820
	Eggs (Hen & Duck)	Tons	423
Northeast	Cattle	1,000 Head	80
	Buffalo	1,000 Head	7.4
	Swine	1,000 Head	602
	Chickens & Ducks	1,000 Birds	61,040
	Eggs (Hen & Duck)	Tons	933
Central Plain	Cattle	1,000 Head	387
	Buffalo	1,000 Head	219.2
	Swine	1,000 Head	3,650
	Chickens & Ducks	1,000 Birds	51,540
	Eggs (Hen & Duck)	Tons	1,760
South	Cattle	1,000 Head	91
	Buffalo	1,000 Head	20
	Swine	1,000 Head	1,050
	Chickens & Ducks	1,000 Birds	25,010
	Eggs (Hen & Duck)	Tons	445

<sup>1</sup>Conditions assumed in Alternatives B1 and B2 to be discussed later.

Table 19d. Estimated BE 2524 Livestock Total Demands for Thailand with Medium Assumed Population Growth and Medium Exports.

Commodity	Unit	Domestic Demand	Export Demand	Total Demand
Thailand Cattle	1,000 Head	784	25	809
Buffalo	1,000 Head	270	10	280
Swine	1,000 Head	6,296	15	6,311
Chickens & Ducks	1,000 Birds	164,410	7,500	171,910
Eggs (Hen & Duck)	Tons	3,561	4,000	7,561

Table 19e. Estimated BE 2524 Domestic, Export, and Total Livestock Product Demands by Region. High Assumed Population Growth Rate and High Exports.<sup>1</sup>

Region and Commodity		Unit	Domestic Demand
North	Cattle	1,000 Head	229
	Buffalo	1,000 Head	23.7
	Swine	1,000 Head	1,010
	Chickens & Ducks	1,000 Birds	27,180
	Eggs (Hen & Duck)	Tons	428
Northeast	Cattle	1,000 Head	81
	Buffalo	1,000 Head	7.5
	Swine	1,000 Head	611
	Chickens & Ducks	1,000 Birds	61,880
	Eggs (Hen & Duck)	Tons	946
Central Plain	Cattle	1,000 Head	393
	Buffalo	1,000 Head	222.3
	Swine	1,000 Head	3,710
	Chickens & Ducks	1,000 Birds	52,240
	Eggs (Hen & Duck)	Tons	1,785
South	Cattle	1,000 Head	92
	Buffalo	1,000 Head	20.3
	Swine	1,000 Head	1,070
	Chickens & Ducks	1,000 Birds	25,350
	Eggs (Hen & Duck)	Tons	451

<sup>1</sup>Conditions assumed in Alternative C to be discussed later.

Table 19f. Estimated BE 2524 Livestock Total Demands for Thailand with High Assumed Population Growth and High Exports.

Commodity	Unit	Domestic Demand	Export Demand	Total Demand
Thailand Cattle	1,000 Head	795	35	830
Buffalo	1,000 Head	273.8	15	288.8
Swine	1,000 Head	6,401	20	6,421
Chickens & Ducks	1,000 Birds	166,650	10,000	176,650
Eggs (Hen & Duck)	Tons	3,610	5,000	8,610

Table 20. Principal and Illustrative Alternatives Analyzed.

Planning Factors	Principal Alternatives			Illustrative Alternatives			
	A	B1	B2	C	D	E	F
Demand Factors:							
(1) Population: Growth Rate (Percent)	2.1	2.5	2.5	2.8	2.1	2.1	2.1
(2) Income:  Growth Rate (Percent) <sup>1</sup>	2.2	2.2	Regional and Land Type Minimum Income Levels Specified See Page 60		2.2	2.2	2.2
(3) Exports	High	Medium	Medium	High	Low	High	High
(4) Commodity Prices	BE 2516 - BE 2518 Average Level or Government Specified Price (See Appendix Table 4)						
Supply Factors (Maximum Use Levels)							
(1) Land Available: (1,000 Rai)							
Total	111,547	111,547	111,547	111,547	111,547	111,547	111,547
Type I	2,927	2,927	2,927	2,927	2,927	2,927	2,927
Type II	19,805	13,649	13,649	19,805	19,805	10,241	10,241
Type III <sup>2</sup>	48,637	54,794	54,794	32,327	32,327	38,242	38,242
Type IV	40,073	40,073	40,073			40,073	40,073
Type V	104	104	104	104	104	104	104
(2) Irrigated Land: (1,000 Rai)							
Total	24,582	16,992	16,992	24,582	24,582	12,205	12,205
Wet Season	19,805	13,665	13,665	19,805	19,805	10,241	10,241
Dry Season	4,900	3,228	3,228	4,900	4,900	1,964	1,964
(3) Technology Adoption: (Percent or 1,000 Rai)							
RD variety use:							
Percent of Land Type II in Wet Season:	62.7	49.9	49.9	62.7	62.7	62.9	31.5
Total Land Type II:	12,420	6,407	6,407	12,420	12,420	6,446	3,223
Percent of Land Type III Area Bound:	27.2	21.5	21.5	27.2	27.2	22.3	14.3
Total Land Type III:	8,788	7,659	7,659	8,798	8,798	8,535	5,470
(4) Fertilizer Use: (Kgs. per Rai)							
On Native Varieties:	25	25	25	25	25	25	Trend
On RD Varieties:	80	60	60	80	80	80	Levels
Area Vertilized (1,000 Rai)	20,567	19,300	19,300	20,567	20,567	18,785	14,974

<sup>1</sup>This growth rate is based on past trends and assumes their continuation.

<sup>2</sup>The portions of Type III Land which can be seeded to paddy under average weather conditions are the Land Type III constraints shown in Table 46.

<sup>3</sup>The maximum dry season rice area was assumed to be 80 percent of irrigable land.

## VI. ALTERNATIVES ANALYZED

## Alternative A

Table 21 provides national and regional information concerning BE 2524 demand factor levels assumed for analysis of Alternative A. The corresponding BE 2524 supply factor levels assumed in the Alternative A analysis are presented in Table 22.

Alternative A is presented for an analysis of future conditions which could prevail given implementation of programs to limit domestic demand, stimulate export demand and improve production and supply management. The two key demand factor assumptions in analysis of Alternative A are those concerning population growth and agricultural exports. First, reduction of population growth to an annual rate of 2.1 percent by BE 2524 implies very effective population planning programs. Secondly, achievement of the levels of agricultural exports indicated in Table 21 implies development of international trade and market channels and arrangements adequate to permit export levels significantly higher than current levels. Under demand conditions discussed above the domestic, export and total demand conditions which would exist are those shown in Table 23.

The key factors affecting the feasibility of achieving the supply conditions implied in analysis A are government programming, program implementation and farmer motivation. Increased use of improved varieties, fertilizer and available irrigation water cannot be achieved unless new variety seed and fertilizer are available and farmers are assisted to the extent necessary to insure their effective use. Available irrigation

Table 21. BE 2524 Demand Factor Levels Assumed in Analysis of Alternative A.

Demand Factor	Assumed BE 2524 Levels				
	Thailand	North	Northeast	Central	South
Total Population: (1,000's)	48,179	10,946	16,386	14,863	5,984
Income:					
Assumed Growth Rate (Percent)	2.2	2.2	2.2	2.2	2.2
Implied Level (Baht Per/Capita)	3,183				
Major Crop Exports (1,000 Tons) <sup>1,2</sup>					
Rice-Glutinous White					
Rice-Nonglutinous White	1,700				
Corn	300				
Sugarcane	10,417				
Cassava	2,600				
Rubber	450				
Kenaf & Jute	100				
Regional Major Crop Prices (Baht Per Ton) in Selected Zones <sup>3</sup>	Not Applicable <sup>4</sup>				
Rice-Glutinous Paddy		2,400	2,400	2,400	2,400
Rice-Nonglutinous Paddy		2,500	2,500	2,500	2,500
Corn		1,720	1,730	1,850	-
Sugarcane		240	176.65	235.09	-
Cassava		320	340	330	240
Rubber		-	-	-	8,000
Kenaf		1,350 <sup>5</sup>	2,090 <sup>6</sup>	-	-
Jute		2,800	2,560	-	-

<sup>1</sup>Export levels were respecified only at the Kingdom level.

<sup>2</sup>For exports of other crops see Appendix Table 6.

<sup>3</sup>For prices of other crops see Appendix Table 4.

<sup>4</sup>Prices used are estimated three year average regional rather than Kingdom prices.

<sup>5</sup>Zone 9.

<sup>6</sup>Zone 4.

Table 22. BE 2524 Supply Factor Levels Assumed in Analysis of Alternative A.

Supply Factor	Assumed BE 2524 Levels				
	Thailand	North	Northeast	Central	South
Economically Active Agricultural Population (Labor Supply) Land Available-Rai					
Total	16,912,005	3,415,409	7,025,657	4,396,980	2,073,959
Type I	111,547,017	24,187,711	47,839,518	24,479,082	15,040,706
Type II	2,927,000	2,591,000	-	336,000	-
Type III	19,805,369	4,034,704	2,337,337	11,726,428	1,381,500
Type IV	48,637,500	8,670,000	33,623,000	3,963,000	2,381,500
Type V	40,072,728	8,892,007	11,879,181	8,453,654	10,847,886
	104,420	-	-	-	104,420
Irrigated Land-Rai					
Total	24,581,887	5,061,768	3,043,805	14,645,544	1,830,770
Wet Season	19,805,369	4,034,704	2,337,337	11,726,428	1,706,900
Dry Season	4,776,518	1,027,064	706,468	2,919,116	123,870
Technology Adoption					
RD Variety Use:					
Percent of Land Type II in Wet Season	62.7	78.4	22.8	68.3	41.6
Total Land Type II Area-Rai	12,420,000	3,163,000	533,000	8,015,000	710,000
Percent of Land Type III Bounds <sup>1</sup>	25.3	32.6	19.4	54.7	37.6
Total Land Type III Area-Rai	8,788,000	1,767,000	4,019,000	2,277,000	726,000
Fertilizer Use Levels (Kgs. Per Rai)					
On Native Varieties	25	25	25	25	25
On RD Varieties	80	80	80	80	80
Rice Area (Rai)	20,567,000	1,834,000	9,084,000	8,121,000	1,528,000
Commodity Prices			See Appendix Table 4		

<sup>1</sup>The portions of Type III Land which can be seeded to paddy under average weather conditions are the Land Type III constraints shown in Table 46.

Table 23. BE 2524 National Domestic and Export Demand Assumed for Major Crops in Analysis of Alternative A (1,000 Tons).

Crop	Domestic	Export <sup>1</sup>
Rice: Glutinous Paddy	5,652	96 <sup>2</sup>
Rice: Nonglutinous Paddy	7,784	1,604 <sup>2</sup>
Maize	610	3,000
Cassava	536 <sup>3</sup>	2,600 <sup>4</sup>
Sugar	486	750
Kenaf	214	100
Rubber	16	450

<sup>1</sup>The assumed level of export demand for all other crops is presented in Appendix Table 6.

<sup>2</sup>White rice.

<sup>3</sup>Root equivalent.

<sup>4</sup>Tapioca products.

water will not be used unless institutions and equitable and acceptable distribution structures and methods are developed. Furthermore, farmers will only adopt the new techniques and technology if the adoption of such techniques in fact improves their income and general situation. Under Alternative A it is assumed that all conditions necessary to insure complete success of both demand and supply management prevail.

#### Alternative B1

Alternative B1 differs from A with respect to two factors affecting product demand and three factors affecting product supply. We will consider the demand factor differences first. The rate of population growth in BE 2524 is assumed to fall less under Alternative B1. The BE 2524 population growth rate is assumed to be 2.5 percent. Second, only medium levels

of product exports are assumed possible. Table 24 indicates the levels of product demand which would prevail under Alternative B1 conditions.

Table 24. BE 2524 Domestic and Export Demand Assumed for Major Crops in Analysis of Alternatives B1 (1,000 Tons).<sup>1</sup>

Crop	National Demand Level	
	Domestic	Export
Rice: Glutinous Paddy	5,732	79 <sup>2</sup>
Rice: Nonglutinous Paddy	7,894	1,321 <sup>2</sup>
Maize	615	2,500
Cassava	544 <sup>3</sup>	2,170 <sup>4</sup>
Sugar	493	550
Kenaf	217	70
Rubber	17	400

<sup>1</sup>Export demand for all other crops is presented in Appendix Table 6.

<sup>2</sup>White rice.

<sup>3</sup>Root equivalent.

<sup>4</sup>Tapioca product.

The differences between Alternatives A and B1 concerning supply factors occur with respect to irrigation, new variety, and fertilizer use levels. In Alternative B1 maximum use levels are lower. In Alternative B1 the response of farmers to programs designed to modify land use and increase the use of new varieties and fertilizers are assumed to be very good. In Alternative A response to such programs is assumed to be excellent. The supply conditions assumed to prevail under Alternative B1 are specified in Table 25.

Table 25. BE 2524 Supply Factor Levels Assumed in Analysis of Alternative B1.

Supply Factors	Assumed BE 2524 Levels				
	Thailand	North	Northeast	Central	South
Economically					
Active Agricultural Population (Labor Supply) Land Available-Rai	16,912,005	3,415,409	7,025,657	4,396,980	2,073,959
Total	111,547,017	24,187,711	47,839,518	24,479,082	15,040,706
Type I	2,927,000	2,591,000	-	336,000	-
Type II	13,665,000	2,783,000	1,612,000	8,090,000	1,177,000
Type III	54,777,869	9,921,704	34,348,337	7,599,428	2,908,400
Type IV	40,072,728	8,892,007	11,879,181	8,453,654	10,847,886
Type V	104,420	-	-	-	104,420
Irrigated Land-Rai					
Total	16,884,034	3,393,516	1,946,775	10,294,066	1,249,677
Wet Season	13,648,868	2,780,516	1,610,775	8,081,267	1,176,310
Dry Season	3,235,166	613,000	336,000	2,212,799	73,367
Technology Adoption					
RD Variety Use:					
Percent of Land Type II in Wet Season	46.9	58.8	17.1	51.0	31.2
Total Land Type II Area-Rai	6,407,000	1,637,000	276,000	4,127,000	367,000
Percent of Land Type III Bounds <sup>1</sup>	21.5	24.5	14.5	41.1	28.1
Total Land Type III Area-Rai	7,659,000	1,537,000	3,076,000	2,386,000	600,000
Fertilizer Use Levels (kgs. Per Rai)					
On Native Varieties	25	25	25	25	25
On RD Varieties	60	60	60	60	60
Rice Area Fertilized (Rai)	19,300,000	1,760,000	8,958,000	7,100,000	1,482,000
Commodity Prices					
			See Appendix Table 4		

<sup>1</sup>The portions of Type III Land which can be seeded to paddy under average weather conditions are the Land Type III constraints shown in Table 46.

## Alternative B2

Alternative A and Alternative B1 results indicate the level of income received by farmers given specified supply and demand factor conditions. However, the analyses conducted under Alternative A and Alternative B1 conditions do not require that the level of farm income be at least equal to a specified minimum. Instead, the level of income related to specified supply and demand factor conditions is accepted. Alternative B2 requires the income per farm to reach at least specified minimum levels.

Alternative B2 specifies an income policy objective and determines an agricultural development strategy which achieves that policy objective. It indicates, for the conditions assumed in the analysis, the distribution of crop production by region and land type required to meet specified minimum regional income levels per farm. The specified minimum levels were at least BE 2516 income levels in all regions and at least 2,000 Baht net income per farm from Land Type IV in the Northeast Region.

The difference between the approach taken in Alternative B2 and the approach taken in Alternatives A and B1 is very significant. In Plan B2 the policy objective of increasing farm income is explicitly identified and analyzed in the same way as the objective of agricultural production adequate to achieve self sufficiency in food production for Thailand. In short, it gives specific attention to achievement of specific farm income level and income redistribution objectives, two objectives explicitly identified as primary policy objectives.

The region and land type minimum income levels specified were as follows: North, 16,662 Baht per farm family; Northeast, 7,195 Baht per farm family; Central, 20,914 Baht per farm family; South, 12,356 Baht per farm family; and Northeast, Land Type IV, 2,000 Baht per farm family.

As stated earlier, Alternatives C, D, E, and F are illustrative alternatives. They are presented to indicate the impact of specific demand and supply factors on achievement of plan objectives. For example, comparison of Alternative C with Alternative A indicates the extent to which population programs which reduce the rate of population growth from a BE 2524 level of 2.8 percent to a level of 2.1 percent increase income, reduce unemployment, etc. Each of the illustrative alternatives and their relationship to Alternative A are discussed below.

#### Alternative C

As indicated above, Alternative C differs from A with respect to the assumed decline in the rate of population growth. Under Alternative A the population growth rate is assumed to decline to a level of 2.1 percent by BE 2524. Under Alternative C it is assumed to be a rate of 2.8 percent.

The purpose of Alternative C is to illustrate the importance of effective population planning if success in achieving government objectives is to be maximized. Table 26 shows the level of domestic demand for major crops if the population growth rate remains at the high level of 2.8 percent assumed in Alternative C and as compared to the low population growth rate of 2.1 percent assumed in Alternative A.

Table 26. BE 2524 Population and Domestic Demand Conditions Under Alternative C as Compared to Alternative A Conditions.

	Alternative C	Alternative A	Difference (C-A)	
			Quantity	Percent Decrease
Population (1,000 Persons)	49,534	48,179	1,355	2.74
Domestic Demand (1,000 Ton)				
Rice-Glutinous White	3,835	3,730	105	2.74
Rice-Nonglutinous White	5,281	5,137	144	2.73
Corn	546	532	14	2.56
Cassava	231	225	6	2.6
Kenaf & Jute	220	214	6	2.7
Rubber	17.34	16.86	0.48	2.77
Sugarcane	6,478	6,302	176	2.72

#### Alternative D

The purpose of Alternative D is to illustrate the impact of fluctuations in the level of major crop exports on the achievement of specified objectives. Exports under Alternative D are low relative to Alternative A levels. The specific major crop export levels of Alternatives A (high exports) and D (low exports) and the differences between the two are shown in Table 27.

#### Alternative E

The purpose of Alternative E is to illustrate the impact of alternative land use patterns and corresponding land use policy success. Under Alternative A increased use of irrigable land and restricted use of native upland areas is assumed. Under Alternative E it is assumed that increased use of irrigable cropland does not occur and that introduction of new native uplands into agricultural use continues. Land use patterns assumed in Alternative A and E analysis are shown in Table 28.

Table 27. Assumed BE 2524 Major Crop Export Levels for Alternative A with High Export Levels and Alternative D with Low Export Levels.

Crop	Assumed BE 2524 Export Levels (1,000 Tons)		
	Alternative A	Alternative D	Difference (Alternative A minus Alternative B)
Rice: Glutinous White	96	56	40
Rice: Nonglutinous White	1,604	944	660
Maize	3,000	2,000	1,000
Cassava	2,600	1,750	850
Sugar	750	350	400
Kenaf	100	50	50
Rubber	450	350	100

Table 28. Levels of Land Use Assumed in Alternative A and E Analysis (1,000 Rai).

Land Classification	Assumed Land Area <sup>1</sup>		Difference (Alternative A Minus Alternative E)
	Alternative A	Alternative E	
Total Land	111,547	111,547	-
Type I	2,927	2,927	-
Type II	19,805	10,241	9,564
Type III <sup>2</sup>	48,638	58,202	9,564
Type IV	40,073	40,073	-
Type V	104	104	-
Irrigated Land <sup>3</sup>			
Total Area	24,705	12,205	12,500
Wet Season	19,805	10,241	9,564
Dry Season	4,900	1,964	2,936

<sup>1</sup>A region specific breakdown of land area by Region appears in Table 46.

<sup>2</sup>The portions of Type III Land which can be seeded to paddy under average weather conditions are the Land Type III constraints shown in Table 46.

<sup>3</sup>This land area is a portion of the total Type II area and is included under Type II land area shown above.

## Alternative F

The purpose of Alternative F is to illustrate the importance of successful planning and programming to insure the adoption of improved technology and farming techniques. The new technologies considered are increased use of fertilizers, RD rice varieties and irrigation water. The level of irrigation water use is included in analysis F as well as E because water availability influences the effectiveness of fertilizer and RD rice varieties. In Alternative F levels of irrigated crop land are assumed to remain at BE 2518 levels and fertilizer use and use of RD varieties are assumed to increase only at past trend rates. The irrigated cropland, fertilizer and RD variety use levels assumed in analysis of Plan Alternatives A and F are shown in Table 29.

Table 29. BE 2524 Irrigable Land Area, Fertilizer and RD Rice Variety Use Assumed in Alternative A and Alternative F.

Technological Factor	Assumed Use Level		Difference (Alternative A minus Alternative F)
	Alternative A	Alternative F	
Irrigable Land Area (1,000 Rai)			
Wet Season	19,805	10,241	9,564
Dry Season	4,900	1,964	2,936
RD Varieties			
Percent of Type II Land Dry Season Area	62.7	31.5	-
Total Type II Land Area (1,000 Rai)	12,420	3,223	9,177
Percent of Type III Land Area Bounds <sup>1</sup>	25.3	14.3	-
Total Type III Land Area (Rai)	8,788	5,470	3,318
Fertilizer Use Levels (Kgs. Per Rai)			
On Native Varieties	25	Current	
On RD Varieties	80	Levels	
Rice Area Fertilized (1,000 Rai)	20,567	14,974	5,593

<sup>1</sup>The portions of Type III Land which can be seeded to paddy under average weather conditions are the Land Type III constraints shown in Table 46.

Comparison of results of Alternative A and F analyses illustrates the influence of programs to insure affective use of irrigation water. Without such programs, rates of technology adoption and fertilizer use can be expected to increase only according to Alternative F's past trend rates. Alternative F may, therefore, also be viewed as the results of total failure of agricultural planning for the Fourth Five-Year Plan period.

## VII. RESULTS OF ALTERNATIVES ANALYZED

Results of the alternatives analyzed are presented and discussed in terms of four specific objectives: income, employment, production and exports. Production and export results are related to self sufficiency in food production and the level of foreign exchange earnings. The Principal Alternatives A, B1, and B2 are presented first followed by presentation of illustrative Alternatives A, B1, and B2. Each alternative is discussed in relation to current conditions, Alternative A and one or more other alternatives.

BE 2524 Employment and Income Under Alternative  
A, B1 and B2 Conditions

BE 2524 employment and income under the conditions assumed for each of Alternatives A, B1 and B2 are presented in Figures 8 through 10 and Table 30, 31 and 32.

As shown in Figure 8 employment continues as a problem under all of the alternatives. Some 58 to 59 percent of the available work force remains unused. The situation varies considerably between regions, however. Annual unemployment varies from a high of 72 percent of the available annual labor unused in BE 2524 in the Northeast to a low of 31 percent unused in the Central Plain.

Annual labor use varies between plan alternatives especially at the regional level. Labor use is relatively higher under Alternative A which assumes higher exports than under B1 which assumes medium export

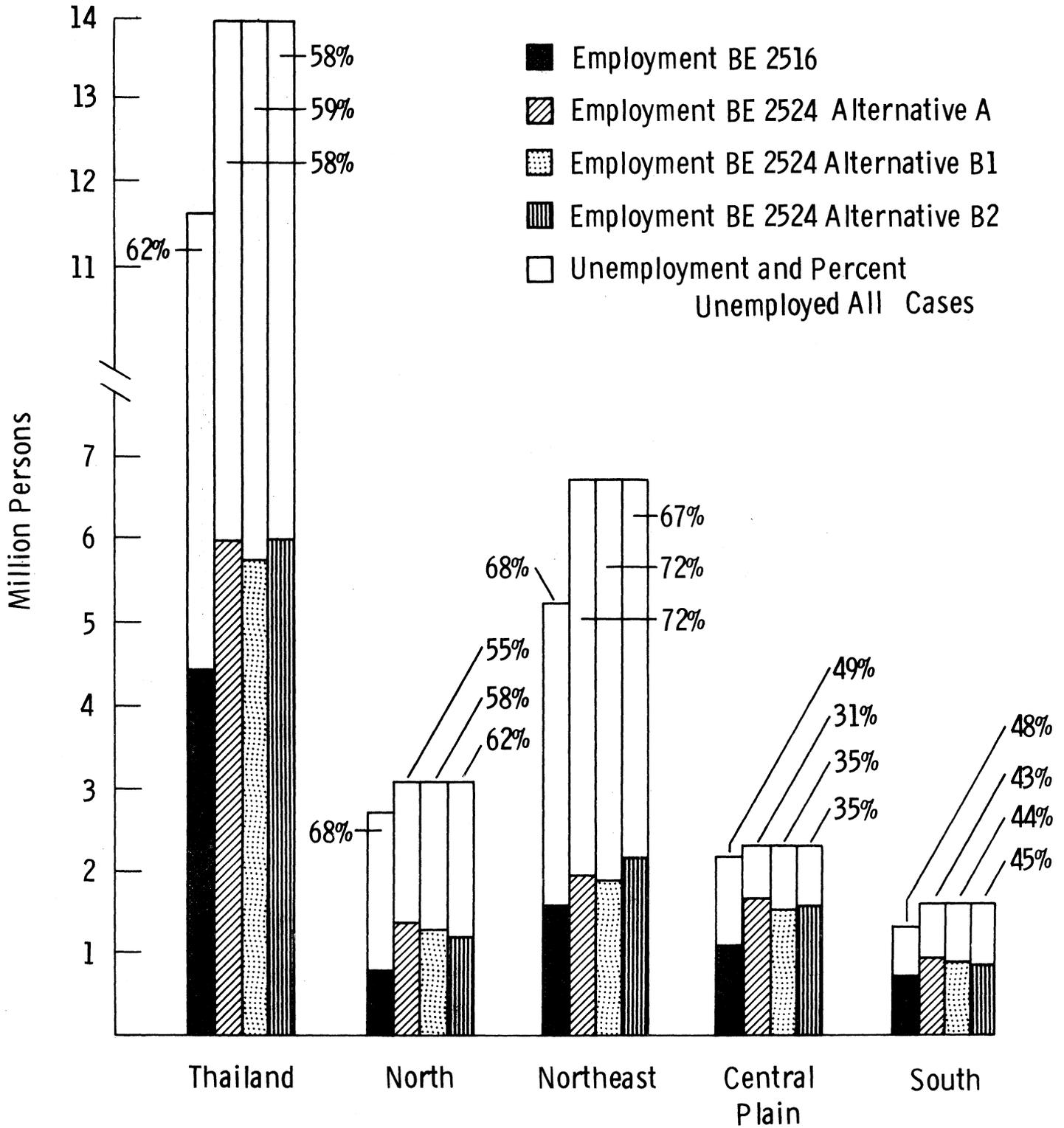


Figure 8. Economically Active Population and Employment Situation in Agriculture in BE 2516 and in BE 2524 under Alternative A, B1 and B2 Conditions.

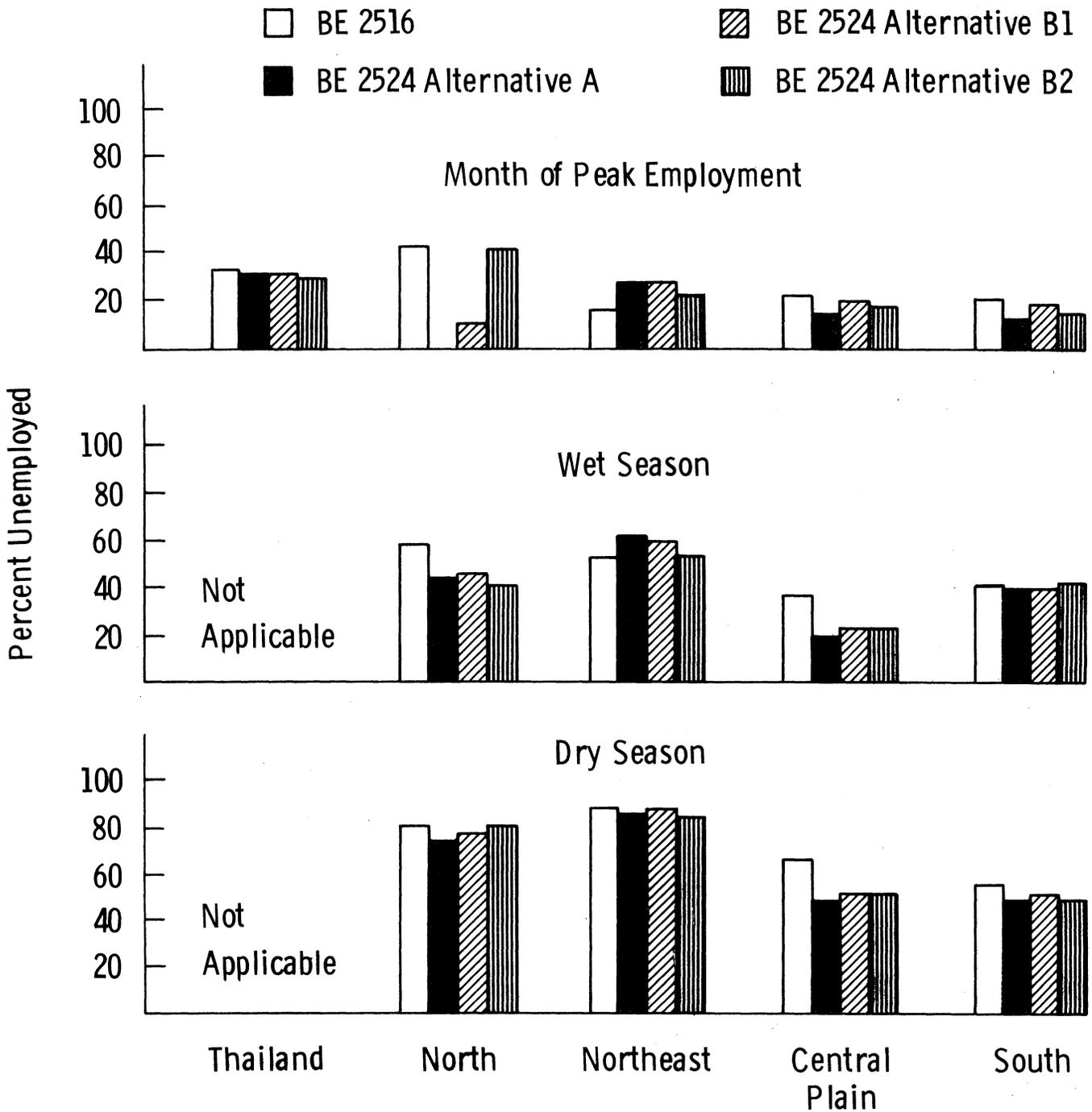


Figure 9. Levels of Unemployment in Thailand by Region BE 2516 and in BE 2524 as Estimated Under Alternatives A, B1 and B2 during the Wet Season, Dry Season and Month of Peak Employment. (These estimates include underemployment that is those persons who farm but do not have work to do every day are defined as unemployed on the days they have no work to do.)

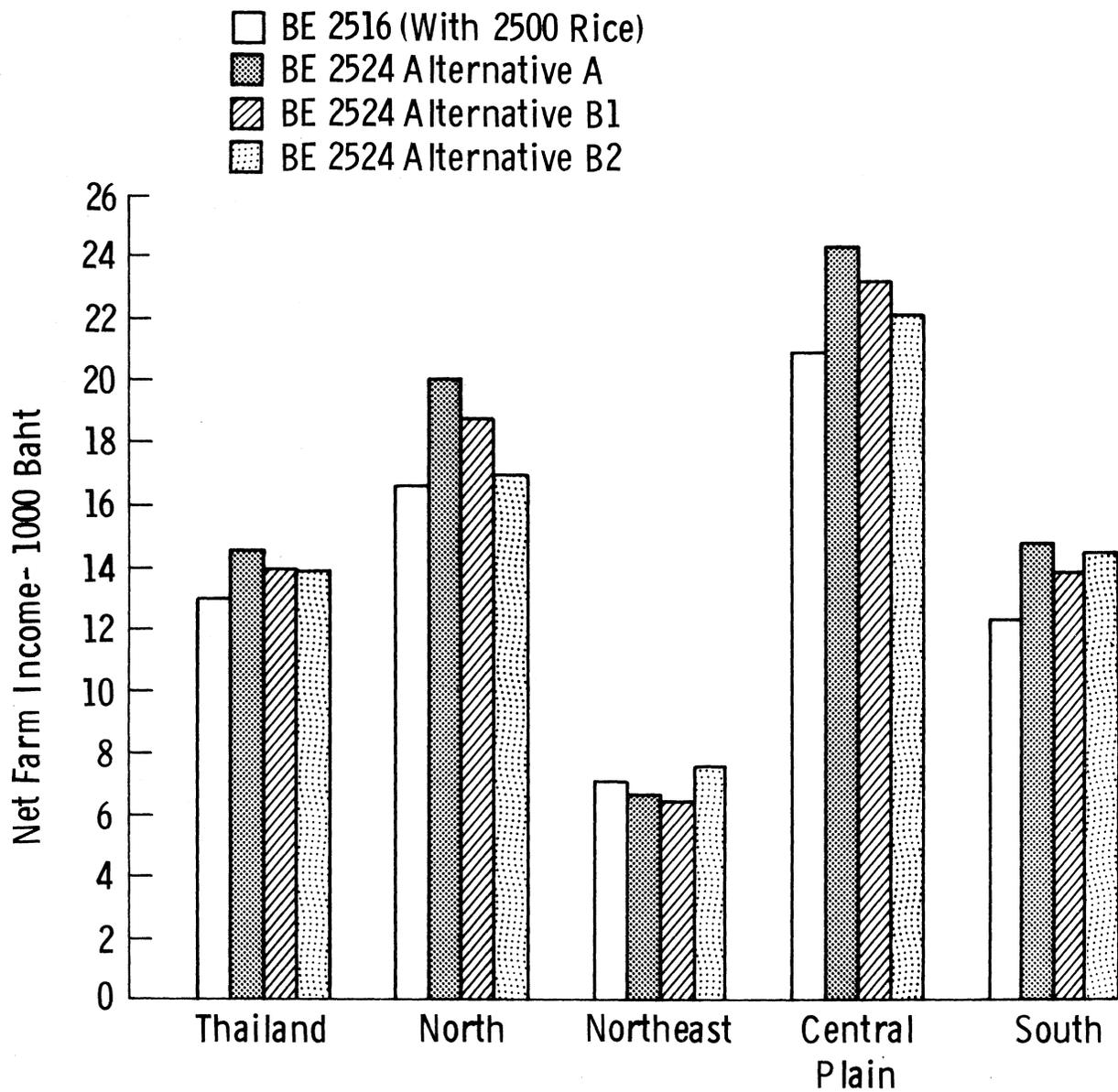


Figure 10. Net Farm Income in Thailand in BE 2516 and in BE 2524 as Estimated Under Alternative A, B1 and B2 Conditions. (The value of rice grown and consumed by the farm family is included.)

Table 30. Thailand's Employment and Income Situation by Region Under Alternative A Conditions, BE 2524.

Descriptive Statistics	Region				
	North	Northeast	Central Plain	South Thailand	
Number of Farms:	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:	3,132	6,814	24,075	1,698	14,052
Employment	1,403	1,921	1,659	973	5,956
Percent Unemployed	55	72	31	43	58
Month of Peak Labor Use:	December	July	August	December	December
Employment	3,132	5,033	2,044	1,511	9,872
Percent Unemployed	None	26	15	11	30
Wet Season:					
Employment	1,811	2,691	1,922	1,020	Not
Percent Unemployed	42	61	20	40	Applicable
Dry Season:					
Employment	819	822	1,281	907	Not
Percent Unemployed	74	88	47	47	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	20,695	15,164	28,812	9,487	74,158
Average Gross Crop Production Per Farm (Baht)	22,303	7,483	25,812	14,727	15,636
Average Crop Operating Expenses Per Farm (Baht)	5,105	1,986	6,576	2,230	3,736
Net Crop Income <sup>1</sup> Per Farm (Baht)	17,198	5,497	18,606	12,497	11,900
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income (Baht)	20,101	6,603	24,407	14,728	14,643

<sup>1</sup>Assumes zero cost for owned land and labor resources and includes rice grown for home consumption.

Table 31. Thailand's Employment and Income Situation by Region Under Alternative B1 Conditions  
BE 2524.

Descriptive Statistics	Region				Thailand
	North	Northeast	Central Plain	South	
Number of Farms	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:					
Employment	3,132	6,814	2,408	1,698	14,052
Percent Unemployed	1,317	1,910	1,558	946	5,732
Month of Peak Labor Use:					
Employment	December	July	July	December	December
Percent Unemployed	2,789	5,019	1,947	1,383	9,803
Wet Season:	11	26	19	19	30
Employment	1,760	2,714	1,829	1,019	Not
Percent Unemployed	44	60	24	40	Applicable
Dry Season:					
Employment	685	764	1,169	844	Not
Percent Unemployed	78	89	51	50	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	18,604	15,164	26,982	9,129	69,885
Average Gross Crop Production Per Farm (Baht)	20,049	7,486	23,583	14,171	14,735
Average Crop Operating Expenses Per Farm (Baht)	4,210	2,025	6,025	2,606	3,496
Net Crop Income <sup>1</sup> Per Farm (Baht)	15,839	5,461	17,558	11,565	11,239
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income (Baht)	18,742	6,567	23,359	13,796	13,982

<sup>1</sup> Assumes zero cost for owned labor and land resources and include rice grown for home consumption.

Table 32. Thailand's Employment and Income Situation by Region Under Alternative B2 Conditions, BE 2524.

Descriptive Statistics	Region				
	North	Northeast	Central Plain	South Thailand	
Number of Farms:	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:	3,132	6,814	2,408	1,698	14,052
Employment	1,191	2,270	1,563	937	5,963
Percent Unemployed	62	67	35	45	58
Month of Peak Labor Use:		July	August	December	December
Employment	1,865	5,289	1,970	1,448	10,171
Percent Unemployed	40	22	18	15	28
Wet Season:					
Employment	1,610	3,159	1,821	978	Not
Percent Unemployed	49	54	24	42	Applicable
Dry Season:					
Employment	591	1,008	1,193	879	Not
Percent Unemployed	81	85	50	48	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	16,416	18,890	25,599	9,073	69,978
Average Gross Crop Production Per Farm (Baht)	17,692	9,322	22,374	14,083	14,755
Average Crop Operating Expenses Per Farm (Baht)	3,770	2,772	5,941	1,781	3,598
Net Crop Income <sup>1</sup> Per Farm (Baht)	13,922	6,550	16,433	12,302	11,157
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income (Baht)	16,825	7,656	22,234	14,533	13,900

<sup>1</sup>Assumes zero cost for owned labor and land resources and includes value of rice grown for home consumption.

levels. Whether or not the high export levels assumed in Alternative A and the associated higher employment can be realized is a question.

Employment levels in Alternative B2 are higher than in B1 even for the same level of total demand. This is associated with the redistribution of production between Alternatives B1 and B2. When the requirement that income in the Northeast be higher is introduced, production must increase in the Northeast region. Since production in the Northeast is more extensive and uses more labor per unit of output total employment in that region and the entire kingdom rises. Most of the employment increase in the Northeast region under Alternative B2 results from a reduction in employment in the North. However, slight declines in employment also occur in the Central Plain and South regions.

Annual employment statistics for Thailand show only one dimension of the employment situation. The other very important dimension is the monthly and seasonal variation in labor use and, hence, employment. Figure 9 illustrates the seasonality of employment. The entire economically active population is employed during December, the month of peak employment, in the North region in BE 2524 under Alternative A conditions. Figure 9 also shows the high levels of use in the wet season as compared to the dry season. Levels of unemployment exceed 40 percent in all regions in the dry season and reach levels of 80 percent in the North and Northeast.

The levels of unemployment are highest in the Northeast under most conditions considered. Only under Alternative B2 conditions are

unemployment levels as high in any other region. Under Alternative B2 the unemployment level in the North in the peak use month is 40 percent as compared to 22 percent for the Northeast. Under all other conditions unemployment is consistently higher in the Northeast.

The results of analyses for the Principal Alternatives A, B1 and B2 indicate that: (a) even under the "best" foreseeable conditions unemployment in Thailand's agricultural sector will be very high; (b) future employment problems will be most severe in Northeastern Thailand; (c) Thailand's employment problems can only be solved if additional jobs can be provided in nonagricultural sectors; and (d) programs to increase employment must be developed keeping the seasonal nature of agricultural labor requirements clearly in mind.

Levels of income vary significantly between Alternatives A, B1 and B2, too. The average level of net farm income in Thailand under Alternative A is 14,643 Baht per farm as compared to 13,900 Baht per farm under Alternative B2. Income varies much more between Alternatives at the regional level. Income in the North is 1,359 Baht lower under B1 medium export level conditions than it is under the high export levels assumed in Alternative A.

A serious problem emphasized by the results of Alternative A, B1 and B2 is the low absolute and relative level of income in the Northeast region. Under Alternative A and B1 income in this region is only 6,603 and 6,567 Baht, respectively. The purpose of Alternative B2 is to consider ways to improve income in the Northeast region. Even with programs to

provide at least 2,000 Baht of net income from Type 4 Land for each Northeastern farmer, net farm income in the region rises to only 7,656 Baht per farm.

An important reason for the low level of income in the Northeast is the low productivity of its land resources compared to other regions. Because of low land productivity farmers of the Northeast can not grow crops as efficiently as farmers in other regions. As shown by comparison of regional income estimates presented in Tables 30 and 31, income in the North region rises by 1,359 Baht per farm when exports increase from medium to high levels. Similarly when exports rise from Plan Alternate B1 to A levels the incomes of Central Plain farmers rise 1,048 Baht and those of Southern farmers rise 932. Under the same conditions income remains almost unchanged in the Northeast since incomes increase by only 36 Baht per farm.

A related reason why increased exports do not measurably increase incomes in the Northeast is the lack of availability and/or use of the products of government programming. Most of the available irrigation water is in the North and Central Plain regions. These regions can increase production more effectively by using water along with RD varieties and fertilizers.

The analysis of Alternatives A, B1 and B2 show that the income of Thai farmers in those regions with the ability to adopt new technology and with available irrigation water can be improved through increased exports. It also shows that the incomes of farmers in the Northeast are

more difficult to improve. Incomes can be improved relative to other regions only if preferential treatment and intensive programming are effectively carried out for the few options open to the region.

#### BE 2524 Employment and Income Under Alternative C and D Conditions

Alternatives C and D are illustrative alternatives analyzed to show the effect of changes in demand for farm products on the objectives of Thai agriculture. In Alternative C a population growth rate of 2.8 percent in BE 2524, as compared to 2.1 percent in Alternative A, is assumed. In Alternative D, exports are assumed to fall to low levels resulting in a decrease in total demand.

Comparison of Alternatives A and C results, presented in Figures 11, 12, and 13 and Tables 33 and 34, shows that the effect of the high population growth rate on demand is relatively small in the Fourth Five-Year Plan Period. This is illustrated by comparison of total rice demand. As shown in Table 26 under the conditions of Alternative A total demand for white rice is 8.87 million tons. Under Alternative C it is 9.12 million tons, an increase of only some 250,000 tons.

The effect of such an increase on employment and income is limited. Agricultural employment in Thailand is estimated to be only approximately 40,000 persons higher. The income effect of such an increase in domestic demand is a 167 Baht increase in average income per farm.

While the effects of higher population growth rates on income are small and positive in the short term, they need qualification.

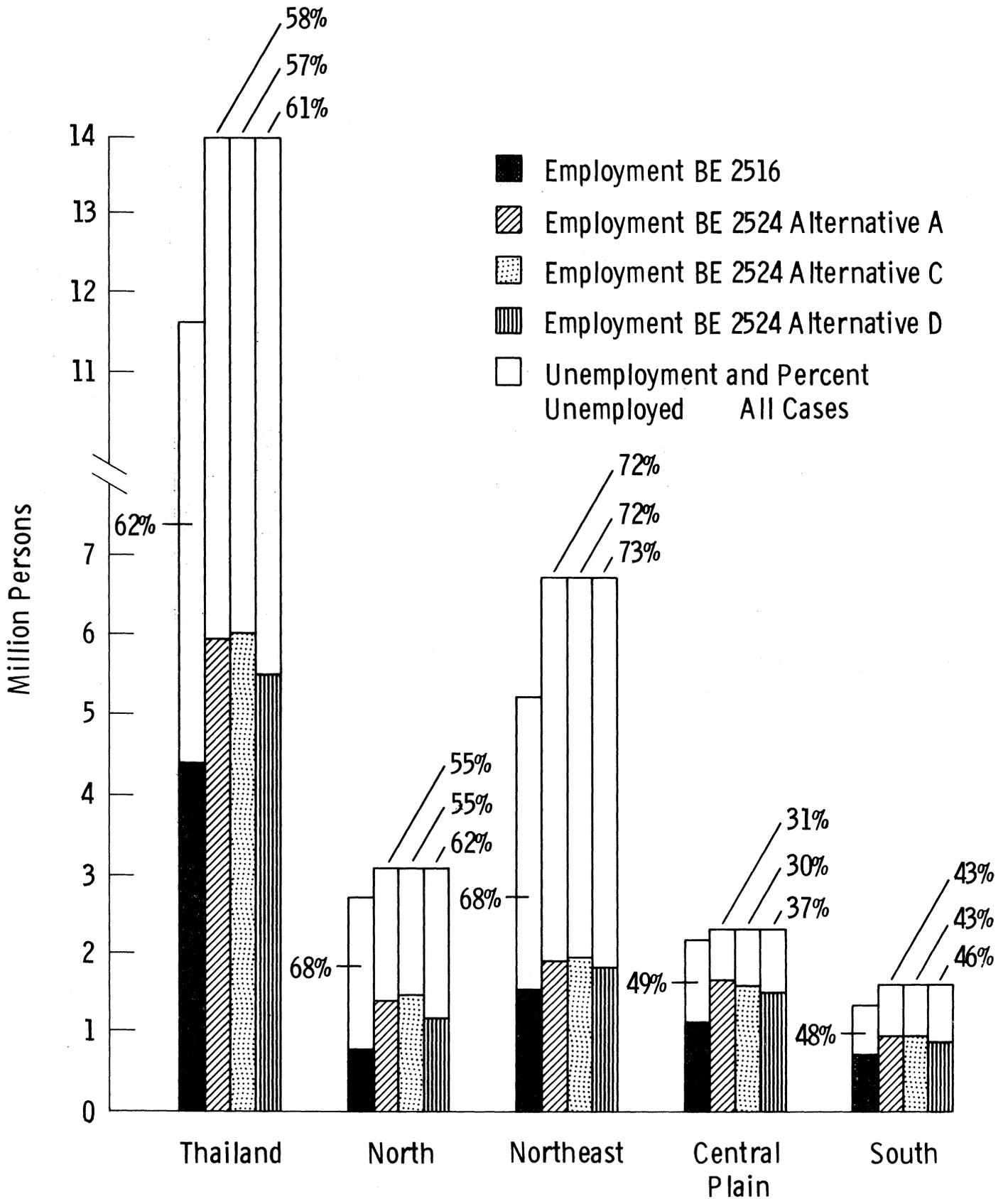


Figure 11. Economically Active Population and Employment Situation in Agriculture in BE 2516 and in BE 2524 under Alternatives A, C and D Conditions.

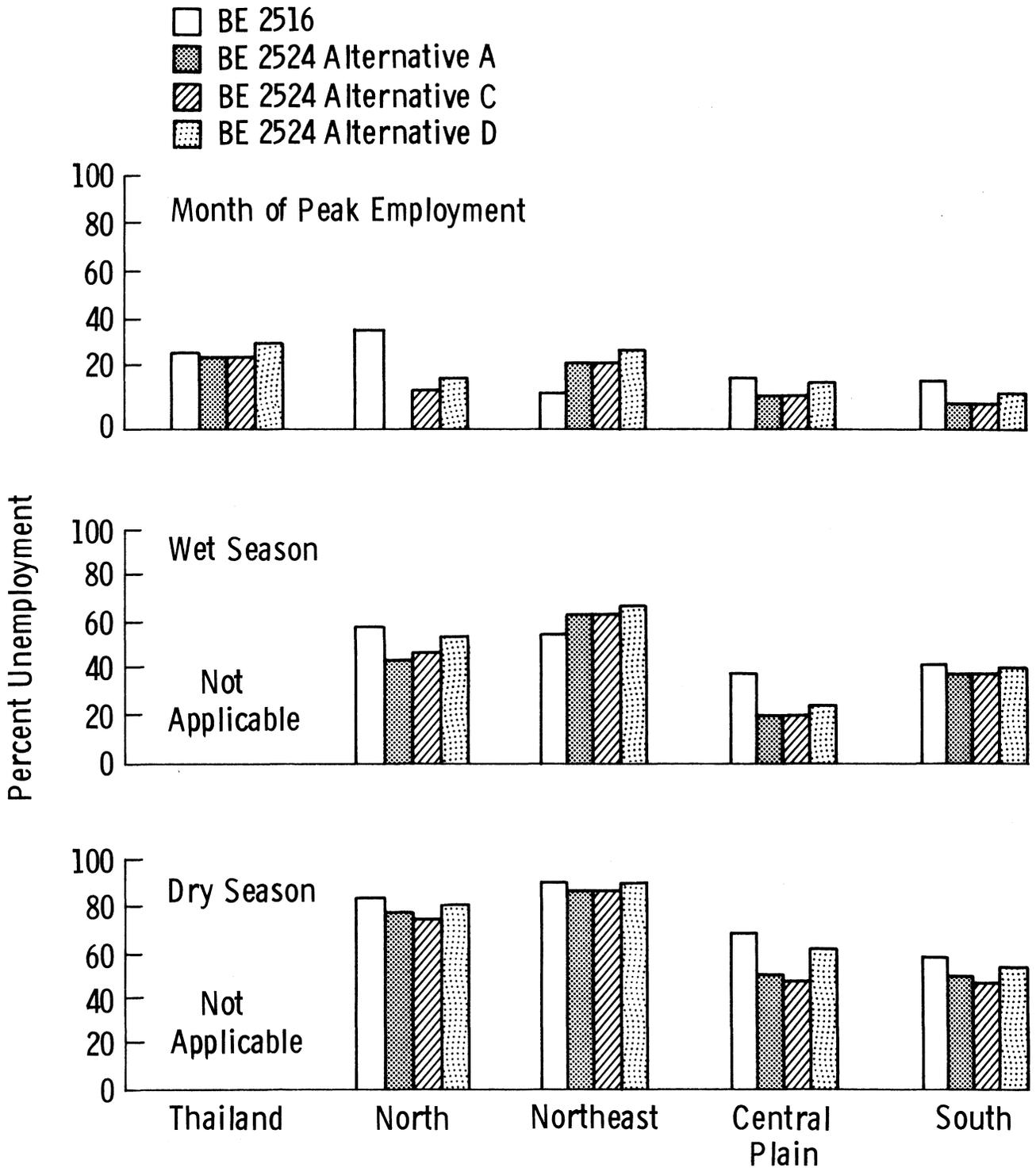


Figure 12. Levels of Unemployment in Thailand by Region in BE 2516 and in BE 2524 as Estimated Under Alternatives A, C and D during the Wet Season, Dry Season and Month of Peak Employment. (These estimates include underemployment; that is those persons who farm but do not have work to do every day are defined as unemployed on the days they have no work to do.)

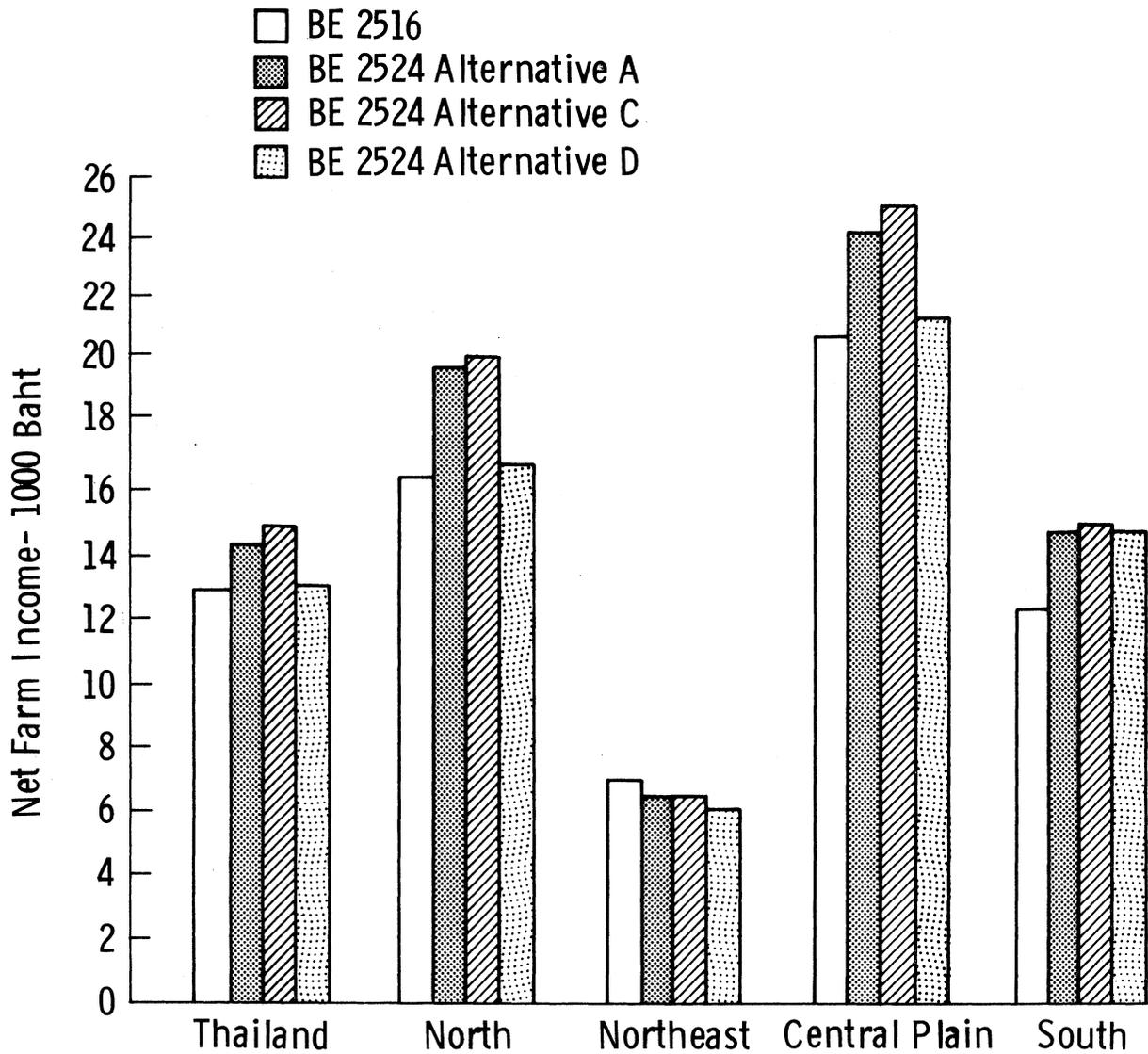


Figure 13. Net Farm Income in Thailand in BE 2516 and in BE 2524 as Estimated Under Alternative A, C and D Conditions. (The value of rice grown and consumed by the farm family is included.)

Table 33. Thailand's Employment and Income Situation by Region Under Alternative C Conditions, BE 2524.

Descriptive Statistics	Region				
	North	Northeast	Central Plain	South Thailand	
Number of Farms:	927, 919	2, 026, 381	1, 144, 132	644, 205	4, 742, 647
Agricultural Employment Situation (1, 000)					
Annual Labor Force:	3, 132	6, 814	2, 407	1, 698	14, 052
Employment	1, 146	1, 925	1, 680	974	5, 995
Percent Unemployed	55	72	30	43	57
Month of Peak Labor Use:	December	July	August	December	December
Employment	2, 598	5, 027	2, 049	1, 513	9, 879
Percent Unemployed	17	26	15	11	30
Wet Season:					
Employment	1, 804	2, 693	1, 922	1, 018	Not
Percent Unemployed	42	60	20	40	Applicable
Dry Season:					
Employment	862	831	1, 333	910	Not
Percent Unemployed	72	88	45	46	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	20, 759	15, 383	29, 711	9, 531	75, 384
Average Gross Crop Production Per Farm (Baht)	22, 371	7, 591	25, 968	14, 795	15, 895
Average Crop Operating Expenses Per Farm (Baht)	5, 135	2, 063	6, 797	2, 222	3, 828
Net Crop Income <sup>1</sup> Per Farm (Baht)	17, 236	5, 528	19, 171	12, 573	12, 067
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2, 903	1, 106	5, 801	2, 231	2, 743
Net Farm Income	20, 139	6, 634	24, 972	14, 804	14, 810

<sup>1</sup> Assumes zero cost for owned land and labor resources and includes rice grown for home consumption.

Table 34. Thailand's Employment and Income Situation by Region Under Alternative D Conditions  
BE 2524.

Descriptive Statistics	Region				Thailand
	North	Northeast	Central Plain	South	
Number of Farms:	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:	3,132	6,814	2,407	1,698	14,052
Employment	1,182	1,841	1,507	919	5,449
Percent Unemployed	62	73	37	46	61
Month of Peak Labor Use:	December	July	August	December	December
Employment	2,550	4,816	1,960	1,424	9,597
Percent Unemployed	19	29	19	16	32
Wet Season:					
Employment	1,531	2,615	1,845	997	Not
Percent Unemployed	51	62	23	41	Applicable
Dry Season:					
Employment	683	739	1,024	808	Not
Percent Unemployed	78	89	57	52	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	16,359	14,237	23,970	9,602	64,168
Average Gross Crop Production Per Farm (Baht)	17,630	7,026	20,950	14,905	13,530
Average Crop Operating Expenses Per Farm (Baht)	3,644	1,895	5,152	2,391	3,091
Net Crop Income <sup>1</sup> Per Farm (Baht)	13,986	5,131	15,798	12,514	10,439
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income	16,889	6,237	21,599	14,745	13,182

<sup>1</sup> Assumes zero cost for owned labor and land resources and includes rice grown for home consumption.

They are positive only because the population increases are assumed to be children not yet old enough to work. When they reach 15 years, they will increase the labor force. Then if they share in an unchanged total available income, average income will fall to a lower level.

Alternative D assumes that exports fall to low levels. The level of major crop exports in Alternative D are compared to those of Alternative A in Table 27. White rice exports are 700,000 tons lower in Alternative D than in Alternative A. Maize and cassava product exports are 1 million tons and 850,000 tons lower, respectively. Other commodity exports are similarly much lower under Alternative D.

The employment and income effects of such declines in exports are substantial. Annual employment in Thailand's agricultural sector falls by 507,000 full-time job equivalents. Average net farm income declines by 1,461 Baht.

A brief look at the regional changes in employment and income under Alternative D conditions illustrates a point mentioned earlier. While expanding exports improve employment and income in general, they do little to improve conditions for Thailand's Northeast region. When exports expand from Alternative D to Alternative A levels, annual employment and net income in the Northeast rise by only 80,000 jobs and 366 Baht per farm. Under the same conditions employment increases by 221,000 persons in the North and average net farm income goes up by some 3,200 Baht.

BE 2524 Employment and Income  
Under Alternative E and F Conditions

The purpose of Alternatives E and F is to measure the effects of fertilizer, RD rice varieties and irrigation water availability and use on planning objectives. Figure 14, 15, and 16 and Tables 35 and 36 indicate the nature of these effects. The effect of reductions in the use of technology and water from irrigation projects is to reduce income and employment in regions where they are most widespread and extensively used.

The actual effects can be determined from the data in Tables 35 and 36 and Table 30. When irrigation water availability is reduced from Alternative A to Alternative E levels, employment in the Central Plains declines by approximately 113,000 jobs and income decreases by some 1,600 Baht. At the same time Northeast region employment increases by 35,000 jobs and net incomes rise by some 200 Baht per farm.

The effects of reduced RD variety and fertilizer availability coupled with lower levels of irrigation water availability have effects similar to those of plan E. However, they have a somewhat more negative impact: when water use is assumed to remain at current levels and only trend rate increases in the use of fertilizer and RD varieties are allowed, high export targets cannot be met. The result is a 11,000 reduction in annual agricultural employment and a decrease of some 600 Baht in average kingdom net income per farm. Since export targets cannot be met, incomes fall in all regions, including the Northeast because of its inability to meet the production requirements formerly met by producers in the Central Plain.

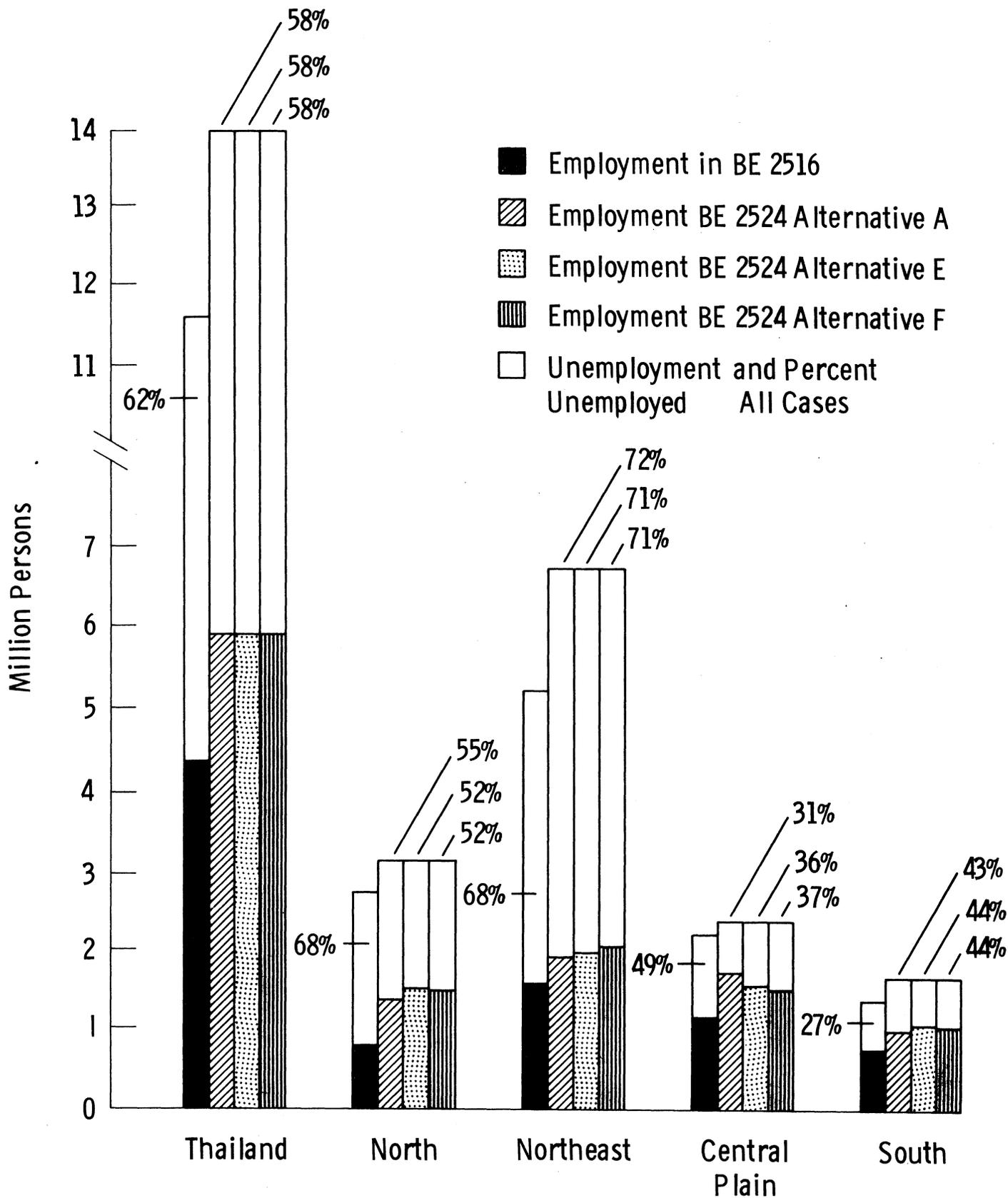


Figure 14. Economically Active Population and Employment Situation in Agriculture in BE 2516 and in BE 2524 under Alternative A, E and F Conditions.

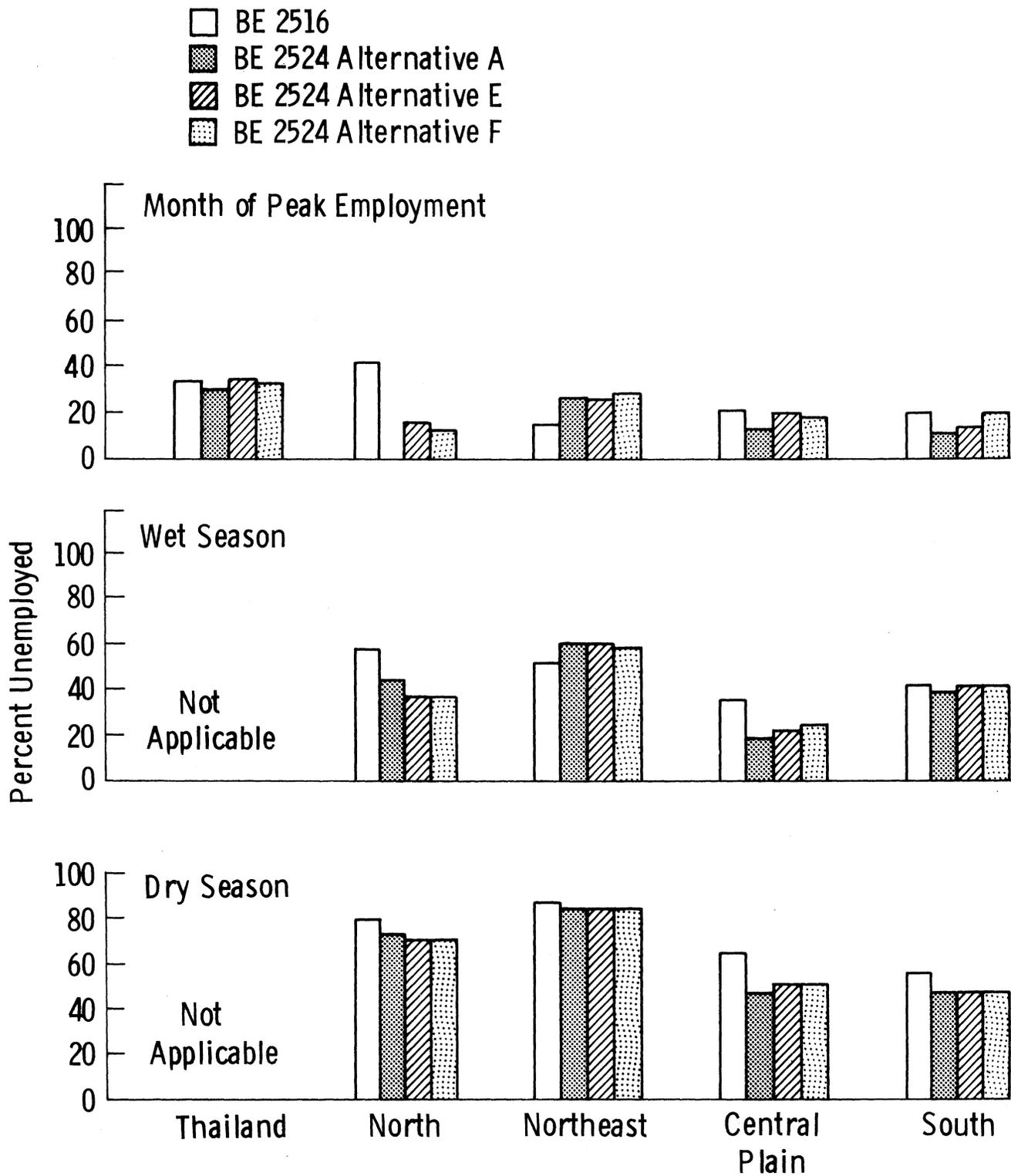


Figure 15. Levels of Unemployment in Thailand by Region in BE 2516 and in BE 2524 as estimated under Alternatives A, E and F during the Wet Season, Dry Season and Month of Peak Employment. (These estimates include underemployment; that is those persons who farm but do not have work to do every day are defined as unemployed on the days they have no work to do.)

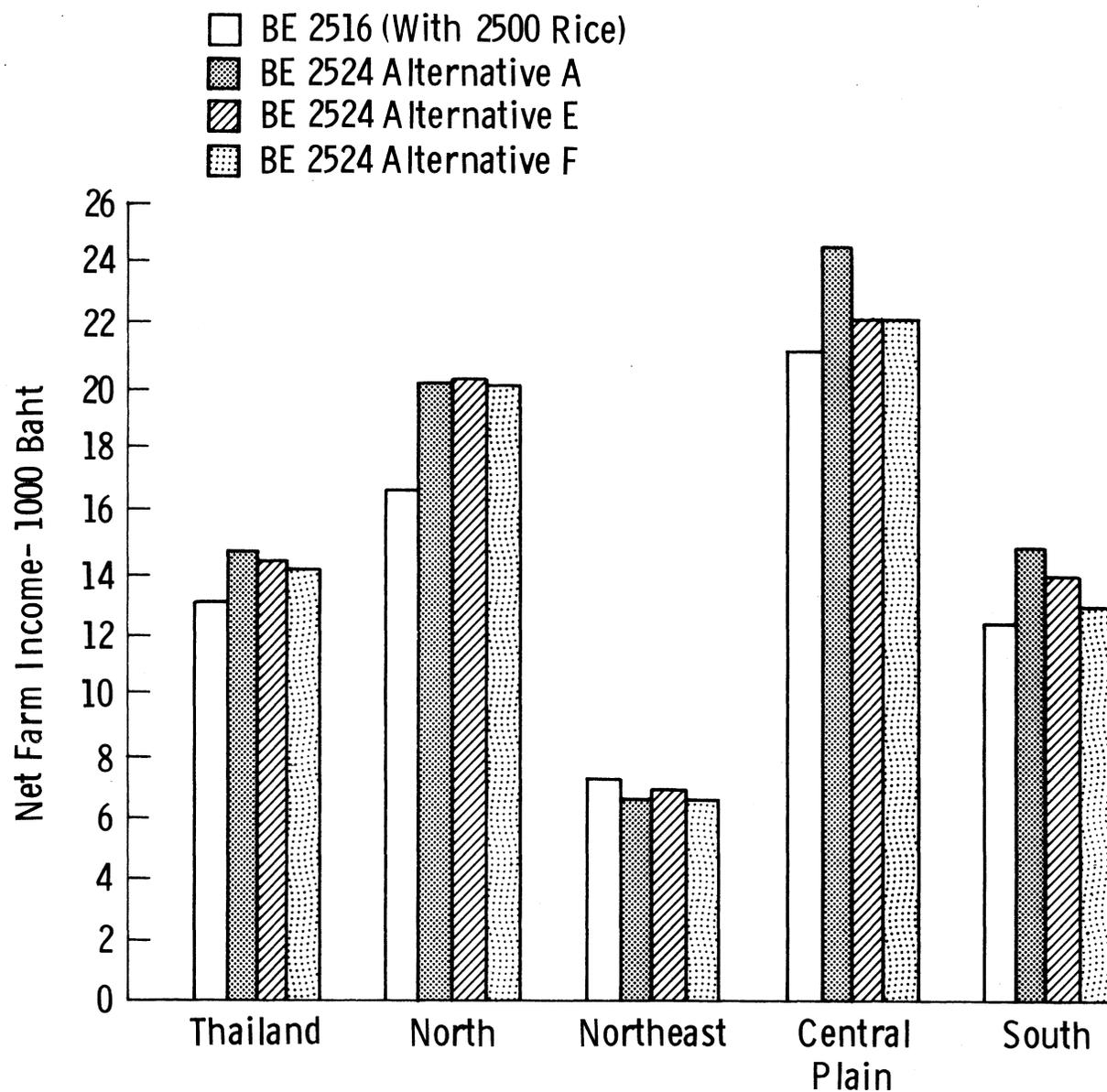


Figure 16. Net Farm Income in Thailand in BE 2516 and in BE 2524 as Estimated Under Alternative A, E and F Conditions. (The value of rice grown and consumed by the farm family is included.)

Table 35. Thailand's Employment and Income Situation by Region Under Alternative E Conditions  
BE 2524.

Descriptive Statistics	Region				Thailand
	North	Northeast	Central Plain	South	
Number of Farms:	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:	1,132	6,814	2,407	1,689	14,052
Employment	1,490	1,956	1,546	947	5,938
Percent Unemployed	52	71	36	44	58
Month of Peak Labor Use:	December	July	July	December	December
Employment	2,653	5,010	1,917	1,454	9,344
Percent Unemployed	15	26	20	14	34
Wet Season:					
Employment	1,946	2,753	1,794	984	Not
Percent Unemployed	38	60	25	42	Applicable
Dry Season:					
Employment	839	819	1,189	893	Not
Percent Unemployed	73	88	51	47	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million Baht)	21,620	16,246	26,506	8,980	73,352
Average Gross Crop Production Per Farm (Baht)	23,299	8,017	23,167	13,940	15,467
Average Crop Operating Expenses Per Farm (Baht)	5,987	2,304	6,175	2,140	3,936
Net Crop Income <sup>1</sup> Per Farm (Baht)	17,312	5,713	16,992	11,800	11,531
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income	20,215	6,819	22,793	14,031	14,274

<sup>1</sup>Assumes zero cost for owned labor and land resources and includes rice grown for home consumption.

Table 36. Thailand's Employment and Income Situation by Region Under Alternative F Conditions  
BE 2524.

Descriptive Statistics	Region				Thailand
	North	Northeast	Central Plain	South	
Number of Farms:	927,919	2,026,381	1,144,132	644,205	4,742,637
Agricultural Employment Situation (1,000)					
Annual Labor Force:	3,132	6,814	2,407	1,698	14,052
Employment	1,499	1,978	1,519	948	5,945
Percent Unemployed	52	71	37	44	58
Month of Peak Labor Use:	December	July	September	December	December
Employment	2,725	4,963	1,958	1,359	9,526
Percent Unemployed	13	27	19	20	32
Wet Season:					
Employment	1,957	2,774	1,760	986	Not
Percent Unemployed	38	59	27	42	Applicable
Dry Season:					
Employment	846	842	1,174	894	Not
Percent Unemployed	73	88	51	47	Applicable
Agricultural Production and Income (Baht)					
Total Value of Crop Production (Million baht)	20,774	14,948	27,047	8,523	71,292
Average Gross Crop Production Per Farm (Baht)	22,388	7,377	23,640	13,230	15,032
Average Crop Operating Expenses Per Farm (Baht)	5,325	1,949	6,626	2,027	3,749
Net Crop Income <sup>1</sup> Per Farm (Baht)	17,063	5,428	17,014	11,203	11,283
Net Income from Forestry, Fishing, Fruits, Vegetables and Livestock (Baht)	2,903	1,106	5,801	2,231	2,743
Net Farm Income	19,966	6,534	22,815	13,434	14,026

<sup>1</sup> Assumes zero cost for owned labor and land resources and includes rice grown for home consumption.

Two major points follow from the analysis of Alternatives E and F: Expansion of fertilizer, RD variety, and water use according to past trends and distribution patterns tends to help mainly the farmers who are not poor. It does little for the majority of farmers in poor regions, and unless use of irrigation water, fertilizers, and RD varieties increases at rates higher than past trends, Thailand's capacity to export agricultural products, especially rice, will become increasingly limited.

#### The Price of Rice and Net Farm Income

The price of rice is an important consideration in Thailand's policies. This is so because the price of rice affects everyone. The amount consumers must pay for rice, a staple in the Thai diet, significantly affects the amount of money available for purchase of other commodities and services. The price of rice, a principal product of Thai agriculture, has a major affect on the income of Thai farmers. This section is to illustrate how rice prices affect farm income and why they are a key factor for consideration in planning the agricultural sector.

Three rice price levels were chosen to illustrate the affect of different price situations on net farm income: (a) a fixed farm level price of 2,500 Baht per ton, (b) current prices, and (c) the minimum price which farmers must receive in order for them to continue to produce rice instead of alternative crops. The average net farm income levels resulting under the conditions of each Alternative and each of the three rice price situations are presented in Table 37. Figure 17

Table 37. BE 2524 Net Farm Income for Each Alternative Under Selected Paddy Rice Price Conditions.

Alternative and Rice Price Situation	Net Farm Income by Region (Baht)				
	North	Northeast	Central Plain	South	Thailand
Alternative A					
2,500 Baht/Ton Set Price	20,067	6,603	22,671	14,212	14,148
Current Price	17,402	5,067	21,809	13,017	12,600
Minimum Price Necessary	10,461	2,032	14,076	10,500	7,738
Alternative B1					
2,500 Baht/Ton Set Price	18,013	6,568	21,176	13,457	13,267
Current Prices	15,669	4,950	20,339	12,412	11,773
Minimum Price Necessary	9,052	2,018	13,179	10,239	7,203
Alternative B2					
2,500 Baht/Ton Set Price	16,825	7,656	22,234	14,533	13,900
Current Prices	13,872	6,099	19,797	13,149	11,881
Minimum Prices Necessary	7,255	3,105	12,638	10,976	7,285
Alternative C					
2,500 Baht/Ton Set Price	20,094	6,634	23,149	14,287	14,291
Current Prices	17,445	5,072	22,230	13,088	12,721
Minimum Prices Necessary	10,521	1,990	14,103	10,553	7,744
Alternative D					
2,500 Baht/Ton Set Price	16,896	6,237	10,161	14,231	12,767
Current Price	14,326	4,713	19,355	13,040	11,257
Minimum Prices Necessary	7,368	1,490	12,427	10,358	6,483
Alternative E					
2,500 Baht/Ton Set Price	20,143	6,819	21,168	13,590	13,807
Current Price	17,654	5,222	20,452	12,557	12,325
Minimum Prices Necessary	12,748	3,308	15,598	11,167	9,187
Alternative F					
2,500 Baht/Ton Set Price	19,775	6,534	21,141	13,046	13,533
Current Price	17,406	5,131	20,346	12,205	12,164
Minimum Prices Necessary	20,762	6,819	22,695	13,375	14,267

<sup>1</sup>The minimum price used in computing this income estimate was the linear programming model shadow price which is the lowest price at which farmers would continue to produce rice in the quantities demanded rather than use their resources to produce alternative crops.

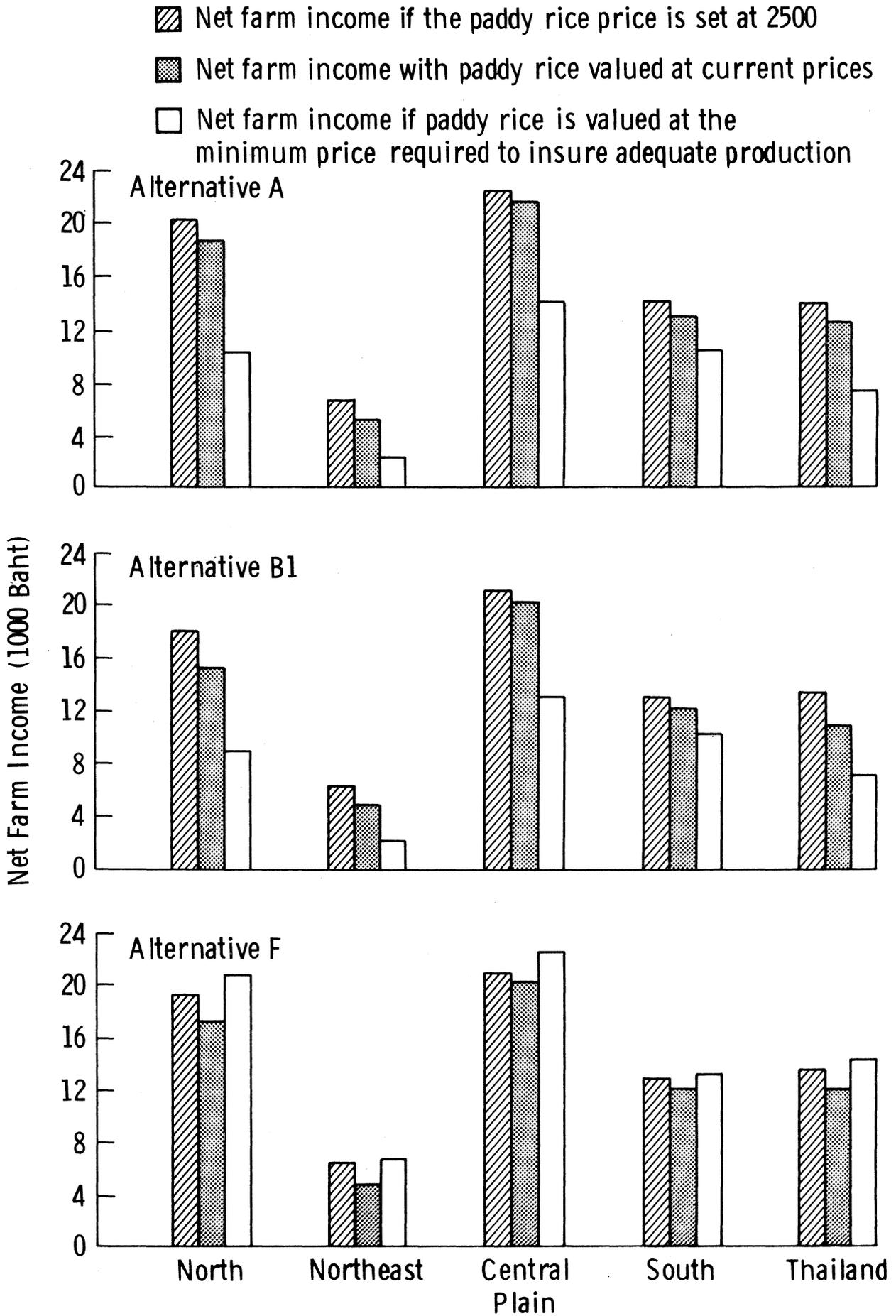


Figure 17. BE 2524 Net Farm Income in Thailand for Several Alternatives under Selected Paddy Rice Price Conditions.

provides an illustration of the income situations resulting from each price situation for Alternatives A, B1, and F.

Figure 17 and Table 37 illustrate three things. First, the price of rice is a very major factor affecting farm income. Second, while increasing the price of rice raises income of all Thai farmers, it helps farmers in higher income regions more than those in lower income regions and does not reduce regional income differences. Third, when rice crops are good and, hence, rice is plentiful relative to demands for rice, rice prices and farm income fall to very low levels in the absence of measures to regulate supply-demand and price conditions.

With rice prices at an assumed level of 2,500 Baht, average net income of Thai farmers reaches 14,291 Baht under Alternative C conditions. Under the same conditions net farm income in the Central Plain region reaches 23,149 Baht while in the Northeast it reaches a level of only 6,634 Baht.

When rice is abundant and market forces determine the price, farmers experience dramatic price and income declines. Rice prices fall to very low levels and incomes are extremely low. When market forces determine rice prices under conditions assumed in Plan Alternatives A and B1, average income of Thai farmers is less than 8,000 Baht in BE 2524 and Northeast region farmers have net incomes of only approximately 2,000 Baht. Under the same market conditions in Plan Alternative D, which assumes the lowest total demand, average net farm income in the Northeast is only 1,490 Baht and the BE 2524 kingdom average net farm income is only some 6,500 Baht.

When supplies of rice are limited and export demand is adequate to raise export price to higher levels, rice prices increase under free market

conditions and incomes rise. Such conditions exist in Alternative F. The national average net farm income is 14,267 Baht under Alternative F conditions, a level lower than only one other alternative, Alternative C. As well, average net farm income in the Northeast region reaches 6,819 Baht, a level only exceeded under Alternative B2 where explicit policy requirements cause income to rise in the region.

#### Output, Employment and Income Generated in Nonagricultural Sectors

The relationship between agricultural production and production in other sectors of the economy is a very important dimension of development planning. Current estimates based on macroeconomic research conducted in the Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government<sup>1</sup> indicate that each 1,000 Baht of agricultural output generates a corresponding nonagricultural sector output of 900 Baht. The total output, employment and income this relationship implies are shown in Figure 18 and Table 38. The BE 2524 Alternative A output of 92,291 million Baht in agriculture generates 83,062 million Baht of nonagricultural output. The nonagricultural sector income and employment associated with that output is 66,450 million Baht and 2,373,000 jobs, respectively. When exports and, hence, agricultural output fall from Alternative A to Alternative D levels, a 9,990 million Baht decline in agricultural output occurs and leads to an 8,991 million

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<sup>1</sup>Economic research conducted by and under the direction of James A. Stephenson, Iowa State University Team, Division of Agricultural Economics, Ministry of Agriculture and Cooperatives, Royal Thai Government. Publication pending.

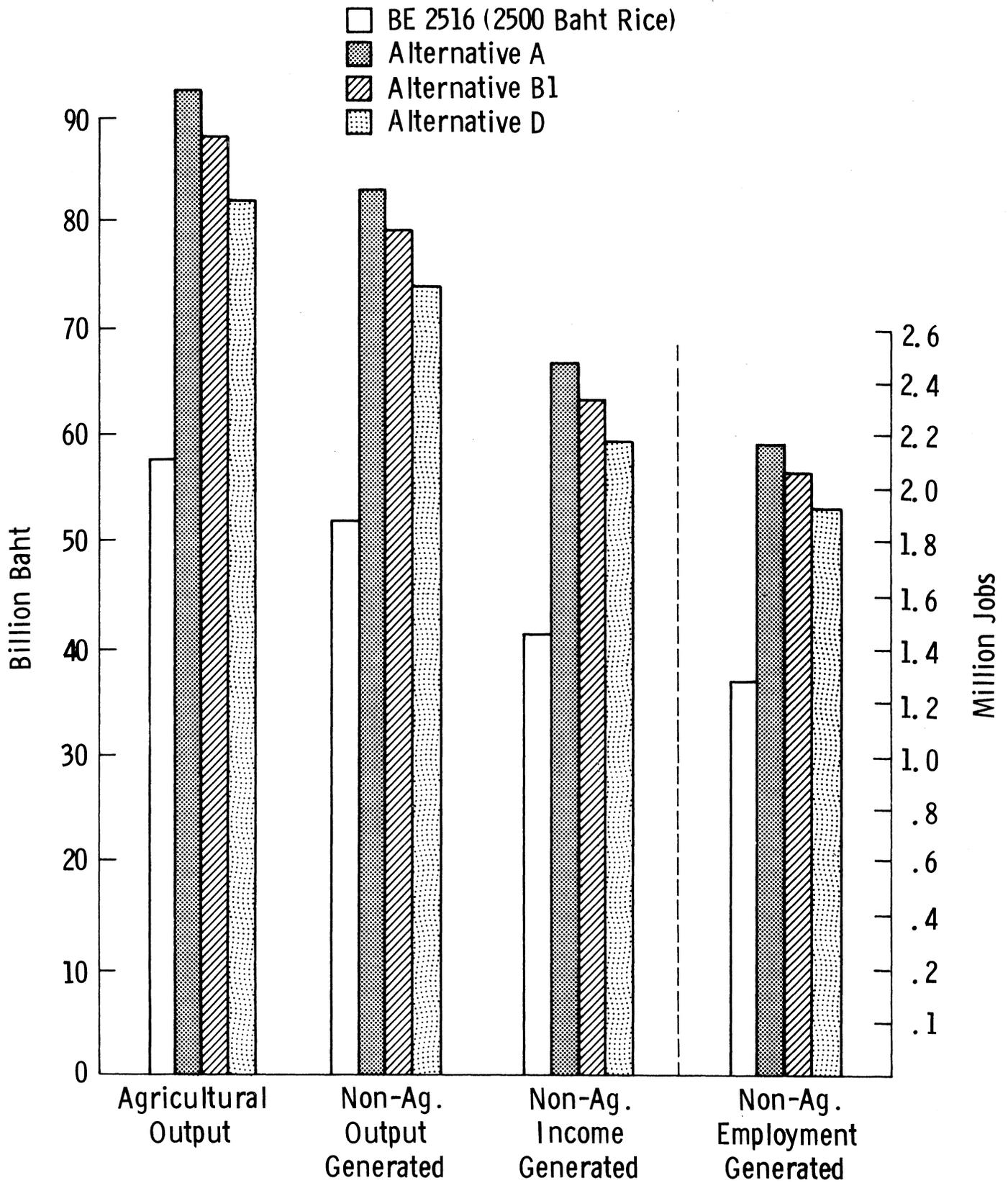


Figure 18. BE 2524 Agricultural Output of Thailand and Nonagricultural Output, Income and employment Generated Under Alternative A, B1 and D Conditions.

Baht decline in nonagricultural output. This decline reduces employment in nonagricultural sectors by some 257,000 jobs and reduces total income by 7,193 million Baht.

Table 38. BE 2524 Agricultural Output of Thailand and Nonagricultural Output, Income and Employment Generated Under Each Alternative Analyzed (Million Baht).<sup>1</sup>

Alternative	Total Agricultural Production	Nonagricultural Output Generated	Nonagricultural Income Generated	Nonagricultural Employment Generated Thousand Jobs
BE2516	57,739	51,965	41,572	1,485
A	92,291	83,062	66,450	2,373
B1	88,018	79,216	63,373	2,263
B2	88,018	79,216	63,373	2,263
C	93,517	84,165	67,332	2,405
D	82,301	74,071	59,257	2,116
E	91,485	82,337	65,870	2,352
F	89,425	80,483	64,386	2,300

<sup>1</sup>The nonagricultural output, income, and employment generated as a result of agricultural production were estimated using a gross agricultural output multiplier estimated using a macroeconomic model constructed by James A. Stephenson and Khajonwan Itharattana members of the Division of Agricultural Economics-Iowa State University Team. Output per work and estimates of income as a percent of nonagricultural output were estimated from data contained in National Income of Thailand-1974-75 Edition, Office of the National Economic and Social Development Board, Government of Thailand. Table 2, page 12.

#### Production, Consumption and Commodity Exports

Production of adequate quantities of agricultural products to meet domestic requirements and expanded export targets is necessary in government planning objectives. Those objectives include adequate food for all Thais and increased foreign exchange earnings.

The levels, value, and distribution of production, consumption, and exports are shown in Figures 19, 20, and 21 and Tables 39 through 45.

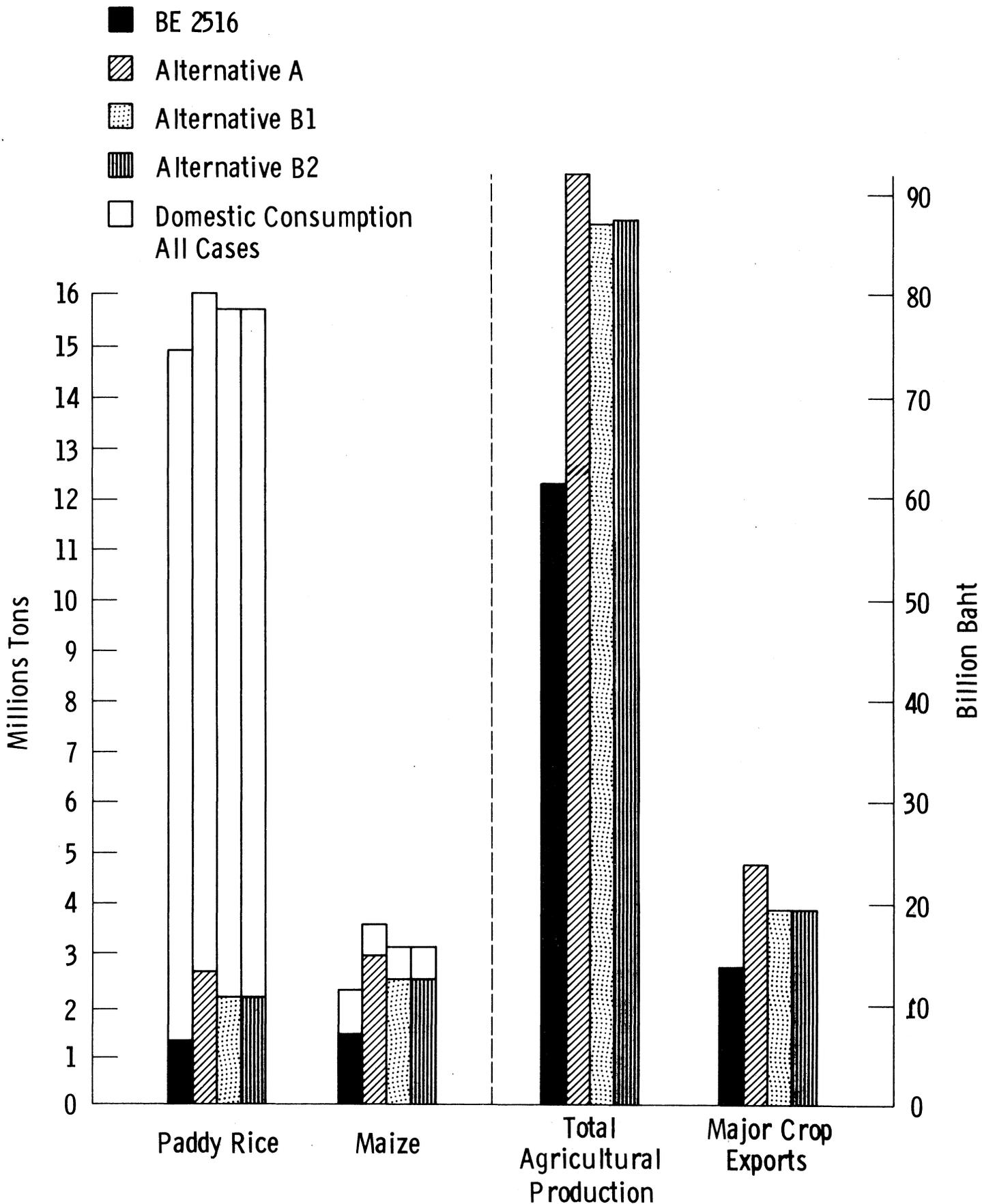


Figure 19. Thailand's Agricultural Production, Consumption and Export Situation in BE 2516 and in BE 2524 under Alternative A, B1 and B2 Conditions.

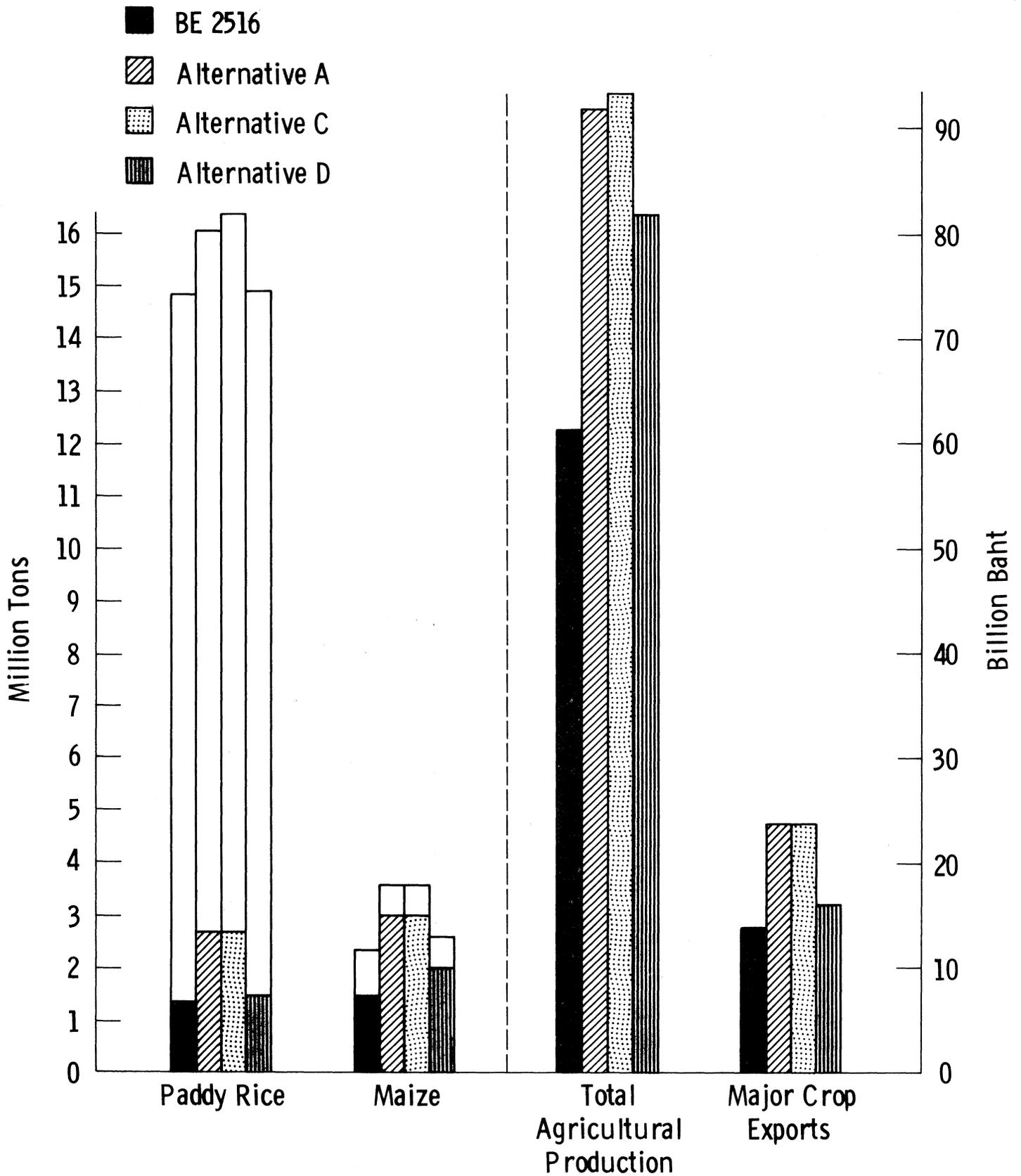


Figure 20. Thailand's Agricultural Production, Consumption and Export Situation in BE 2516 and in BE 2524 under Alternative A, C and D Conditions.

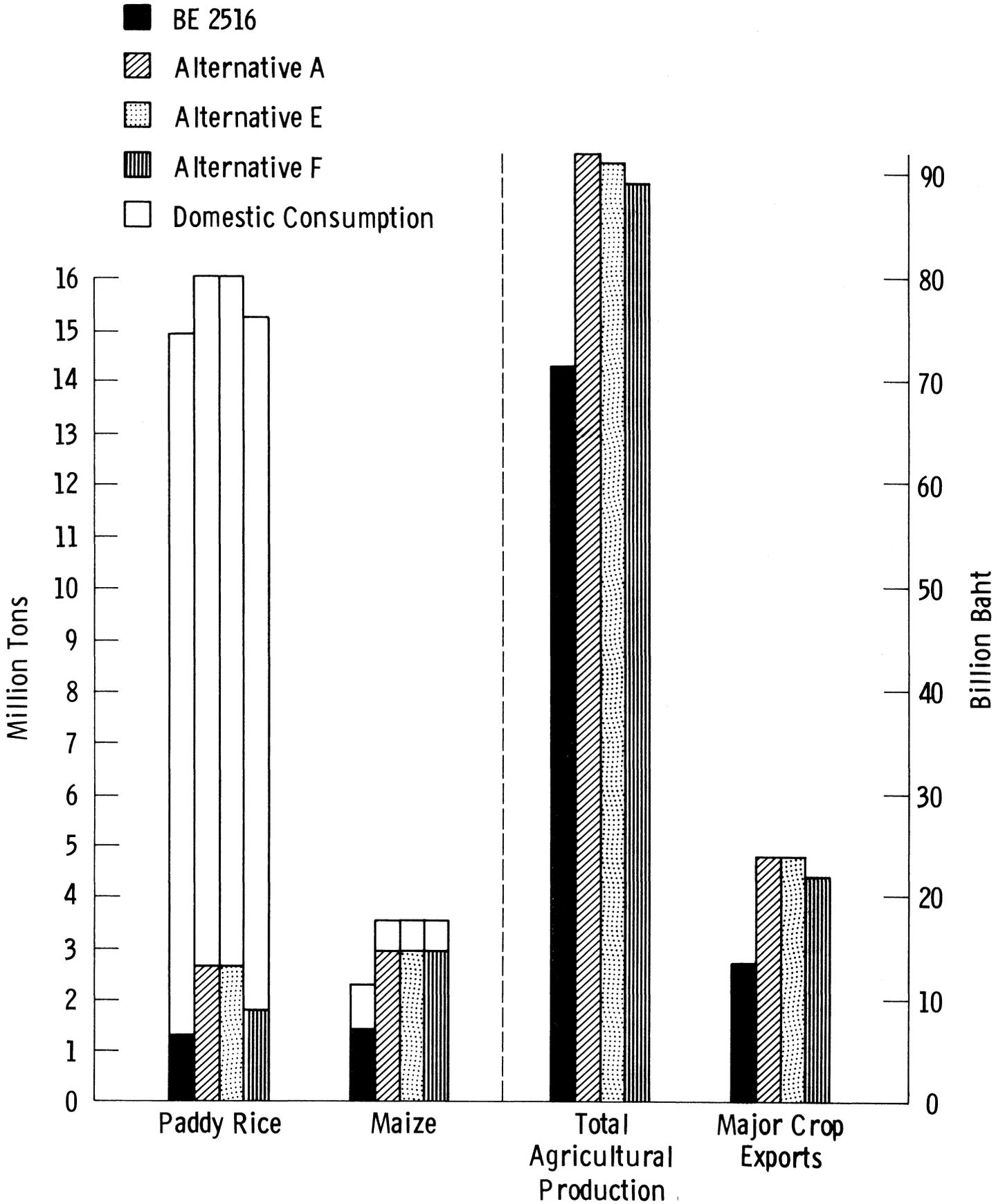


Figure 21. Thailand's Agricultural Production, Consumption and Export Situation in BE 2516 and in BE 2524 under Alternative A, E and F Conditions.

Table 39. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative A.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.27	1.64	5.14	1.19	10.24
Consumption	1.26	1.36	3.73	1.43	7.78
Exports	1.01	.28	1.41	-.24	2.46
<b>Rice (Glutinous Paddy):</b>					
Production	2.19	3.06	.52	.03	5.80
Consumption	1.99	3.58	.06	.03	5.66
Exports	.20	-.52	.46	0	.14
<b>Maize:</b>					
Production	2.17	.04	1.40	0	3.61
Consumption	.17	.04	.40	0	.61
Exports	2.0	0	1.0	0	3.00
<b>Kenaf &amp; Jute:</b>					
Production	.04	.28	0	0	.32
Consumption	0	.18	.04	0	.22
Exports	.04	.10	-.04	0	.10
<b>Cassava:</b>					
Production	.04	.42	4.99	1.65	7.10
Consumption	.04	.07	.40	.02	.53
Export	0	.35	4.59	1.60	6.57
<b>Sugarcane:</b>					
Production	.60	.64	15.06	0	16.30
Consumption	.60	.64	5.06	0	6.30
Exports	0	0	10.00	0	10.00
<b>Rubber:</b>					
Production	0	0	.05	.42	.47
Consumption	0	0	.02	0	.02
Exports	0	0	.03	.42	.45

Table 40. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative B1.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.14	1.72	4.97	1.08	9.91
Consumption	1.27	1.38	3.79	1.45	7.89
Exports	0.87	.034	1.18	-0.37	2.02
<b>Rice (Glutinous Paddy):</b>					
Production	2.31	3.05	0.49	0.02	5.87
Consumption	2.02	3.63	0.06	0.02	5.73
Exports	0.29	-.58	0.43	0	0.14
<b>Maize:</b>					
Production	1.32	0.04	1.75	0	3.11
Consumption	0.17	0.04	0.41	0	0.62
Exports	1.15	0	1.34	0	2.49
<b>Kenaf &amp; Jute:</b>					
Production	0.04	0.26	0	0	0.30
Consumption	0	0.18	0.04	0	.22
Exports	0.04	.08	-0.04	0	.08
<b>Cassava:</b>					
Production	0.04	0.07	2.22	3.70	6.03
Consumption	0.04	0.07	.42	0.02	.54
Export	0	0	1.80	3.68	5.48
<b>Sugarcane:</b>					
Production	0.61	0.65	12.47	0	13.73
Consumption	0.61	0.65	5.14	0	6.40
Exports	0	0	7.33	0	7.33
<b>Rubber:</b>					
Production	0	0	0.04	0.37	0.41
Consumption	0	0	0.01	0	.01
Exports	0	0	.03	.37	.40

Table 41. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative B2.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.15	1.72	4.97	1.08	9.92
Consumption	1.28	1.38	3.79	1.45	7.90
Exports	.87	.34	1.18	-.37	2.02
<b>Rice (Glutinous Paddy):</b>					
Production	2.31	3.05	.49	.02	5.87
Consumption	2.02	3.63	.06	.02	5.73
Exports	.29	-.58	.43	0	0.14
<b>Maize:</b>					
Production	1.32	.56	1.24	0	3.12
Consumption	.17	.04	.41	0	.62
Exports	1.15	.52	.83	0	2.50
<b>Kenaf &amp; Jute:</b>					
Production	0	.30	0	0	.30
Consumption	0	.18	.04	0	.22
Exports	0	.12	-.04	0	.08
<b>Cassava:</b>					
Production	.04	1.64	4.20	.14	6.02
Consumption	.04	.07	.41	.02	.54
Export	0	1.57	3.79	.12	5.48
<b>Sugarcane:</b>					
Production	.61	.65	12.47	0	13.72
Consumption	.61	.65	5.14	0	6.39
Exports	0	0	7.33	0	7.33
<b>Rubber:</b>					
Production	0	0	0	.41	.41
Consumption	0	0	.01	0	.01
Exports	0	0	-.01	.41	.40

Table 42. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative C.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.23	1.65	5.40	1.20	10.48
Consumption	1.30	1.40	3.85	1.47	8.02
Exports	0.94	0.25	1.55	-.27	2.46
<b>Rice (Glutinous Paddy):</b>					
Production	2.22	3.13	.56	.03	5.94
Consumption	2.04	3.66	.06	.03	5.79
Exports	.18	-.53	.50	0	.15
<b>Maize:</b>					
Production	2.17	.04	1.40	0	3.61
Consumption	.17	.04	.40	0	.61
Exports	2.00	0	1.00	0	3.00
<b>Kenaf &amp; Jute:</b>					
Production	.04	.29	0	0	.33
Consumption	0	.18	.05	0	.23
Exports	.04	.11	-.05	0	.10
<b>Cassava:</b>					
Production	.04	.54	5.02	1.52	7.12
Consumption	.04	.08	.41	.02	.55
Export	0	.46	4.61	1.50	6.57
<b>Sugarcane:</b>					
Production	.61	.66	15.21	0	16.48
Consumption	.61	.66	5.21	0	6.48
Exports	0	0	10.0	0	10.00
<b>Rubber:</b>					
Production	0	0	.05	.42	.47
Consumption	0	0	.02	0	.02
Exports	0	0	.03	.42	.45

Table 43. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative D.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South Thailand	Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.28	1.60	4.16	1.19	9.23
Consumption	1.26	1.36	3.73	1.43	7.78
Exports	1.02	0.24	0.43	-0.24	1.45
<b>Rice (Glutinous Paddy):</b>					
Production	1.99	3.06	0.66	0.03	5.74
Consumption	1.99	3.58	0.06	0.03	5.66
Exports	0	-0.52	0.60	0	0.08
<b>Maize:</b>					
Production	0.87	0.04	1.70	0	2.61
Consumption	0.17	0.04	0.40	0	0.61
Exports	0.7	0	1.3	0	2.0
<b>Kenaf &amp; Jute:</b>					
Production	0.04	0.23	0	0	0.27
Consumption	0	0.14	0.04	0	.22
Exports	0	.09	-.04	0	.05
<b>Cassava:</b>					
Production	0.04	0.07	2.21	2.63	4.95
Consumption	0.04	0.07	.39	0.02	.52
Export	0	0	1.83	2.60	4.43
<b>Sugarcane:</b>					
Production	0.60	0.64	9.73	0	10.97
Consumption	0.60	0.64	5.06	0	6.30
Exports	0	0	4.67	0	4.67
<b>Rubber:</b>					
Production	0	0	0.01	0.36	0.37
Consumption	0	0	0.02	0	.02
Exports	0	0	-0.01	0.36	.35

Table 44. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative E.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	2.41	1.89	4.91	1.03	10.24
Consumption	1.26	1.36	3.73	1.43	7.78
Exports	1.15	.53	1.18	-.40	2.46
<b>Rice (Glutinous Paddy):</b>					
Production	2.51	3.00	0.26	0.04	5.81
Consumption	1.99	3.57	.06	0.03	5.65
Exports	.52	.57	.20	0.01	0.16
<b>Maize:</b>					
Production	2.26	0.33	1.02	0	3.61
Consumption	0.17	0.04	.40	0	.61
Exports	2.09	0.29	.62	0	3.00
<b>Kenaf &amp; Jute:</b>					
Production	0.04	0.28	0	0	.32
Consumption	0	.18	0.04	0	.22
Exports	0.04	.10	-0.04	0	.10
<b>Cassava:</b>					
Production	0.04	1.07	4.34	1.66	7.10
Consumption	0.04	.07	.40	0.02	.53
Export	0	1.00	3.94	1.63	6.57
<b>Sugarcane:</b>					
Production	0.60	.64	15.06	0	16.30
Consumption	0.60	.64	5.06	0	6.30
Exports	0	0	10.0	0	10.00
<b>Rubber:</b>					
Production	0	0	0.05	0.42	0.47
Consumption	0	0	0.02	0	.02
Exports	0	0	0.03	.42	.45

Table 45. BE 2524 Levels of Major Crop Production, Consumption and Exports by Region - Alternative F.

Commodity and Statistic	Region (Million Tons)				
	North	Northeast	Central	South	Thailand Plain
<b>Rice (Nonglutinous Paddy):</b>					
Production	1.98	1.50	5.04	.90	9.42
Consumption	1.26	1.36	3.73	1.43	7.78
Exports	.72	.14	1.31	-.53	1.64
<b>Rice (Glutinous Paddy):</b>					
Production	2.74	2.79	.31	.03	5.87
Consumption	1.99	3.58	.06	.03	5.66
Exports	.75	-.79	.25	0	.21
<b>Maize:</b>					
Production	2.15	.48	.98	0	3.61
Consumption	.17	.04	.40	0	.61
Exports	1.98	.44	.58	0	3.00
<b>Kenaf &amp; Jute:</b>					
Production	.04	.28	0	0	.32
Consumption	0	.18	.04	0	.22
Exports	.04	.10	-.04	0	.10
<b>Cassava:</b>					
Production	.04	1.17	4.24	1.65	7.10
Consumption	.04	.07	.40	.02	.53
Export	0	1.10	3.84	1.63	6.57
<b>Sugarcane:</b>					
Production	.60	.64	15.06	0	16.30
Consumption	.60	.64	5.06	0	6.30
Exports	0	0	10.00	0	10.00
<b>Rubber:</b>					
Production	0	0	.05	.42	.47
Consumption	0	0	.02	0	.02
Exports	0	0	.03	.42	.45

The results contained in those figures and tables may be summarized as follows:

(a) Domestic and export production requirements can be met under all alternatives analyzed except Alternative F.

(b) The value of total agricultural production and major crop exports are higher or lower depending on the export assumption under consideration.

(c) The regional patterns of production are consistent with changes in income and employment between alternatives.

(d) The changes in the levels and patterns of production between Alternatives B1 and B2 suggest corn and cassava as crops with potential in programs designed to maintain and stimulate income of farmers in Northeast Thailand.

Under Alternative F conditions it is not possible to meet high export target levels. The results presented in Table 43 show that maximum rice exports possible are only 1.22 million tons of white rice, almost .5 million tons short of the high export target of 1.7 million tons. Unless rice production methods are intensified through use of yield increasing technologies Thailand will not be in a position to respond to expansions in export markets as they occur.

Variations in the value of total production and exports under the alternatives need little explanation. Under Alternative A with high exports and high population growth rate, total value of production is highest at 93.5 billion Baht.<sup>1</sup> Under Alternatives A, C, and E with high

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<sup>1</sup>See Table 38.

exports, the value of major crop exports reaches 23.9 billion Baht. Under the low export assumption of Alternative D are only 15.2 billion Baht.

Regional patterns of production and exports are expected to respond to economic forces. Unless land and similar constraints are imposed on production to prevent it, production shifts among regions to reduce costs and raise net incomes. Comparison of the analytical results with current conditions shows shifts of corn and cassava production out of the Northeast region into the Central Plain, South and North regions.<sup>1</sup> Thus, economic forces tend to favor production of these crops in other regions other than the Northeast where income already is relatively low. While all other alternatives suggest that corn and cassava can be produced more efficiently in regions other than in the Northeast, Alternative B2 indicates that these are crops with potential to maintain and improve farm incomes in the latter region.

#### Use of Land, Water, RD Rice Varieties, and Fertilizer

The use of available land, irrigation water, RD rice varieties, and fertilizer were identified as potential policy instruments for achieving agricultural policy objectives. Tables 46, 47, and 48 summarize the degree to which quantities of each of the four input categories is used under each alternative analyzed.

The extent to which each of the inputs is used for an alternative depends on the availability of the input and its relative cost. When land availability is highest and demand is lowest, the use of RD varieties is low. Such conditions exist in the case of Alternative D where RD

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<sup>1</sup>Based on unpublished Division of Agricultural Economics estimates of crop production by region.

Table 46. BE 2524 Land Area Available and Land Area Used by Region Land Type and Alternative Analyzed.

Region	Land Availability and Percent Used	Land Type (1,000 Rai)				
		Type 1	Type 2 Wet Season	Type 2 Dry Season	Type 3	Type 4
Alternative A						
North	Available Land	2,591	4,034	1,027	5,420	8,892
	Land Used	2,591	4,034	730	5,420	7,548
	Percent Used	100	100	71	100	85
Northeast	Available Land	0	2,337	706	20,719	11,878
	Land Used	0	2,337	455	19,848	4,120
	Percent Used	0	100	64	96	35
Central Plain	Available Land	336	11,726	2,919	4,165	8,453
	Land Used	336	11,430	1,766	3,537	7,386
	Percent Used	100	97	61	85	87
South	Available Land	0	1,706	124	1,932	10,847
	Land Used	0	1,706	99	1,931	10,651
	Percent Used	0	100	80	100	98
Thailand	Available Land	2,927	19,805	4,900	32,327	40,071
	Land Used	2,927	19,509	3,052	30,739	29,706
	Percent Used	100	99	62	95	74
Alternative B1						
North	Available Land	2,591	2,783	613	6,286	8,891
	Land Used	2,591	2,783	476	6,286	5,101
	Percent Used	100	100	59	100	57
Northeast	Available Land	0	1,612	336	21,139	11,879
	Land Used	0	1,612	273	21,139	3,807
	Percent Used	0	100	81	100	32
Central Plain	Available Land	336	8,091	2,205	5,803	8,453
	Land Used	336	8,091	1,931	5,234	7,129
	Percent Used	100	100	82	90	84
South	Available Land	0	1,177	73	2,351	10,848
	Land Used	0	1,177	58	2,351	10,648
	Percent Used	0	100	79	100	98

Table 46. Continued.

Region	Land Availability and Percent Used	Land Type (1,000 Rai)				
		Type 1	Type 2 Wet Season	Type 2 Dry Season	Type 3	Type 4
Thailand	Available Land	2,927	13,665	3,228	35,579	40,072
	Land Used	2,927	13,665	2,738	35,011	26,686
	Percent Used	100	100	85	98	67
Alternative B2						
North	Available Land	2,591	2,783	613	6,286	8,891
	Land Used	2,591	2,783	363	6,286	4,255
	Percent Used	100	100	59	100	48
Northeast	Available Land	0	1,612	336	21,139	11,879
	Land Used	0	1,612	273	21,139	6,818
	Percent Used	0	100	81	100	57
Central Plain	Available	366	8,091	2,205	5,803	8,453
	Land Used	366	8,091	1,797	5,485	6,134
	Percent Used	100	100	81	95	73
South	Available Land	0	1,177	73	2,351	10,848
	Land Used	0	1,177	58	2,351	10,306
	Percent Used	0	100	79	100	95
Thailand	Available Land	2,927	13,665	3,228	35,579	40,072
	Land Used	2,927	13,665	2,493	35,263	27,515
	Percent Used	100	100	77	99	69
Alternative C						
North	Available Land	2,591	4,034	1,027	5,420	8,892
	Land Used	2,591	4,034	730	5,420	7,661
	Percent Used	100	100	71	100	86
Northeast	Available Land	0	2,337	706	20,719	11,878
	Land Used	0	2,337	461	19,928	4,143
	Percent Used	0	100	65	96	35
Central Plain	Available Land	336	11,726	2,919	4,165	8,453
	Land Used	336	11,430	2,303	3,537	7,386
	Percent Used	100	97	79	85	87

Table 46. Continued.

Region	Land Availability and Percent Used	Land Type (1,000 Rai)				
		Type 1	Type 2 Wet Season	Type 2 Dry Season	Type 3	Type 4
South	Available Land	0	1,706	124	1,932	10,847
	Land Used	0	1,706	99	1,931	10,646
	Percent Used	0	100	80	100	98
Thailand	Available Land	2,927	19,805	4,900	32,327	40,071
	Land Used	2,927	19,509	3,594	30,818	29,838
	Percent Used	100	99	73	95	74
Alternative D						
North	Available Land	2,591	4,034	1,027	5,420	8,892
	Land Used	1,964	4,034	568	5,420	3,832
	Percent Used	76	100	55	100	43
Northeast	Available Land	0	2,337	706	20,719	11,878
	Land Used	0	2,337	344	19,848	2,909
	Percent Used	0	100	49	96	24
Central Plain	Available Land	336	11,726	2,919	4,165	8,453
	Land Used	336	11,509	1,368	3,221	6,946
	Percent Used	100	98	47	77	82
South	Available Land	0	1,706	124	1,932	10,847
	Land Used	0	1,706	99	1,931	10,092
	Percent Used	0	100	80	100	93
Thailand	Available Land	2,927	19,805	4,900	32,327	40,071
	Land Used	2,300	19,588	2,380	30,422	23,780
	Percent Used	79	99	49	94	59
Alternative E						
North	Available Land	2,591	1,353	275	7,239	8,892
	Land Used	1,783	1,353	274	7,015	7,699
	Percent Used	69	100	100	97	87
Northeast	Available Land	0	1,184	33	21,435	11,877
	Land Used	0	1,184	31	21,435	4,198
	Percent Used	0	100	94	100	35

Table 46. Continued.

Region	Land Availability and Percent Used	Land Type (1,000 Baht)				
		Type 1	Type 2 Wet Season	Type 2 Dry Season	Type 3	Type 4
Central Plain	Available Land	336	7,198	1,623	6,114	8,453
	Land Used	336	7,198	1,530	6,114	6,934
	Percent Used	100	100	94	100	82
South	Available Land	0	505	31	2,858	10,847
	Land Used	0	505	24	2,858	10,651
	Percent Used	0	100	77	100	98
Thailand	Available Land	2,927	10,241	1,964	38,242	40,069
	Land Used	2,119	10,241	1,861	37,651	29,483
	Percent Used	72	100	95	98	74
North	Available Land	2,591	1,353	275	7,239	8,892
	Land Used	2,591	1,353	274	7,238	7,428
	Percent Used	100	100	100	100	84
Northeast	Available Land	0	1,184	33	21,435	11,877
	Land Used	0	1,184	31	21,435	4,280
	Percent Used	0	100	94	100	36
Central Plain	Available Land	336	7,198	1,623	6,114	8,453
	Land Used	336	7,198	1,440	6,114	7,218
	Percent Used	100	100	89	100	85
South	Available Land	0	505	31	2,835	10,847
	Land Used	0	505	24	2,834	10,651
	Percent Used	0	100	77	100	98
Thailand	Available Land	2,927	10,241	1,964	38,242	40,069
	Land Used	2,927	10,241	1,771	37,852	29,579
	Percent Used	100	100	90	99	74



Table 48. Rice Area Fertilized and Fertilized Rice Area Bound by Region for each Alternative BE 2524.

Alternative	Area	Region (1,000 Rai)				
		North	Northeast	Central Plain	South	Thailand
A	Maximum Area					
	Allowed	1,834	9,084	8,121	1,528	20,567
	Area Fertilized	1,097	9,084	6,363	1,354	17,898
	Present Used	60	100	78	89	87
B1	Maximum Area					
	Allowed	1,760	8,958	7,100	1,482	19,300
	Area Fertilized	1,165	8,436	6,760	1,347	17,708
	Percent Used	66	94	95	91	92
B2	Maximum Area					
	Allowed	1,760	8,958	7,100	1,482	19,300
	Area Fertilized	1,165	8,436	6,564	1,347	17,512
	Percent Used	66	94	92	91	91
C	Maximum Area					
	Allowed	1,834	9,084	8,121	1,528	20,567
	Area Fertilized	1,097	9,084	6,361	1,394	17,936
	Percent Used	60	100	78	91	87
D	Maximum Area					
	Allowed	1,834	9,084	8,121	1,528	20,567
	Area Fertilized	1,097	9,084	5,934	1,337	17,452
	Percent Used	60	100	27	13	15
E	Maximum Area					
	Allowed	1,667	8,912	6,803	1,403	18,785
	Area Fertilized	1,343	8,912	6,803	1,403	18,461
	Percent Used	81	100	100	100	98
F	Maximum Area					
	Allowed	1,010	6,718	6,126	1,110	14,974
	Area Fertilized	1,020	6,718	6,126	1,110	14,974
	Percent Used	100	100	100	100	100

variety use is low (as it is under alternatives A and C which also have the largest available land areas in both the wet and dry seasons). Area fertilized is also lowest under Alternative D.

When lower levels of available land are assumed the use of fertilizers and RD varieties increases even though total production costs increase. For example, under Alternative B1 conditions, RD variety use increases about levels of Alternative A. The maximum RD variety area actually used rises 11 percent on Type 2 land and 30 percent on Type 3 land. Eighty-seven percent of the upper limit on area fertilized is actually fertilized under Alternative A conditions. In Alternative B1, 92 percent is fertilized.

The levels and patterns of identified input use indicate that output can be effectively expanded through their introduction and that if they are not introduced productive capacity rather than export demand may limit exports. Stated another way, unless the use of technology increases Thailand's agricultural exports will be reduced as domestic requirements increase. In fact, at some future time imports may be required.

Appendix Table 1. Thailand's Agricultural Import-Export Situation BE 2513 to BE 2517.

Commodity	(Except where indicated units are 1,000 tons and million Baht)				
	2513 (1970)	2514 (1971)	2515 (1972)	2516 (1973)	2516 (1974)
Rice (nonglutinous white)	977.0	1,487.0	1,995.0	822.0	1,001.0
Rice (glutinous white)	2,347.0	910.0	4,436.6	4,594.3	9,435.0
Rubber	87.0	104.0	118.0	27.0	35.0
Maize	170.0	0.1	0.2	0.1	357.0
Sugar	298.0	308.0	318.0	391.0	363.0
Cassava Products	2,249.7	1,906.7	1,862.2	4,572.6	5,037.4
Kenaf and Jute	1,520.0	1,806.0	1,932.0	1,456.0	2,260.0
Gunny Bags, 1,000 units	1,856.9	2,185.6	1,980.2	2,861.2	5,964.6
Silk Fabric, 1,000 units	168.0	386.0	408.0	276.0	447.0
Mungbeans	139.5	467.4	1,264.8	1,156.6	3,744.6
Soybeans	1,327.0	1,122.0	1,311.0	1,836.0	2,392.0
Sorghum	1,227.2	1,238.7	1,547.3	2,536.6	2,836.2
Castor seed	258.0	271.0	255.0	265.0	247.0
Tobacco Leaf and Manufactured	719.0	934.8	1,086.8	1,054.1	845.3
	12,118.0	34,605.0	26,036.0	49,342.0	46,394.0
Exports	62.7	117.8	170.2	312.2	343.1
	518.0	441.0	399.0	480.0	346.0
	33.6	30.0	28.6	39.0	34.4
	49.0	38.0	40.0	59.0	53.0
	131.0	134.2	144.6	209.4	266.2
	6.0	6.0	9.0	14.0	9.0
	16.2	17.1	23.1	75.9	47.0
	80.0	131.0	131.0	125.0	189.0
	103.4	157.1	137.9	240.6	426.3
	36.0	47.0	29.0	27.0	28.0
	92.9	124.2	97.3	271.7	215.4
	11.0	13.0	18.0	17.0	15.0
	202.1	236.0	283.8	317.9	447.6

Appendix Table 1. Continued.

Commodity	(Except where indicated units are 1,000 tons and million Baht)					
	2513 (1970)	2514 (1971)	2515 (1972)	2516 (1973)	2517 (1974)	
	Exports					
Teak, 1,000 cubic meters	Q	29.0	38.0	40.0	51.0	35.0
	V	155.7	182.6	208.5	421.9	401.5
Buffaloes, 1,000 Head	Q	26.0	25.0	25.0	20.0	11.0
	V	57.2	68.4	76.2	80.2	57.8
Bullocks & Cows, 1,000 Head	Q	9.0	12.0	18.0	26.0	18.0
	V	15.6	22.7	39.3	58.4	57.8
Swine, 1,000 Head	Q	16.0	9.0	1.0	11.0	1.0
	V	10.8	6.3	0.9	8.3	1.0
Fish (Fresh)	Q	15.0	21.0	27.0	28.0	29.0
	V	43.6	72.3	78.5	106.1	21.4
Shrimps, Prawns, Lobster, (Fresh)	Q	6.0	6.0	7.0	15.0	10.0
	V	224.1	247.0	339.7	803.8	604.0
Others (Value)	V	1,123.8	1,278.1	19,703.7	3,420.9	3,811.7
Total Agricultural Exports (V)		10,977.7	12,396.5	15,897.1	22,150.8	36,022.3
	Imports					
Maize	Q	0.01	3.00	6.00	1.00	0.05
	V	0.50	0.60	7.40	1.00	0.50
Wheat	Q	65.00	46.00	87.00	80.00	89.70
	V	94.30	72.70	127.80	202.00	403.60
Malt	Q	5.00	4.00	4.00	7.00	7.30
	V	24.40	16.40	16.90	31.10	47.80
Cereal (Prepared)	Q	4.00	4.00	4.00	5.00	5.10
	V	92.70	93.20	99.10	134.50	143.80
Vegetables Fresh and Dried	Q	0.60	4.00	3.00	0.80	0.50
	V	21.00	37.40	25.20	26.00	28.70
Coffee	Q	3.00	3.00	3.00	2.00	1.00
	V	33.00	28.90	31.50	19.90	21.10
Tea	Q	1.00	1.00	1.00	1.00	0.08
	V	30.60	28.30	36.10	23.50	20.80

Appendix Table 1. Continued.

Commodity	(Except where indicated units are 1,000 tons and million Baht)					
	2513 (1970)	2514 (1971)	2515 (1972)	2516 (1973)	2517 (1974)	
Silk Yarn and Thread	Q	2.0	0.40	0.10	0.10	0.10
	V	48.40	46.20	47.70	82.40	55.80
Cotton Yarn and Thread,	Q	2.00	2.00	0.80	1.00	0.30
Grey and Other	V	03.30	73.10	52.80	37.20	23.10
Cotton Fabrics and Others-	Q	47.00	45.00	39.00	37.00	34.70
Million Square Yards	V	337.00	186.50	177.00	202.40	299.40
Cotton Raw and Linters	Q	40.00	48.00	49.00	85.00	62.30
	V	478.00	679.60	727.10	1,316.90	1,465.30
*Rubber Products	V	207.90	177.90	172.40	142.40	210.80
Milk and Cream	Q	39.00	29.00	25.00	37.00	24.00
	V	307.90	275.20	374.80	446.10	521.40
Cheese Butter and Ghee	Q	7.00	9.00	3.00	3.00	2.20
	V	89.40	141.60	76.20	65.10	63.70
Oil and Animal Fat	Q	4.00	4.00	5.00	7.00	8.60
	V	17.10	19.50	26.30	55.30	92.20
Livestock, Live (1,000 Heads)	Q	314.00	324.00	514.00	724.00	672.00
	V	12.70	15.50	14.30	21.50	23.50
- Buffaloes	Q	-	-	-	0.20	1.10
	V	-	-	-	0.30	0.30
- Horses	Q	0.10	0.10	0.09	0.02	0.02
	V	2.70	2.60	2.60	1.20	0.50
- Poultry	Q	313.00	323.00	513.00	721.00	663.00
	V	6.20	7.90	10.50	17.20	20.40
- Swine	Q	0.30	0.03	0.40	0.60	0.10
	V	0.40	0.20	1.20	2.40	0.80
- Bullocks and Cows	Q	0.20	0.80	-	2.20	7.50
	V	3.40	4.80	-	0.40	1.50

Appendix Table 1. Continued.

Commodity	(Except where indicated units are 1,000 tons and million Baht)					
	2513 (1970)	2514 (1971)	2515 (1972)	2516 (1973) 2517 (1974)		
Others	V	1,742.50	1,454.60	1,760.80	2,321.90	3,489.00
Total Agricultural Imports	V	3,884.40	3,856.40	4,364.30	5,519.70	7,546.70
*Balance of Trade in Ag. Sector	V	7,093.30	8,540.10	11,532.80	16,631.10	28,425.60

Source: Department of Customs, Royal Thai Government, Bangkok, Thailand. Foreign Trade Statistics of Thailand 1970-1974.

Appendix Table 2. BE 2524 Commercial Livestock Enterprise Labor Requirements.<sup>1</sup>

Region	Man Years or Full Time Jobs
North	315,048
Northeast	489,048
Central Plain	66,180
South	126,784
Thailand	997,060

<sup>1</sup>Farm children under 15 years of age and family members 65 years of age and over are not counted as part of the labor supply. Instead they are assumed to provide enough labor to care for noncommercial livestock.

Appendix Table 3. BE 2524 Regional Livestock Feed Grain Requirements.<sup>1</sup>

Region	Tons of Grain
North	43,955
Northeast	81,011
Central Plain	54,728
South	47,365
Thailand	227,059

<sup>1</sup>Mainly fixed paddy; includes less than .2 percent other grains.

Appendix Table 4. Region Center Commodity Prices Used Throughout the Analysis.

Commodity	Region Price (Baht per Kg.)			
	North	Northeast	Central Plain	South
Rice (nonglutinous paddy)	2.78	2.76	2.87	3.04
Rice (glutinous paddy)	2.68	2.66	2.77	2.94
Maize (feed)	2.05	2.00	2.47	
Maize (human food)	.21	.28	.32	.24
Sorghum	2.25	1.55	2.25	
Mungbeans	4.05	4.20	5.31	5.33
Soybeans	4.03	4.25	5.16	
Black Beans	4.03	4.79	5.16	
Kak Beans	4.94	4.79	4.94	
Groundnuts	4.11	3.95	4.23	4.58
Black Sesame	8.48	8.48	8.75	
White Sesame	8.15	8.48	9.01	
Kenaf	2.34	2.26	2.29	
Jute	3.24	3.24	3.27	
Cotton	5.13	4.24	5.30	
Castor seed	4.06	5.86	6.06	
Cassava	.35	.35	.45	.24
Sugarcane (fresh eating)	.49	.86	1.45	1.15
Sugarcane (sugar making)	.30	.30	.30	
Tobacco (native)	8.00	8.00	8.00	8.00
Tobacco (virginia)	20.75	16.12	20.75	
Tobacco (berley)	20.75	16.12	20.75	
Coconuts			1.91	1.91
Garlic	4.62	6.00	4.62	4.62
Sericulture Produce Thread				
Native Variety		100.00	100.00	
Sericulture Produce Thread				
Hybrid Variety		150.00	150.00	
Watermelon	4.00	4.00	4.00	4.00
Rubber			8.00	8.00

Appendix Table 5. BE 2524 Regional and Kingdom Land Bounds by Land Type and Alternative (1,000 Rai).

Region and Land Type	Alternative						
	A	B1	B2	C	D	E	F
<b>North:</b>							
Type I	2,591	2,591	2,591	2,591	2,591	2,591	2,591
Type II Wet Season	4,034	2,783	2,783	4,034	4,034	1,353	1,353
Type II Dry Season	1,027	613	613	1,027	1,027	275	275
Type III <sup>1</sup>	5,420	6,286	6,286	5,420	5,420	7,239	7,239
Type IV	8,892	8,891	8,891	8,892	8,892	8,892	8,892
<b>Northeast:</b>							
Type II Wet Season	2,337	1,612	1,612	2,337	2,337	1,184	1,184
Type II Dry Season	706	336	336	706	706	33	33
Type III	20,719	21,139	21,139	20,719	20,719	21,435	21,435
Type IV	11,878	11,879	11,879	11,878	11,878	11,877	11,877
<b>Central Plain:</b>							
Type I	336	336	336	336	336	336	336
Type II Wet Season	11,726	8,091	8,091	11,726	11,726	7,198	7,198
Type II Dry Season	2,919	2,205	2,205	2,919	2,919	1,623	1,623
Type III	4,165	5,803	5,803	4,165	4,165	6,114	6,114
Type IV	8,453	8,453	8,453	8,453	8,453	8,453	8,453
<b>South:</b>							
Type II Wet Season	1,706	1,777	1,777	1,706	1,706	505	505
Type II Dry Season	123	73	73	124	124	31	31
Type III	1,932	2,351	2,351	1,932	1,932	2,858	2,835
Type IV	10,847	10,848	10,848	10,847	10,847	10,847	10,847
Type V	104	104	104	104	104	104	104
<b>Thailand:</b>							
Type I	2,927	2,927	2,927	2,927	2,927	2,927	2,927
Type II Wet Season	19,805	13,665	13,665	19,805	19,805	10,241	10,241
Type II Dry Season	4,900	3,228	3,228	4,900	4,900	1,964	1,964
Type III	32,327	35,579	35,579	32,327	32,327	38,242	38,242
Type IV	40,071	40,072	40,072	40,071	40,071	40,069	40,069
Type V	104	104	104	104	104	104	104

<sup>1</sup>The portion of Type III paddy land which can be seeded to paddy under normal weather conditions. See Table 46.

Appendix Table 6. Agricultural Commodity Exports Under Alternative Export Level Assumptions.

Commodity	Assumed Export Level		
	High	Medium	Low
MAJOR CROPS (1,000 tons)			
Maize	3,000	2,500	2,000
Rubber	450	400	350
Cassava (processed)	2,600	2,170	1,752
Sugar	750	550	350
Kenaf	100	75	50
Rice (white)	1,700	1,400	1,000
MINOR CROPS (1,000 tons)			
Mungbeans	125	110	85
Soybeans	30	20	10
Ground Nuts	10	7	4
Castor Beans	40	30	20
Sesame	15	12	8
Sorghum	300	220	160
Jute	4	3	2
Cotton	5	4	3
Tobacco	40	30	20
Coconuts	300	200	150
LIVESTOCK AND LIVESTOCK PRODUCTS:			
Cattle (1,000 head)	35	25	20
Buffalo (1,000 head)	15	10	5
Swine (1,000 head)	20	15	8
Chickens and Ducks (1,000 Birds)	10,000	7,500	3,500
Duck and Hen Eggs (tons)	5,000	4,000	3,000

Appendix Table 7. Minimum Rice Price<sup>1</sup> Necessary to Insure Production of Rice Rather Than Alternative Crops Given Conditions Assumed by Alternative: Unit-Baht Per Ton.

Alternative and Type of Paddy Rice	Region			
	North	Northeast	Central Plain	South
A - Nonglutinous	726	719	803	907
glutinous	619	726	642	746
B1 - Nonglutinous	787	780	864	968
glutinous	686	793	709	813
B2 - Nonglutinous	787	708	864	968
glutinous	686	793	709	813
C - Nonglutinous	726	719	803	907
glutinous	619	726	642	538
D - Nonglutinous	639	632	716	820
glutinous	569	629	545	441
E - Nonglutinous	1,218	1,211	1,295	1,399
glutinous	1,161	1,268	1,184	1,080
F - Nonglutinous	2,793	2,786	2,869	2,973
glutinous	2,747	2,853	2,770	2,681

<sup>1</sup>Linear programming model shadow price.