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# THIRD ANNUAL REPORT: AGRICULTURAL SECTOR ANALYSIS IN THAILAND

DAE-CARD Sector Analysis Series: No. 6
June 1977

# THIRD ANNUAL REPORT:

# AGRICULTURAL SECTOR ANALYSIS

# IN THAILAND

The Division of Agricultural Economics
Office of the Under Secretary of State for Agriculture
Ministry of Agriculture and Cooperatives
Royal Thai Government, Bangkok, Thailand

in cooperation with

The Center for Agricultural and Rural Development
Iowa State University, Ames, Iowa 50011

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# INTRODUCTION

The Thailand Agricultural Sector Analysis Program is a cooperative project between Iowa State University, the Ministry of Agriculture and Cooperatives (through its Division of Agricultural Economics) and USOM/Thailand.[1] The project, which has now completed its third year, was initiated July 1, 1973, in response to direct requests by the Ministry of Agriculture and Cooperatives for cooperation and collaboration in the development and application of sector analysis models and methods that have practical utility in guiding future development of Thailand's agriculture at national, regional, and local levels.

The agricultural sector analysis planning activity is centered in the Division of Agricultural Economics (DAE) which is in the Office of the Under Secretary of State, Ministry of Agriculture and Cooperatives (MOAC), Royal Thai Government.

The purpose of the project is to provide Thai planners with an assessment of possible policy decisions at the Kingdom, region, or local level. The focal point of the project is the welfare of the 24 million people living in Thailand's rural households.

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[1] AID Project CM/SA-C-73-19; July 1, 1973. Project directors are Dr. Earl O. Heady and Dr. Somnuk Sriplung. The staff members serving in Thailand to date have been: Keith Rogers, Western Illinois University; Lee Blakeslee, Washington State University; Arthur Stoecker, Iowa State University; Dennis Conley, Iowa State University; James Stephenson, Iowa State University; Charles Framingham, University of Manitoba; and Herbert Fullerton, Utah State University.

The agricultural policy makers in Thailand have control over certain policies that influence agricultural production, farm income, consumer food prices, employment, agriculture's contribution to the balance of payments, revenues from indirect taxes, rural-to-urban migration, etc. These policies relate to land and water use, import and export taxes or subsidies, farm credit, project investment budgets, and agricultural price stabilization.

There are large differences in per capita income between the rural and urban sectors and within the rural sector there also are large regional income differences. With these income differences come the related problems of underemployment. Historically, Thailand has maintained a food surplus by expanding the land area under cultivation, but the supplies of potential cropland are being rapidly diminished by a growing population.

The agricultural food surplus can be maintained by the increased use of inputs to increase the production from a given land area. There are real questions which must be answered such as how much, what kind, and in what location should investments be made. Finally, the impact of these investments on total farm income, employment, and the distribution of income must be considered.

The staff of the DAE works as a policy research group within either a set of general guidelines or on specific policy issues to assess probable impacts of specific policies or sets of policies on agricultural and non-agricultural variables. The interaction between the policy makers and the policy research group is shown in Figure 1.

The policy-making group is responsible for a set of guidelines or specific policy proposals. The modeling group must incorporate the set of

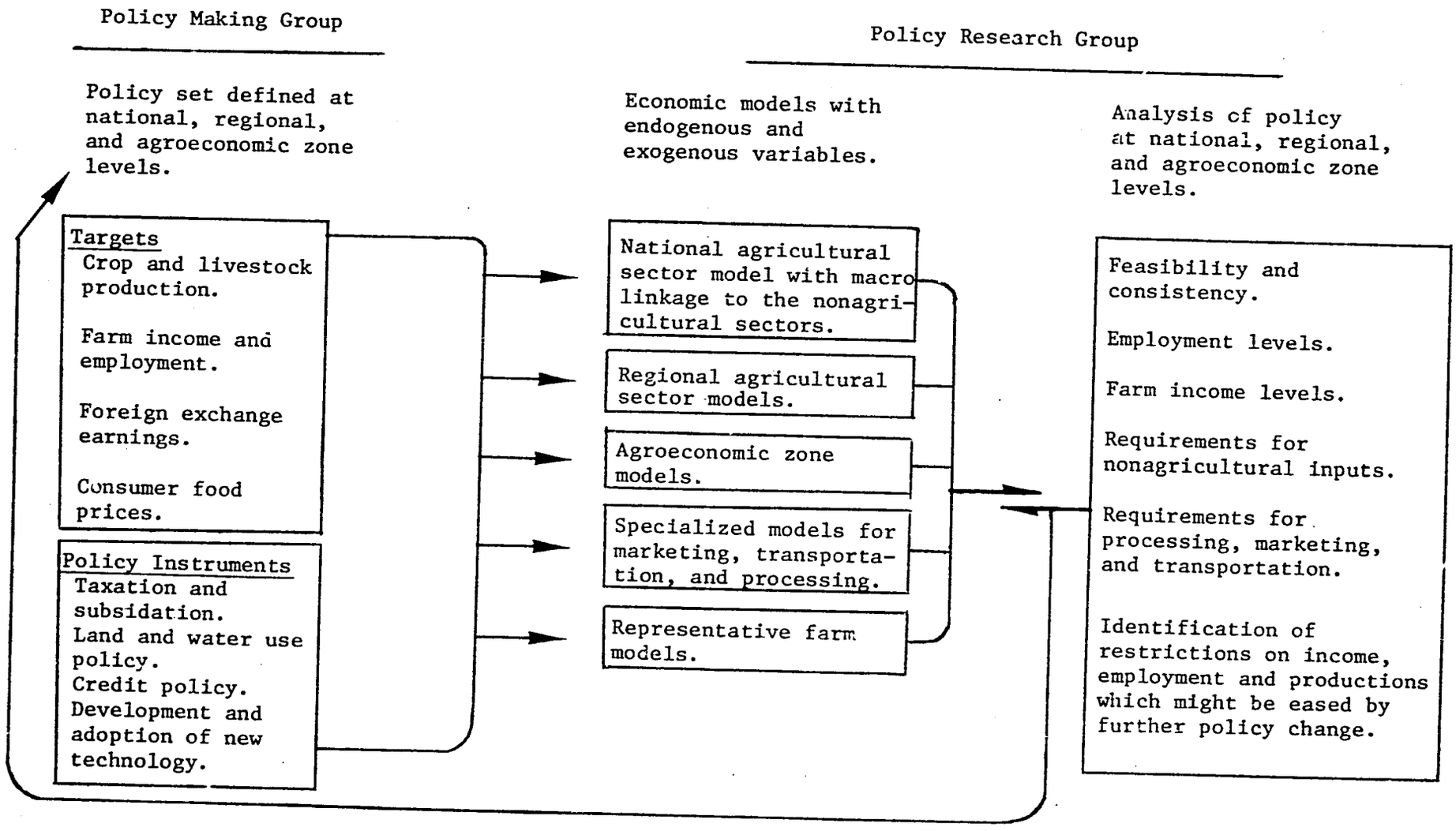


Figure 1. Interaction between the policy set and the economic models of the agricultural sector.

guidelines, current proposals, and existing programs and policies into the appropriate economic model of the economy. Each item in the policy set must be formulated in the model so the economic model is affected realistically. For example, the maximum loan capacity of institutions is entered as a constraint in each agroeconomic zone. The export price of rice may be entered to reflect the world price of rice less freight rates, export taxes, and domestic handling charges. The area in irrigation projects scheduled for completion by a specified target date is added to the irrigated land base and subtracted from the nonirrigated land base in the specific agroeconomic zone where the project is to occur. Policies regarding allocation of land between agriculture and forest uses are reflected in the supply of agricultural land in each part of the Kingdom.

As shown in Figure 1, the policy analysis need not begin at the Kingdom level. If the policy proposal deals with a specific region of Thailand, then the analysis begins with the model of the appropriate region or agroeconomic zone.

The results generated by a particular model are analyzed in terms of how the particular policy or set of policies affects the dependent variables of the system. The solution analysis may lead back to the modeling group for further refinement until the analysis is completed. The results are then summarized and presented to the policy-making group. The policy-making group may accept the analysis as final or it may revise targets, policy proposals, etc., and the cycle would be repeated.

## REVIEW OF PREVIOUS PROGRESS

Prior to the initiation of the project, the staff of the DAE had delineated Thailand into 19 agroeconomic zones which were recognized regions for data collection and dissemination and economic planning (Figure 2). Further, the staff had completed a general farm survey of 20,000 farms. This survey contained a 7,000 farm subset which provided detailed information on farm costs and returns for individual crops and livestock enterprises. The hand tabulations of this survey were largely completed prior to July 1973.

Fiscal years 1974 and 1975 were spent in DAE staff training in construction of linear programming models, demand estimation, and computer programming. The training was mainly on-the-job, but more formal classes were offered as part of the ongoing DAE in-service training program.

The initial project effort through cooperative interaction between the DAE and ISU staff was to define the general outline of what became a typical agroeconomic zone model of crop production. The initial model was for Zone 7, a zone of mixed rice and upland cultivation. This effort provided training to the ISU staff on production techniques, resource limitations, and problems of the Thai farmer and a feel for the data base. The close cooperative effort between the DAE and ISU staff members was necessary to develop the techniques for coefficient estimation and the identification of the most relevant resource constraints for modeling agricultural production. The model for Zone 7 served as a prototype for the construction of models for each of the remaining agroeconomic zones. The responsibility for

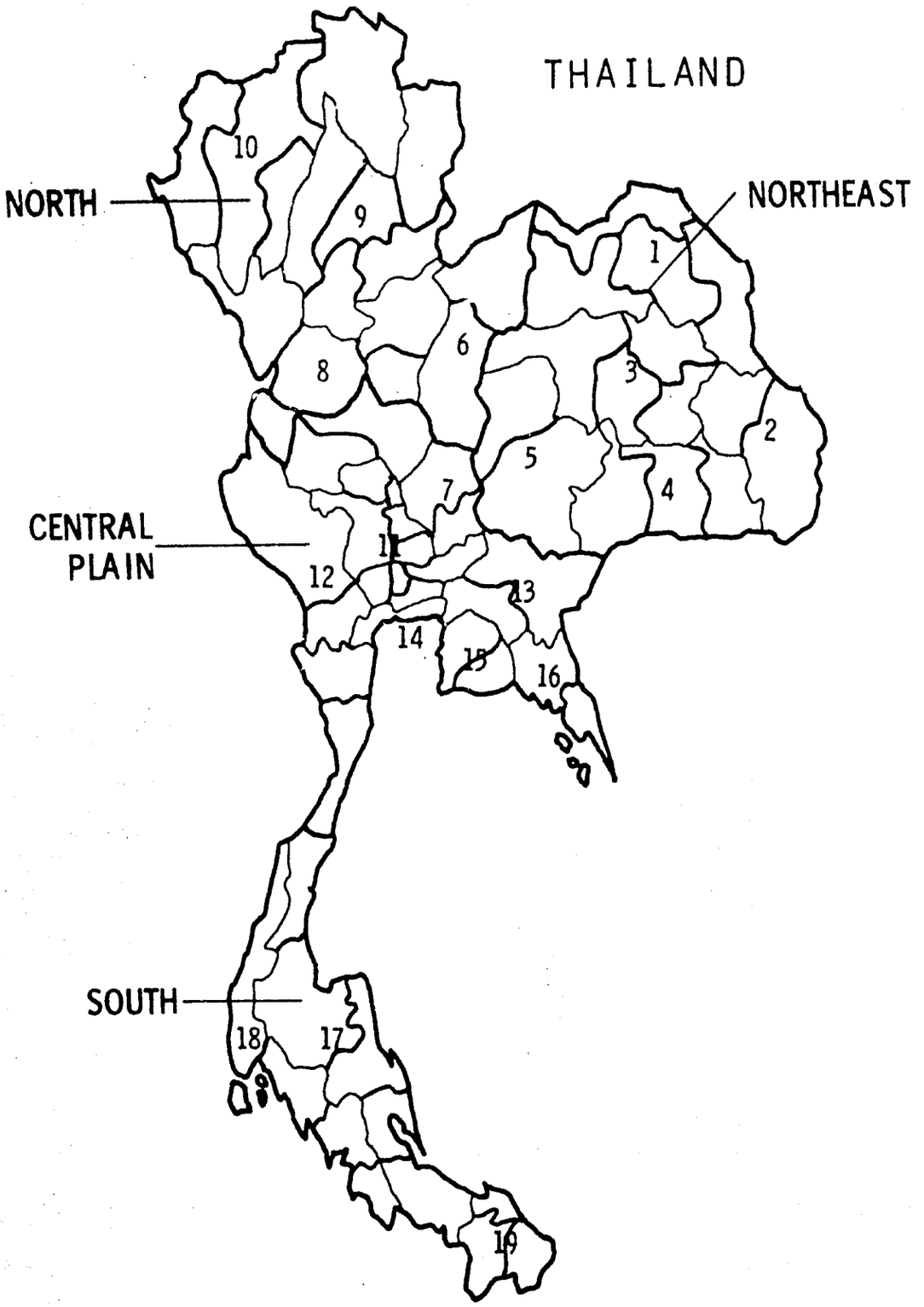


Figure 2. Thailand's agricultural zones and regions as specified for analysis and plan formulation

activity definition and resource construction in the remaining zones was largely assumed by the DAE staff.

The individual agroeconomic zone models (Figure 3) require estimates of crop yields by production technique by land class. Production processes for some 40 crops have been estimated. Resource use by type and month of the year was studied in the agroeconomic zone models. The restrictions in the agroeconomic zone models included monthly supplies of four different land classes, monthly labor supplies, monthly capital use, and annual restraints on capital borrowing from alternative sources of credit. Minimum production requirement (subsistence) to meet onfarm holding consumption needs were specified. The construction and testing of each agroeconomic zone model facilitates model validation and staff familiarity with the programming process.

After the general form of the crop model was established, the coefficient estimation techniques worked out, and the sequential construction of the agroeconomic zone crop models well underway, part of the DAE-ISU staff began work on the estimation of time series demand relationships. Econometric studies of individual commodity markets have been completed for kenaf and studies are underway for rice, maize, cassava, soybeans, mungbeans, and rubber. The empirically estimated domestic and export demand equations are to be incorporated into the programming models when the demand studies are completed.

When the construction of the agroeconomic zone models was completed for a region, members of the DAE-ISU staff began to combine the agroeconomic zone models into a model for that particular region. The regional models

Figure 3. Generalized matrix of crop model for an agroeconomic zone

| Resource Supplies | Type of Constraint | Crop Production Activities On Land Type | | | | Capitol Borrowing | | | Capitol Trons | | Approximate No. of Rows |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Land 1 | Land 2 | Land 3 | Land 4 | Institutions | Relatives | Merchants | | | |
| Land I | ≥ | 1 | | | | | | | | | 1 |
| Land II Mar. | ≥ | | | | | | | | | | |
| | ≥ | | 1 | | | | | | | | 12 |
| Land II Feb. | ≥ | | | | | | | | | | |
| Land III Mar. | ≥ | | | | | | | | | | |
| | | | | 1 | | | | | | | 12 |
| Land III Feb. | ≥ | | | | | | | | | | |
| Land IV Mar. | ≥ | | | | | | | | | | |
| | | | | | 1 | | | | | | 12 |
| Land IV Feb. | ≥ | | | | | | | | | | |
| Labor Mar. | ≥ | | | | | | | | | | |
| | | a | a | a | a | | | | | | 12 |
| Labor Feb. | ≥ | | | | | | | | | | |
| Capitol Mar. | ≥ | | | | | | | | 1 | | |
| Capitol Apr. | ≥ | | | | | | 1 | 1 | -1 | | |
| | | | | | | | | | | | 12 |
| | | a | a | a | a | 1 | | | | | |
| Capitol Jan. | ≥ | | | | | | | | | 1 | |
| Capitol Feb. | ≥ | | | | | | | | | -1 | |
| Inst. Max. | ≥ | | | | | 1 | | | | | 1 |
| Relative | ≥ | | | | | | 1 | | | | 1 |
| Merchant Max. | ≥ | | | | | | | 1 | | | 1 |
| Subsistence D | ≤ | a | a | a | a | | | | | | 6 |
| Objective Func. | | $nr_1$ | $nr_2$ | $nr_3$ | $nr_4$ | $-r_i$ | $-r_r$ | $-r_m$ | 0 | 0 | 1 |

have proven useful for studies of seasonal employment, crop supply response, and labor productivity. The area of regional analysis is being expanded to include analysis of investment potentials for agricultural processing.

By the beginning of the second year, work was started on a macro model of the Thai economy with emphasis on the interrelationships between agricultural and nonagricultural sectors. The macro modeling effort is to provide an assessment of the effects of changes in the agricultural sector on the nonagricultural sector and of changes in the nonagricultural sector on the agricultural sector. A 52-equation macro model with some nonlinear equations has just been completed. At the current time, a formal linkage between agricultural models and the macro model has not been completed. Although linkage is being completed, the multipliers generated by the macro model have been used as interim measures of impacts of changes in the agricultural sector on the nonagricultural sector.

Research in agricultural marketing has produce a basic set of transportation costs between parts of the Kingdom. DAE staff members are now constructing a detailed model of rice marketing, processing, and storage.

Still other DAE staff members are developing livestock commodity models. These livestock studies provide basic guidelines for livestock development projects and outline the most relevant crop-livestock interactions to be specified in the more general regional and national models.

Thus, several rather unique features have been combined to enhance the potential of conducting an extensive agricultural sector analysis in a relatively short period of time. First, an essentially complete cross-sectional data base was already in place before the project (DAE/ISU) was

formally initiated. Second, the project director, chief of party, and the director of the DAE as well as several of the other scientists were known to each other and had worked under a similar system in the United States. Third, the DAE and its director have had a unique consultative role in high levels of public decision making for several years. Hence, confidence and communication with research clientele were already in place at the time of project initiation. Fourth, in the first three years of the project, a liberal quantity of scholarship aid was made available sufficient to accommodate 68 students. Forty of these have already completed their degrees and have reentered employment with DAE. Fifth, in the first 18 months of the project, the team was able to deliver useful research material on a variety of issues ranging from rice buffer stocks to fish marketing and still were able to make satisfactory progress on project objectives. This enhanced credibility and confidence with their clientele and among fellow researchers in the DAE.

## POLICY ANALYSIS

The major purpose of the DAE-ISU project is to improve policy analysis in Thailand. During the period prior to July 1976, the major project emphasis was the specification and construction of models for policy analysis. During this initial phase some policy analysis was done with the Northeast region models in the areas of employment and potential crop supply. Other research included work on rice storage policy with a buffer stock model. Staff members also participated in numerous "brush-fire" type small policy decisions. However, no policy analyses with a national perspective were possible until near the end of the 1974-75 fiscal year.

By the end of the 1974-75 fiscal year, construction of a zone-specific regional crop model for Thailand had been completed. This model was applied to study the implications of alternate land availability conditions for Thai agriculture. Thus, the project had a modeling capacity adequate for the analysis of alternate agricultural crop production policies for Thailand.

## Policy Analyses Conducted During 1975-76

As indicated above, an initial application of the national linear programming crop model was completed in July 1975. These results indicated the implications of alternative and development policies for income and employment of Thai farmers. The results were summarized in a manner suitable for presentation to senior civil servants and elected government representatives. The results of the initial analysis were presented to the National Economic and Social Development Board Staff for its consideration. The same results, complemented by further model analyses of alternate land policies conducted solely by the Thai staff, were presented to the Minister of Agriculture and Cooperatives. These presentations generated a request for extensive policy analysis applications of the crop model.

One aim specified for the project was that of conducting analytical research and related activity to support development of Thailand's Fourth Five-Year Plan for Agriculture. The National Economic and Social Development Board's response to consideration of the initial model results was to request analysis of alternative development plans for consideration as elements of the Fourth Five-Year Plan. Fulfillment of this request thus became the focus of agricultural policy analysis pursued during the fiscal year 1975-76.

Seven plan alternatives were specified and analyzed to provide supporting research for the Fourth Five-Year Plan. Within each plan alternative specific demand and supply factor levels were considered. Comparison of conditions under alternate plans provided measures of the impact of selected factors. The set of demand and supply factors explicitly considered in each plan alternative analyzed is shown in Table 1.

Table 1. Demand and supply factors explicitly considered in policy analyse analyses conducted to support preparation of Thailand's Fourth Five-Year Plan

| Factors Affecting Product Demand | Factors Affecting Product Supply |
|---|---|
| Population | Agricultural Land Area and Use |
| Income | Irrigation |
| Exports | Technology Adoption (Use of fertilizer and improved rice varieties) |
| Commodity Prices | Commodity Prices |
| | Input Costs |
| | Climatic Conditions |

The demand and supply factors in Table 1 along with other related issues were analyzed in seven alternative solutions. Each solution corresponded to a specified level of exports, population growth, irrigation development, or technology adoption. The purpose was to estimate regional income, employment, output, exports and foreign exchange earnings for each situation. The seven alternative situations are shown in Table 2. The

Table 2. Principal and illustrative alternatives analyzed

| Planning Factors | Principal Alternatives | | | Illustrative Alternatives | | | |
|---|---|---|---|---|---|---|---|
| Demand Factors: | A | B1 | B2 | C | D | E | F |
| 1) Population: Growth Rate (Percent) | 2.1 | 2.5 | 2.5 | 2.8 | 2.1 | 2.1 | 2.1 |
| 2) Income: Growth Rate (Percent)[a] | 2.2 | 2.2 | 2.2 | 2.2 | 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 Controls | | | | | | |
| Supply Factor 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 | 48,637 | 54,794 | 54,794 | 48,637 | 48,637 | 58,202 | 58,202 |
| Type III Total Usable | 32,237 | 35,544 | 35,544 | 32,237 | 32,237 | 37,614 | 37,614 |
| Type IV | 40,073 | 40,073 | 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: | | | | | | | |
| Max. Percent of Land II for RD in Wet Season[b] | 62.7 | 49.9 | 49.9 | 62.7 | 62.7 | 62.9 | 31.5 |
| Max. RD Area on Land II | 12,420 | 6,407 | 6,407 | 12,420 | 12,420 | 6,446 | 3,223 |
| Max. Percent Land III | 27.2 | 21.5 | 21.5 | 27.2 | 27.2 | 22.3 | 14.3 |
| Max. RD Area on Land III | 8,788 | 7,659 | 7,659 | 8,798 | 8,798 | 8,535 | 5,470 |

(continued on next page)

Table 2 (continued)

| Planning Factors | Principal Alternatives | | | | Illustrative Alternatives | | |
|---|---|---|---|---|---|---|---|
| Demand Factors: | A | B1 | B2 | C | D | E | F |
| 4) Max. Fertilizer Use: (Kgs. per rai) | | | | | | | |
| On Native Varieties | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| On RD Varieties | 80 | 60 | 60 | 80 | 80 | 80 | Levels |
| Area Fertilized (1,000 rai) | 20,567 | 19,300 | 19,300 | 20,567 | 20,567 | 18,758 | 14,974 |

[a]This growth rate is based on past trends and assumes their continuation.

[b]The maximum dry season rice area was assumed to be 80 percent of irrigable land.

SOURCE: Thailand's Fourth Five-Year Agricultural Development Plan, B.E. 2524 - Guidelines, Prepared by Division of Agricultural Economics, Ministry of Agriculture and Cooperatives on behalf of The National Economic and Social Development Board, Office of the Prime Minister, Royal Thai Government.

values of the parameters (Table 2) represent national sums of individual parameters specified at the zone or regional level.

The nature of the results produced through analysis of the seven alternatives is illustrated by the income and employment results for the three principal alternatives (Table 3). A complete set of results for each of the seven analyses conducted is presented in the document entitled "Thailand's Fourth Five-Year Agricultural Development Plan BE.2524--Guidelines." That document also describes the context in which the analyses were conducted and the procedures employed.

Table 3. BE.2524 employment and income conditions in Thailand by region under the three principal plan alternatives

| | Region | | | | |
|---|---|---|---|---|---|
| | North | North-east | Central Plain | South | Thailand |
| **Plan Alternative A** | | | | | |
| Employment: | | | | | |
| Percent Unemployed Peak Use Month | None | 26 | 15 | 11 | 30 |
| Percent Unemployed Dry Season | 74 | 88 | 47 | 47 | NA[a] |
| Average Net Farm Income: (Baht/farm) | 20,101 | 6,603 | 24,407 | 14,728 | 14,643 |
| **Plan Alternative B1** | | | | | |
| Employment: | | | | | |
| Percent Unemployed Peak Use Month | 11 | 26 | 19 | 19 | 30 |
| Percent Unemployed Dry Season | 78 | 89 | 51 | 50 | NA[a] |
| Average Net Farm Income: (Baht/farm) | 18,742 | 6,567 | 23,359 | 13,796 | 13,982 |
| **Plan Alternative B2** | | | | | |
| Employment: | | | | | |
| Percent Unemployed Peak Use Month | 40 | 22 | 18 | 15 | 28 |
| Percent Unemployed Dry Season | 81 | 85 | 50 | 48 | NA[a] |
| Average Net Farm Income: (Baht/farm) | 16,825 | 7,656 | 22,234 | 14,533 | 13,900 |

[a]Not applicable.

The results of the plan alternatives analyzed were presented to NESDB staff, department directors within the Ministry of Agriculture and Cooperatives, and other selected guests at a seminar sponsored by DAE in June 1976. That seminar and the distribution of numerous copies of the Guidelines document available in both Thai and English have been the communication mediums used to make results of the analyses available to users. As well, presentation of the material to the Cabinet of the Royal Thai Government is planned by the DAE.

## NATIONAL MODELING ACTIVITIES

The main accomplishments during 1975-76 were related to the application of the national model to the analysis of crop production alternatives for the Fourth Five-Year Agricultural Plan.

It might appear that setting up a model for policy analysis is a simple rote process. This is not the case. The process of policy analysis in a modeling context requires thorough thinking of how that policy is to be implemented. For example, policy may state only that the farm price of rice is to be 2,500 Baht per ton of paddy. The further questions of whether this means exactly 2,500 Baht in all changwats, or at least 2,500 Baht have to be answered before meaningful modeling can begin. Then there are questions of what instruments are admissible and what are the admissible values of these instruments. For example, the 2,500 Baht per farm level price may be implemented by production controls, public purchases for storage export, changes in taxes or subsidies on output or inputs, or just declaring the only legal price as 2,500 Baht. The alternative means of policy implementation

may have very different consequences on farm income, employment, and land use. Because questions of a similar nature arise on all policy questions, it is essential to maintain a very direct dialogue between the policy maker and the policy research group.

The current state of model development did not allow for a full analysis of all aspects of agricultural production. However, the current state of model development was felt adequate to begin analysis of crop production alternatives. The questions of major relevance were identified as the expansion of the irrigation area, the expanded use of fertilizers and new rice varieties, and the feasibility of meeting specified upland crop production targets. The major objectives were to indicate the feasibility of meeting production targets and to quantify the impacts of farm income, employment, and land use by region.

The model updating during 1975-76 included the following:

1. Reestimation of a rice yields for each production technique in each region. This reestimation process pooled the cross section yield data according to production technique using three years data from the general farm survey. The general farm survey information was supplemented with results from specific rice yield surveys taken during two of the three years covered by the general farm survey. The updating process used a weighted version of the following linear model,

$$Y = U + B_i + G_j + V_k + eijk$$

where:

$Y$ is the yield per rai;

$B_i$ is the effect of broadcasting or transplanting;

$G_j$ is the effect of glutinous or nonglutinous type of rice; and

$V_k$ is the effect of new or native varieties of rice.

The estimates of rice fertilizer response to rice in the current model were derived from experimental data. The rice response functions were estimated by a regression procedure which incorporated several years of experimental data and allowed testing different rates of fertilizer response due to soil type and rice variety.

2. The yields for all upland crops were reestimated using data from all completed general farm surveys.
3. The areas actually receiving irrigation water in the wet and dry season were estimated from reports of individual irrigation project areas. Target areas for project completion were also obtained from reports of individual irrigation projects.
5. Other revisions included demand requirements for individual commodities in each region for alternative rates of population growth. Labor supplies were also reestimated.

## National Crop Model of Thailand

Because of computer space limitations it was necessary that any national model be more aggregative than the agroeconomic zone model outlined in Figure 3. For example, the average zone crop model contains about 80 restrictions. To construct an unaggregated national model would require more than 1,500 equations. Experience has shown the practical limit for an 8K IBM 1130 computer to be about 350-400 equations.

The national crop model then was constructed from aggregated modules of the individual agroeconomic zone models. The monthly constraints for the

use of each class of land, labor, and capital were aggregated into wet and dry season period. The seasonal resource constraints on production processes are still specified by agroeconomic zone. All of the production processes defined in the zone models were retained in the national model.

Further aggregation was obtained by combining the 19 agroeconomic zones into four consuming regions. The agroeconomic zones in each consuming region and the noncentral cities in each consuming region were designated as interconsuming region shipment points. Noncentral cities were defined as shipment points because of the export orientation of Thai development policy. The major portion of regional exports do, in fact, pass through the designated cities.

The structure of the national crop model is shown schematically in Figure 4. The model contains between 350 and 450 equations depending on the particular policy set being analyzed.

The current model of crop production does not contain price variable demand relationships. The fixed point demand projections used in the model are based on per capita demands, income, and population growth rates. Fixed point demands were used for all agricultural exports rice and maize. For rice and maize, exports were allowed to vary up to a specified maximum at a constant price.

The model shown in Figure 4 may be formally stated as

$$\text{(1) maximize} \quad \sum_i E_i P_i - \sum_z \sum_j C_{zj} X_{zj} - \sum_z \sum_k b_{zks} K_{zks}$$

$$- \sum_{\substack{c \\ c \neq d}} \sum_i S_{cdi} T_{cdi} - \sum_d \sum_i S_{dci} T_{dci}$$

Figure 4. Schematic diagram of national crop model with 4 consuming regions and 19 agroeconomic producing areas

| | Zone Level Crop Production Activities | | | | | | | | | | | | | | | | | | Transportation | | | | | | | | Export |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | $P_6$ | $P_8$ | $P_9$ | $P_{10}$ | $P_{11}$ | $P_{12}$ | $P_{13}$ | $P_{14}$ | $P_{15}$ | $P_{16}$ | $P_{17}$ | $P_{18}$ | $P_{19}$ | T | T | T | T | T | T | T | T | E |
| Bounds | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | B | | | | | | | | | |
| Objective | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | -c | P |
| Resource Z1 | A | | | | | | | | | | | | | | | | | | | | | | | | | | |
| " Z2 | | A | | | | | | | | | | | | | | | | | | | | | | | | | |
| " Z3 | | | A | | | | | | | | | | | | | | | | | | | | | | | | |
| " Z4 | | | | A | | | | | | | | | | | | | | | | | | | | | | | |
| " Z5 | | | | | A | | | | | | | | | | | | | | | | | | | | | | |
| Demand N.E. | -Y | -Y | -Y | -Y | -Y | | | | | | | | | | | | | | I | I | | -I | | | -I | | |
| Resource Z6 | | | | | | A | | | | | | | | | | | | | | | | | | | | | |
| " Z8 | | | | | | | A | | | | | | | | | | | | | | | | | | | | |
| " Z9 | | | | | | | | A | | | | | | | | | | | | | | | | | | | |
| " Z10 | | | | | | | | | A | | | | | | | | | | | | | | | | | | |
| Demand North | | | | | | -Y | -Y | -Y | -Y | | | | | | | | | | | -I | I | I | | -I | | | |
| Resource Z7 | | | | | | | | | | A | | | | | | | | | | | | | | | | | |
| " Z11 | | | | | | | | | | | A | | | | | | | | | | | | | | | | |
| " Z12 | | | | | | | | | | | | A | | | | | | | | | | | | | | | |
| " Z13 | | | | | | | | | | | | | A | | | | | | | | | | | | | | |
| " Z14 | | | | | | | | | | | | | | A | | | | | | | | | | | | | |
| " Z15 | | | | | | | | | | | | | | | A | | | | | | | | | | | | |
| " Z16 | | | | | | | | | | | | | | | | A | | | | | | | | | | | |
| Demand Central | | | | | | | | | | -Y | -Y | -Y | -Y | -Y | -Y | -Y | | | -I | | -I | | -I | I | I | I | I |
| Resource Z17 | | | | | | | | | | | | | | | | | A | | | | | | | | | | |
| " Z18 | | | | | | | | | | | | | | | | | | A | | | | | | | | | |
| " Z19 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Demand South | | | | | | | | | | | | | | | -Y | -Y | -Y | | | | | | I | | | -I | |

where:

$E_i$ is the amount of product i exported at price $P_i$;

$X_{zj}$ is the level of production process j in zone z;

$C_{zj}$ is the variable cost associated with production process j in zone z. The variable cost includes farmer-purchased inputs, processing plus assembly and shipment to the region shipment point.

$K_{zks}$ is the amount of capital borrowed from source k, in zone z in season s (k = 1, 3; s = 1, 2);

$b_{zks}$ is the interest charge on money borrowed from source k, in zone z for the duration of season s;

$T_{cdi}$ is the amount of commodity i shipped from consuming region c to consuming region d (c, d = 1, 4); and

$S_{cdi}$ is the cost of shipping one unit of commodity i from consuming region c to consuming region d.

The constraints of the model are summarized in equations (2) through (9). Equation (2) requires that the quantity of glutinous rice, nonglutinous rice, and maize exported be less than or equal to an export target, $EM_i$.

(2) $E_i \leq EM_i$, i = 1, 3

(3) $E_i = EM_i$, i = 4, n

Fixed export targets were specified for the remaining commodity exports as shown in equation (3). Within each of the 19 agroeconomic zones production is required to meet onfarm subsistence demands. The constraints for glutinous and nonglutinous rice (commodities land 2) are shown in equation (4).

(4) $\sum_j Y_{jz} X_{jz} \geq SD_{iz}$, (1 = 1, 2)

Production to meet subsistence demand requirements for the remaining commodities takes the form of the lower bounds on production processes shown in equation (5).

$$(5) \quad X_{jz} \geq LB_{jz}$$

Four regional consuming regions are defined. For commodity i in consuming region c equation (6) insures that total production plus in-shipments less out-shipments exceeds total disappearance in consuming region c. $Y_{jzi}$ is the amount of product i produced by production process jz. The total disappearance $D_{ic}$ includes total consumer demand (commercial + subsistence) plus foreign exports or imports if an export port is located in consuming region c.

$$(6) \quad \sum_{z} \sum_{d} Y_{jzi} X_{jz} + \sum_{c} T_{cdi} - \sum_{d} T_{dci} \geq D_{ic}$$

Production in each agroeconomic zone is limited by availability of land, labor, and capital supplies. The supplies of land, labor, and capital resources are determined by natural occurrence, past economic activity, and the particular policy set being analyzed. Supplies of cropland are divided into four classes and each classification is divided into wet season and dry season use, equation (7), that the use of land type t, in season s, in zone z be less than equal to the supply of that land.

$$(7) \quad \sum_{j} X_{zj} \leq LD_{tsz} \qquad t = 1, 5;\ s = 1, 2;\ z = 1, 19$$

Equation (8) requires that the seasonal demand for labor not exceed the seasonal supply of labor for crop production. Equation (9) requires the onfarm supply of

$$(8) \quad \sum_{d} a_{zjs} X_{zj} \leq LB_{zs} \qquad s = 1, 3$$

where $a_{zjs}$ is the number of hours of labor in zone z for activity j in season s.

$$(9) \quad \sum_{j} a_{zjs} X_{zj} - K_{zks} - FC_{zs} \leq 0$$

where:

$a_{zjs}$ is the amount of short-term capital required for production process j;

$K_{zks}$ is the amount of capital borrowed from source k, zone z in season s; and

$FC_{zs}$ is the amount of farmer capital on hand at the beginning of season s.

Objective function

The motivation contained in the objective function as stated in equation (1) along with the fixed demand requirements is analogous to the motivation of a subsistence farmer who wants to maximize his off-farm cash sales after first insuring that there will be sufficient production to meet family consumption needs. In equation (1) the export earnings are similar to the case sales of the subsistence farmer.

Fixed demand requirements are equivalent to the assumption that the demand for a product is perfectly inelastic. The cost minimizing solution to a linear programming model with fixed levels of demand does generate a set of prices which, if implemented in an economy with decentralized decision making, would guide production decisions so that final demand targets could be met within certain limits.

If a feasible solution exists to linear programming such as shown in Figure 5, the equilibrium price Pe represents the minimum price necessary to cause production of output level qd. The step-type supply curve generated by an LP model (shown in Figure 5) shows that when the price is exactly Pe the output level will be indeterminate between q1 and q2. That is, if the equilibrium price Pe were put into a profit-maximizing model, the output level would fall between q1 and q2. The amount of indeterminancy is reduced as the number of constraints is increased.

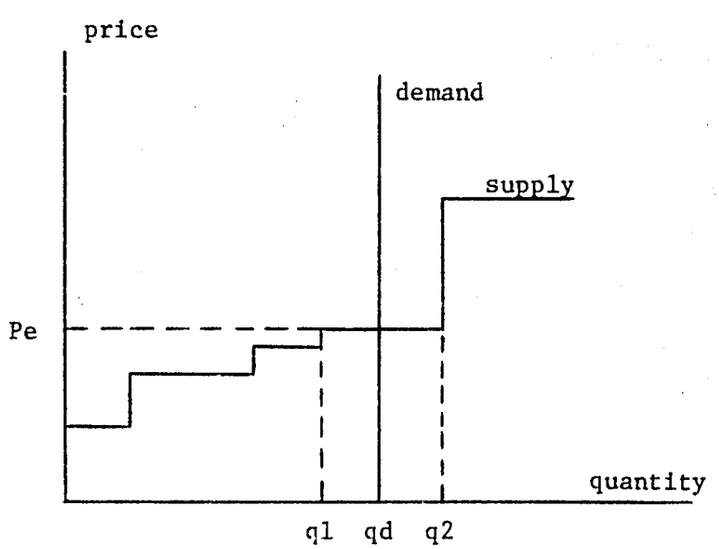


Figure 5. Cost minimizing solution to linear program with fixed point demand

If the demand for the final product is not perfectly inelastic, the assumption of fixed levels of demand will result in an error in estimating both the final levels of demand and the equilibrium price. The amount of error depends on the elasticity or slope of the demand function with respect

to its own price and the amount of influence from the prices of other products. If the effect of the own product price on consumption is small, then the assumption of fixed levels of demand will cause no real problem. If the price effect on consumption is significant, price-dependent demand relationships should be incorporated into the model.

Crops in the model

Part of the planned development policy was concerned with increased introduction rates of new rice varieties and the use of more fertilizer on both new and old rice varieties.

The basic set of crops and crop production techniques defined in the model by land type and agroeconomic zone are shown in Table 4.[1] Each activity in the model is a specific production process. For example, the production of native variety nonglutinous rice on land type 3 in the wet season in zone 5 is one activity. The production of that same crop with an RD (Rice Department) variety required an additional activity.

The use of new varieties and(or) new production techniques by farmers is modeled by defining additional activities. Figure 6 shows two hypothetical fertilizer response functions--one for a native variety and one for an RD variety--when the effects of fertilizer and higher yielding varieties are considered together. The model contains at least two activities for each variety. There are four activities outlined in Figure 6. Activity OVO with yield YOVO represents production of native variety rice without

[1]The definition of alternative varieties and production techniques similar to those shown for rice are currently being developed for other crops.

Table 4. Major crops and crop production techniques specified by land class and agroeconomic zone analyzed in the national crop model for Thailand

| | |
|---|---|
| Nonglutinous rice (tp, ov, f) | Cotton |
| Nonglutinous rice (tp, nv, f) | Caster seed |
| Nonglutinous rice (bc, ov, f) | Cassava |
| Nonglutinous rice (bc, nv, f) | Sugarcane (fresh) |
| Glutinous rice (tp, ov, f) | Sugarcane (manufacturing) |
| Glutinous rice (tp, nv, f) | Tobacco (native) |
| Glutinous rice (be, ov, f) | Tobacco (Virginia) |
| Glutinous rice (bc, nv, f) | Tobacco (Burley) |
| Maize for livestock | Tobacco (Turkish) |
| Maize for human food | |
| Sorghum | Mulberry with native and hybrid types of sericulture |
| Mung bean | Upland nonglutinous rice |
| Soybean SJ 1 | Upland glutinous rice |
| Soybean SJ 2 | Watermelon |
| Soybean native | White sesame |
| Black bean | Kenaf |
| Kak bean | Jute |
| Groundnut | Rubber (ov) |
| White sesame | |
| Black sesame | Rubber (nv) budded stump |
| Coconut, native | Rubber (nv) field bud |
| Coconut, hybrid | Intercropping on replanted rubber |
| Coconut, sugar | |

Abbreviations used: tp - transplanted; bc - broadcast; nv - new variety; ov - old variety, f - yield variable with fertilizer

fertilizer. Activity OVf1 with yield YOVf1 represents production of native variety rice with fertilizer level f1. Similarly, activities RDO and RDf2 with respective yields YRDO and YRDf2 describe production of an RD rice with zero and f2 levels of fertilizer. The solution gives the optimal area planted to each variety along with the optimal use of fertilizer for each variety. Accuracy is increased by defining additional activities with more levels of fertilizer for variety. Constraints were added to reflect reasonable rates of adoption for both fertilizer use and for changing from a native variety to a new variety. These constraints are discussed in a later section.

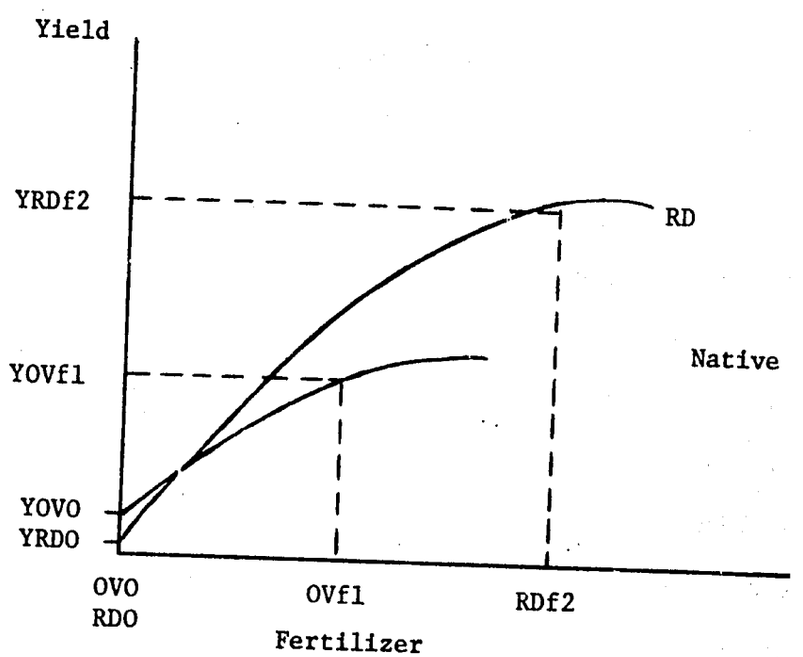


Figure 6. Hypothetical fertilizer response for native and new varieties of rice and definition of activities which allow farmer choice between varieties and fertilizer levels

Farm-level fertilizer response data were preferred for the planning model. However, available farm level data were not sufficient to permit complete specification of fertilizer response surfaces. The procedure adopted was to fit a general response function from four years of data from experimental fertilizer trials on rice with allowances made for differences between years, varieties, and soil types. The experimental response surface was then adjusted to farm-level conditions by a ratio technique based on observed farm-level rice response to fertilizer.

The activities used in a particular solution must be consistent with the assumptions of the policy set analyzed for that solution. In obtaining solution A, those rice activities with high levels of fertilizer were included in the model. When obtaining solution F, activities representing fertilizer application rates beyond current levels were simply excluded from the model.

## Evaluation of Development Alternatives

The DAE was requested by the National Economic and Social Development Board of Thailand to develop a series of guidelines for the agricultural part of the Fourth Five-Year Plan for Thailand. The national crop model was used to evaluate the potential effects of alternative programs involving irrigation, new rice varieties, increased use of fertilizers, and agricultural credit.

There are several sources of uncertainty which planners must face. The uncertainties include future world conditions that will influence demands for Thai exports, population growth rates, and unexpected difficulties with proposed projects.

The assessment of possible impacts from alternative programs and levels of program achievement was made by obtaining a series of seven solutions from the national crop model. Each of the solutions was designed to show the consequence of success or failure of one or more parts of a basic package or programs designed to increase agricultural income and employment through the increased use of irrigation, fertilizers, varieties and credit.

To reduce the number of solutions required, the model was designed to represent conditions in the last year (BE 2524, 1981) of the forthcoming Five-Year Plan. The solutions were then compared.

The parameters or major assumptions for the model used for each of the seven alternatives are summarized in Table 2. Each of the seven alternatives represents an export market condition in combination with a particular level of attainment for programs in irrigation, varieties, and fertilizer adoption. The main assumptions for each model solution are:

A. In solution A it is assumed that all targets are realized and that world markets are very good so that "high" levels of Thai commodities can be exported. The population growth rate in Thailand was assumed to be 2.1 percent per year in 1981. All development programs have been implemented to their maximum planned levels by 1981.

B1. Alternative B1 represents conditions for a medium level of success in all areas. The export levels are assumed to be medium, and it is assumed that the population growth rate has been slowed to a medium level (2.5 percent). The levels of irrigation project

are assumed to be medium. Similarly, it is assumed that fewer farmers have adopted RD varieties and smaller amounts of fertilizer are applied to each rai of paddy land receiving fertilizer than in alternative A. With alternative B1, planners are assuming a higher level of domestic consumption, a lower level of export demand, and a smaller productive capacity than for alternative A.

B2. The parameters for alternative B2 are the same as for B1 except that it is assumed that a policy to increase annual incomes in the Northeast by approximately $50 per household through expansion of upland crops has been adopted. Alternative B2 was added to the solution set after solutions to the remaining alternatives showed that a strict economic efficiency criterion would shift production out of the Northeast, thus creating high levels of unemployment and potentials for mass migration.

C. The model assumptions for alternative C are the same as for alternative A except that population growth continues high at 2.8 percent per year. All other program levels except the population targets are assumed to be reached. Export levels are high.

D. The model parameters for alternative D are the same as for alternative A except that only "low" levels of commodities can be exported. All other development targets are assumed to be obtained.

E: Alternative E represents a situation where export potentials are high, the population growth rate is low, but the areas receiving irrigation water and planted to RD varieties remain at current levels.

F. Alternative F represents a situation with no increase in technology or productive capacity over current levels. Population growth rates are low and export levels are high as in alternative A.

Data requirements

Conceptually, the number of coefficients required for a programming model is the product obtained by multiplying the number of equations or constraints by the number of variables or activities. In practice, the density of such models is low. The crop model describes here contained only 11,000 of a possible 400,000 coefficients.

Model constraints data

The supply of each resource by season and by type specified in the model above must be known. The sources of the principle constraints used in this study are listed by item and source:

| Item | Source |
|---|---|
| Land use | Division of Agricultural Economics General Farm Survey (GFS) |
| Irrigation area | Royal Irrigation Department |
| Farm credit | |
| Crop labor | GFS, BE 2513 Population Census, Royal Thai Government growth rates approved for planning. |
| Area fertilized | GFS, DAE Specific Rice Survey (SRS) |
| RD varieties | GFS |
| Domestic demand | DAE unpublished income elasticity studies, Approved population growth rates. |

| Item | Source |
|---|---|
| Export demand | DAE unpublished time series projections DAE-NESDB agreement based on discussion meetings and available |
| Subsistence demand | GFS, DAE unpublished special surveys. |

Coefficient estimation

The total set of coefficients required for a programming model is equivalent to the set of coefficients required for enterprise budgets with the same resource detail. In both the programming model and the budgeting procedure, the use of each input and each output by each enterprise must be accounted for. In the budgeting procedure employed, both the price and quantity of each input and output were specified in advance. In a programming mode, the inputs and outputs where price and quantity are prespecified may be included in the objective function. Those items (both inputs and outputs) where either the quantity or the price is to be determined by the model solution make up the tableau of the programming model.

Selected coefficients in the model have been estimated from the following data sources:

| | |
|---|---|
| Rice yields | GFS for 1971-72, 1974-75<br>Rice 1973, 1974 |
| Rice fertilizer response | GFS, fertilizer trials by DAE, Rice Department, other agencies between 1971-1972. |
| Upland crop yields | GFS for 1971-72 and 1974-75 |
| Labor requirements | GFS for 1971-72, DAE farm records |

| | |
|---|---|
| Capital requirements and variable costs | GFS for 1971-72, DAE farm records with all values updated to 1975 price levels |
| Transportation costs | Unpublished transportation survey and transportation study. |

The major portion of the model presented has been constructed from primary cross-section survey data while supplementary information has been obtained from secondary sources.

## SUMMARY AND CONCLUSIONS

The income and employment results of the optimistic development situations are shown in Figures 7 and 8. These are the optimistic development situation, A; the moderate development situation, B2; and the no technical change situation, F.

The levels of employment are naturally higher with high export levels in solution A. Figure 7 does indicate a high degree of seasonal underemployment and unemployment will continue to be a problem even if market conditions remain favorable for "high" levels of exports. On a regional basis, the problems of finding further employment opportunities are greatest in the Northeast and North.

The graphs in Figure 8 include estimates of farm income from livestock, fruits, and vegetables in addition to the crop income figures examined previously. The results show the implementation of the program for irrigation, fertilizer, and rice varieties could be expected to increase income for the average agricultural household. However, if households in

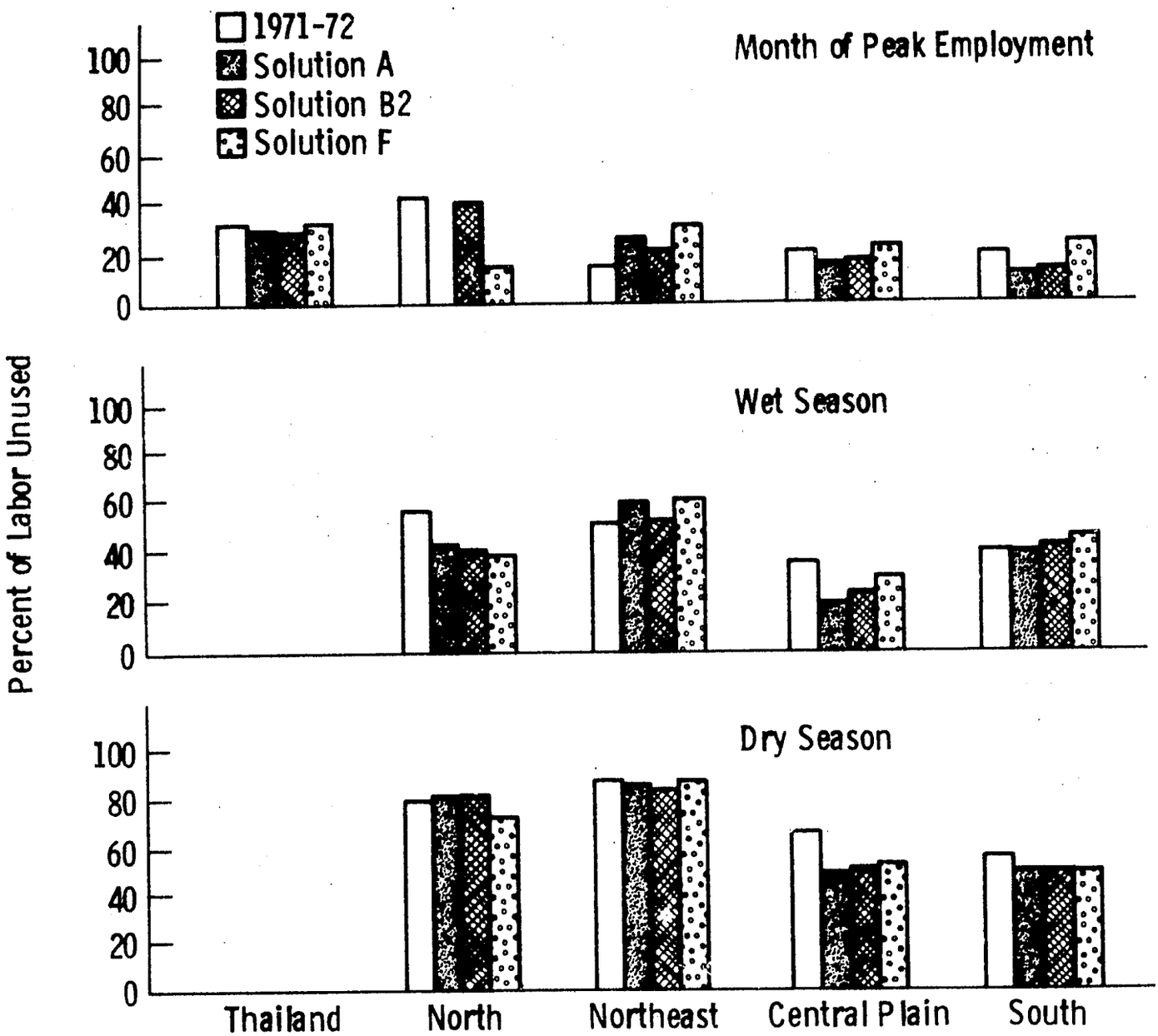


Figure 7. Levels of underemployment[a] in Thailand in solutions A, B2, and F in 1981 and calculated levels for 1971-72

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[a]Underemployment or unemployment measured here is the percentage of the total days in each period when labor is not required.

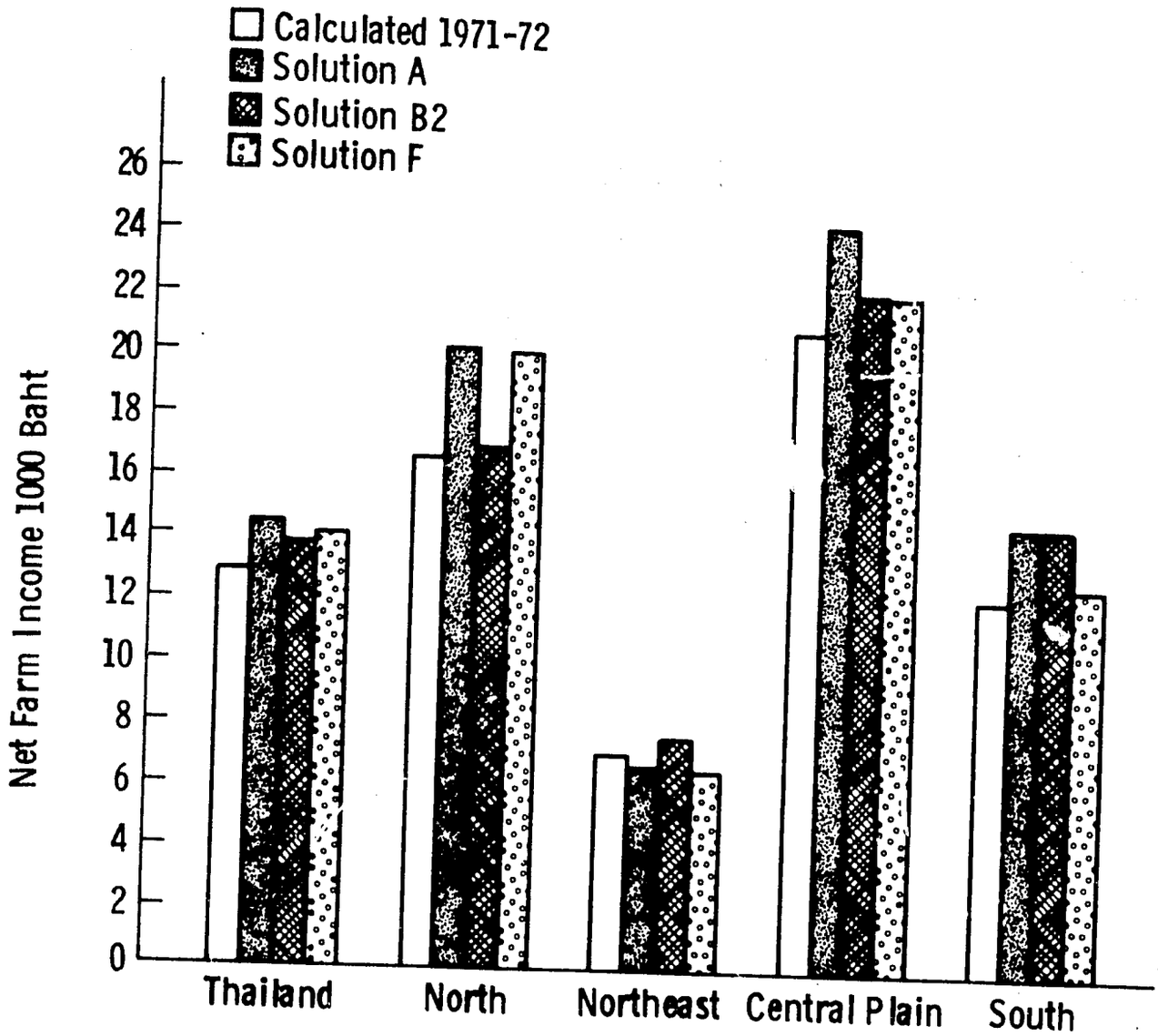


Figure 8. Net farm income in Thailand for solutions A, B2, and F and as calculated for 1971-72

all regions are to receive nonnegative gains, additional measures must be adopted to increase farm income in the Northeast.

The results of the model give only general guidelines as to how the results for solution B2 can be implemented. The model indicates the increased income might be generated most readily through increased production of crops such as maize and cassava. The production of the crops must increase at rates at least as great as past trends. Further research in the area of finding varieties and production practices which would lower cost per unit or production in the Northeast is already in process.

## Regional Analysis

Much interest in the policy research area centers on gaining more complete knowledge of the broader economic implications of interrelationships between the agricultural sector and the rest of the economy. Interest focuses not only on what will happen in the agricultural sector under alternative policy sets, but also to the total regional and national economies. The national macro econometric models, previously discussed, represent a first research effort by the ISU team which addresses this problem at the national level. The next obvious step was to develop regional models with similar capability. Formal efforts were initiated on the project when Dr. Herbert H. Fullerton, a regional economist, joined the ISU team in January 1976. Numerous economic base, econometric, and interindustry studies were reviewed as potential sources of a methodology which would facilitate addressing the essential regional policy questions and would at the same time be feasible in terms of budget and data constraints and the time frame of the project.

Methods

The economic base model typically focuses on the interrelations of sectors within a regional economy. Its importance for programming of regional development is based on its capability of describing how growth in one sector, say agriculture, may induce growth among other sectors of the region's economy. Economic base multipliers are the most commonly used techniques for estimating regional impact. Base analyses distinguish between basic and nonbasic economic activities for the purpose of implementing the commonly held premise that economic growth in a region is predicated on the expansion of sales of regionally produced goods outside the region. The primary advantage of base analysis is the ease of conducting such a study and the relatively light data requirement. The arguments against its use are many, but the most important are its theoretical poverty in terms of not recognizing internal as well as external sources of growth, the fixity of its parameters, and the rather arbitrary classifications which must necessarily be employed in measuring the economic base. From the policy analysts' point of view, it is not a very useful method because it makes no explicit identification of policy instruments which can be directly related to ministry programs. In a less developed economy where a major thrust of policy may involve very substantial quantitative and some qualitative changes within the plan period, it does not appear to hold much promise. At best it is a method that gives very limited information. It may serve to legitimize a new area of research while data support for better methodologies are being developed.

Numerous econometric studies have been applied at the national level, but very few have been done for subnational economies for the simple reason that time series data of sufficient spatial and activity detail are not generally available. In Thailand a series of regional econometric models for the major planning regions would be the cleanest conceptual extension of the regional work because they would be consistent with the Kingdom level work of Dr. Stephenson and could eventually be linked with regional agricultural models (linear programming) in approximately the same manner as is envisioned for the national linear program and macro econometric models. Although regional accounts data are now available, they are of relatively short duration and not in sufficient detail to facilitate examination of realistic policy questions which would distinguish this approach from a simple economic base study. The inescapable conclusion is that any method that must rely on an extensive and detailed regional data base must be developed from cross sectional data because detailed time areas data are not currently available. Some variations of the Leontiff input-output models appear to be feasible under these conditions.

Input-output analysis is a logical extension and further disaggregation of the economic base model, which can be developed from a cross section data base. It provides a far more complete description of the structure of transactions among a region's industries and also describes the linkage between production activities and the exogenous final demands (final sales of goods and services) and primary inputs (factor payments) accounts for the region. However, not all of the objections to economic base analysis

are overcome by using input-output analysis. Important relationships between agricultural industries and other industries which supply their inputs or purchase their outputs are elucidated. However, the fixity of relative prices, production, and trade coefficients must be accepted and explicit identification of policy instruments is still lacking. The question which must be answered is whether the additional information available from input-output models is sufficient to justify the very substantial data processment and development effort.

Progress to date

The strategy which has evolved in the past six months reflects the necessity of responding to near-term information needs and at the same time of investing in the development of a much greater capability in DAE to deal with impact analysis. Decisions which have evolved in the past four months are approximately as follows:

1) In the foreseeable future we must rely on regional models which can be developed from a cross-sectional data base. This eliminates regional econometric models for the present and places economic base models and input-output models at the head of the list of possibilities.

2) Because some information on region level impacts will be required in the near term, it was decided that a limited effort would be committed to the estimation of economic base multipliers at least for the major planning regions which could be used in conjunction with the regional linear program models.

3) Longer-term possibilities are thus restricted to some embellished application of the economic base models and(or) the development of

input-output models. The latter alternative was judged to be most desirable although it does involve a substantial commitment of resources and will of necessity require continuing interaction with numerous other agencies in the Thai government.

As of June 30, 1976, two preliminary meetings with representatives from the input-output section of NESDB have resulted in tentative agreements to cooperate with DAE in the development of input-output models for the major planning regions. The full extent of this cooperation has not been specified beyond exchange of survey instruments and an informal exchange of ideas and published data. The critical questions that must be resolved are how responsibility will be shared in the development of the next national input-output study and if the primary data base can be extended by enough to facilitate the development of reliable regional tables.

Preliminary data work for the estimation of regional economic base multipliers was initiated and estimates of location quotients and minimum requirements have been developed for the four planning regions. No further work is envisioned with the multipliers until national agricultural sector plan alternatives are evaluated in the regional linear programming models. Primary effort will be devoted to further development of the computer software and prototype regional models to familiarize the staff with input-output methodology and data.

## Macroeconometric Models

The work on a macro econometric model of the nonagricultural sector began in September 1974. The position of applied econometrician was added

to the project so the impacts of changes in the agricultural sector on the additional team member was to research and model the linkages between the agricultural and nonagricultural sectors of Thailand.

The initial work consisted of:

1) investigation of previously completed econometric models of the Thai economy, and

2) investigation of the availability, adequacy, and consistency of time series data needed for macroeconometric analysis. The main data base selected was the series from 1960-1974.

By the end of the first year a small 21-equation, highly-aggregated model of the Thai economy had been completed.

Research during 1975-76

The work that has been carried out during the 1975-76 fiscal year has been for the greatest part concerned with the construction of two fairly disaggregated macroeconometric models of the Thai economy, simulation of these models to judge their predictive capability and dynamic stability, and the preparation of a document describing these models in detail (see End of Tour Report by James A. Stephenson, Macroeconomist and Applied Econometrician, contract AID/DM/SA-C-73-19).

Model I is a straightforward extension of the small 21-equation model that was completed at the time of the previous annual report. As the smaller model was, it is strictly linear in both parameters and variables. It consists of 45 equations, with 36 behavioral equations and 9 identities. The behavior equations include seven private consumption expenditure equations, three government expenditure equations, seven export equations

four import equations, two gross fixed capital formation equations, eight output equations, and five income distribution equations. It is a strictly real model in the sense of containing no monetary or price variables as endogenous variables. Model I has been extensively analyzed by reduced form analysis and has been found to be highly successful in similating the historical period 1962-74. On the basis of the Theil U-Statistic test of predictive power, which reflects roughly the percent average absolute error of predictions, all of the 45 endogenous variables had a percent error of less than 10 percent and 41 of the 45 were less than 5 percent.

Model I was constructed specifically to be linear in both variables and parameters in order to facilitate the linkage of the macroeconometric model with the national linear model of Thai agriculture. Constraining oneself to a totally linear model, however, means that many interesting economic questions cannot be explored, at least in a straightforward way. For example, per capita consumption rather than just levels of consumption may be of interest. Nonlinear specifications may provide a greater degree of flexibility in capturing and predicting some variables. Also, as stated above, Model I includes no monetary or price variables explicitly.

For these reasons, Model II, a modification of Model I, was constructed. It consists of 55 equations with 45 behavioral equations and 10 identities. It compares with Model I in the following ways. It has the same Private Consumption Equation groups, but the equations are in per capita terms. The Government expenditure and export equations are unchanged from Model I. Three of the four import groups are put in per capita terms. The two gross fixed capital formation equations are disaggregated into seven groups reflecting industrial origin. The output

equations are changed to nonlinear form using a modified Cobb-Douglas production function form. The income distribution equations are unchanged from Model I. Finally, five equations are added reflecting the monetary sector and which predict the GDP and private consumption price deflators, thereby monetizing the model.

Model II was also analyzed with respect to its predictive performance and dynamic stability properties by the use of a Gauss-Seidel iterative algorithm. (Because of the nonlinear nature of the model, reduced form analysis cannot be used.) The performance of Model II was again very good, and although not directly comparable with Model I, the results were on average about the same, which was very gratifying given the greater complexity and flexibility of Model II.

The results of Models I and II were presented in a seminar at USOM in Bangkok.

## The linkage with the national LP model and other further work

It was initially planned that the linkage of the macroeconometric model and the national LP model would be completed during the 1975-76 year. However, because of the very heavy responsibilities that the national model group had in conjunction with the preparation of a document for the Fourth Five-Year Plan, the linking process has been delayed to the 1976-77 year. As discussed in last year's annual report, the linking may be done by adding the macro model equations to those of the LP model and solving simultaneously. Alternatively, the linking may be carried out by treating the agricultural and nonagricultural sectors in a block recursive manner and solving the two sector models separately.

In terms of this linking process, the primary activity in the macro modeling effort will be to modify the existing models as it appears necessary from the linking. Also, work will continue in the improvement of the present models. Since the long-term overseas position of macroeconomist and applied econometrician terminates at the end of July 1976, this work will be done partly at Iowa State University in cooperation with DAE.

Other activities during 1975-76

1. Teaching of an in-service training course at DAE on applied econometrics.

2. Consultation with member of DAE's marketing branch on agricultural commodity models.

3. Supervision of a Ph.D. dissertation being prepared partly at DAE on a multinational econometric model of rubber.

## Center for Agricultural Statistics

During the past year, work with the Agricultural Statistics Center was focused on two areas: (1) development of an automated data storage system and (2) improving the survey processing software.

The long-awaited installation of the additional computer equipment came in November 1975. This equipment increased the CPU from 8K words to 16K words and added two additional disk drives to make a total of three.

With the additional equipment it was feasible to begin development of an automated data bank. At present, one section of the data bank is functional, two sections are in development, and a fourth section is being planned.

Since the current data storage facilities are not suitable for the storage of raw survey data, changwat-level summaries of this data are stored in the data bank. At the present time over one million pieces of information are stored in this section of the data bank. The user has access to estimated population totals, standard errors, averages, and number of respondents at the changwat, zone, region, or Kingdom level as either printed or punched card output. Information is available on land holdings, crop areas, production, income and expenses, etc.. This section of the data bank is now in operation.

Under development are two sections of the data bank: (1) a master list frame of villages and (2) price data. The master list frame of villages will be used in definition of the population, sample allocation, and sample selection for the DAE agricultural surveys. The price data section will make the price information collected by the marketing branch readily accessible for anyone in DAE.

Being planned is a section of the data bank to contain the raw data from the farm record-keeping programs.

Also, with the installation of the additional equipment, the survey processing programs for two-stage surveys were reprogrammed to take advantage of the additional 8K of CPU. For some survey processing jobs the new programs reduced the computer time required to 30-35 percent of that required by the previous system.

New software developed included a processing program for a three-stage sampling procedure and a generalized Gauss-Seidel program for solution of a nonlinear system of simultaneous equations.

Computer usage was near capacity for most of the year:

| | Month | CPU hours |
|---|---|---|
| 1975 | July | 457 |
| | August | 306 |
| | September | 430 |
| | October | 343 |
| | November | 231 |
| | December | 119 |
| 1976 | January | 313 |
| | February | 472 |
| | March | 387 |
| | April | 583 |
| | May | 534 |
| | June | 403 |

The low totals for November and December are largely due to the installation of the new computer equipment in November and problems with getting the new hardware fully operational. It was late December before the new equipment was operating smoothly.

Work plan for 1976

1. Complete the price data and list frame sections of the data bank.
2. Development of a section in the data bank for data from the farm record-keeping projects.
3. Development of software to allow extensive use of all sections of the data bank.

### Technical Assistance to Ongoing DAE Programs

The team efforts in this area consisted of course offerings in the DAE in-service training program as well as participation in DAE research activities not directly related to agricultural sector analysis.

Between July 1975 and June 1976 the following courses were offered by ISU staff members:

| | |
|---|---|
| Linear Programming | Art Stoecker |
| Computer Programming | Larry Kinyon |
| Regional Economics | Herbert Fullerton |
| Policy Analysis | Charles Framingham |
| Applied Econometrics | James Stephenson |

Assistance was provided to a pre-experiment evaluation of designs for a swine experiment. This was a cooperative project with the Livestock Department. Assistance was provided to an irrigation fertilizer experiment in the village of Ban Pan. Several alternative designs were analyzed. Computer programs were developed so the variance profiles of alternative experimental designs could be evaluated.

## PERSONNEL

The sector analysis project in Thailand is a team effort. Both long-term and short-term personnel from Iowa State University serve as an integral part of the DAE staff and together work to a common research goal. The primary work has been with the Planning and Statistics Branches of the DAE. Essential support has been received from the Production Economics, Farm Management, and Marketing Branches. The person providing the most leadership in issue identification, model formulation, staff motivation is Dr. Somnuk Sriplung, Chief of the Division of Agricultural Economics.

The total staff inputs for ISU personnel from the beginning of the project are shown below in order of dates of service:

Iowa State University

| Name | Position | Assignment | M-M |
|---|---|---|---|
| 1. Dr. Keith D. Rogers | Chief of Party, Resource and Regional Development | 7/18/73-7/23/75 | 23.7 |
| 2. Dr. Earl O. Heady | Senior Technical Advisor | 7/21/73-8/31/73 | 1.3 |
| 3. Dr. Leroy L. Blakeslee | Demand and Agricultural Projection | 8/1/73- | 18.0 |
| 4. Dr. Arthur L. Stoecker | Linear Programmer Chief of Party 7/1/75-6/30/76 | 8/5/73-on board | 35.6 |
| 5. Dr. Jerry A. Fedeler | Marketing and Participant Training | 1/14/74-2/16/74 | 1.0 |
| 6. Dr. Dennis M. Conley | Agro-Industry, Marketing, Transportation | 1/26/74-2/8/76 | 25.0 |
| 7. Dr. Earl O. Heady | Senior Technical Advisor | 4/9/74-4/25/74 | 0.5 |
| 8. Dr. Earl O. Heady | Senior Technical Advisor | 7/2/74-8/20/74 | 1.6 |
| 9. Dr. J.T. Scott | Marketing Consultant | 7/16/74-7/31/74 | 0.5 |
| 10. Mr. Lawrence Kinyon | Research Statistician | 7/22/74-on board | 23.0 |
| 11. Dr. James A. Stephenson | Applied Econometrician | 8/29/74-8/6/76 | 23.0 |
| 12. Dr. Jerry A. Fedeler | Marketing and Contract Negotiation | 12/4/74-12/21/74 | 0.6 |
| 13. Dean Lee Kolmer | Administrative Visit | 2/17/75-2/22/75 | 0.3 |
| | | Subtotal | 154.1 |

| Name | Position | Assignment | M-M |
|---|---|---|---|
| 14. Dr. J.T. Scott | Marketing Consultant | 2/17/75-2/22/75 | 0.3 |
| 15. Dr. Charles F. Framingham | Policy Analyst | 7/28/75-on board | 11.8 |
| 16. Dr. Leroy L. Blakeslee | Demand Consultant | 8/16/75-9/7/75 | 0.7 |
| 17. Dr. Earl O. Heady | Senior Technical Advisor | 12/5/75-12/12/75 | 0.3 |
| 18. Dr. Herbert Fullerton | Regional Economist | 1/8/75-on board | 5.8 |
| 19. Dr. Leroy Blakeslee | Demand Consultant | 4/5/76-4/25/76 | 0.7 |
| 20. Dr. Keith D. Rogers | Regional Consultant<br>Acting Chief of Party | 6/5/76-7/24/76 | 1.6 |
| | | Grand Total | 175.3 |

## Division of Agricultural Economics

| Name | Degree | Grade |
|---|---|---|
| Dr. Somnuk Sriplung | Ph.D. | Director of Division |
| **A. Statistics** | | |
| 1. Mr. Kleun Chaisand | M.S. | Sta.6 |
| 2. Mr. Rasamee Kasemsup | M.Sc. | Sta.6 |
| 3. Mr. Santisuk Permpongsri | B.S. | Sta.5 |
| 4. Mr. Lertchai Ninsalab | M.Sc. | Computer Officer 5 |
| 5. Mrs. Nantana Somsopon | B.Sc. | Sta.5 |
| 6. Mr. Opas Chaiyaprukkul | B.Sc. | Sta.5 |
| 7. Mrs. Chuleevan Bunnag | M.Sc. | Agr.4 |
| 8. Mr. Serm Pandhuwat | B.S. | Agr.4 |
| 9. Mr. Decha Supawan | B.Sc. | Sta.4 |
| 10. Mr. Woranit Utawanit | B.S. | Sta.4 |
| 11. Mr. Wisut Wongworawut | M.Sc. | Sta.4 |

| Name | Degree | Grade |
|---|---|---|
| 12. Mr. Amnart Thirarat | B.S. | Agr.4 |
| 13. Miss Supawan Kuchaisit | B.S. | Agr.4 |
| 14. Mr. Prakob-Kot Phusirimongkol | B.S. | Agr.4 |
| 15. Mr. Apichart Pongsrihadulchai | M.Sc. | Sta.4 |

B. Marketing

| | | |
|---|---|---|
| 1. Mr. Nguen Srisuruksa | M.S. | Eco.6 |
| 2. Mr. Vinai Jatutong | M.S. | Eco.5 |
| 3. Mr. Thongchai Petcharatana | M.S. | Eco.5 |
| 4. Mr. Manoo Tianniam | M.S. | Eco.4 |
| 5. Mr. Tawee Chinthatum | B.S. | Eco.5 |
| 6. Miss Juraiwan Distapanya | M.Sc. | Eco.4 |
| 7. Mr. Kumpanart Lohachareonwanich | B.S. | AID Trainee |
| 8. Mr. Prasit Supradit | B.S. | Eco.4 |
| 9. Miss Chaya Sukkapoo | B.S. | Eco.4 |
| 10. Mr. Boonserm Poosalee | M.S. | Eco.4 |
| 11. Mr. Chavengsak Imtaisong | B.S. | Eco.4 |
| 12. Mr. Bocnma Chanmuan | B.S. | Eco.4 |
| 13. Mrs. Suvaphun Smathakarnaksornkit | B.S. | Eco.4 |
| 14. Mr. Samrit Herankitrarangsee | B.S. | Eco.4 |

C. Planning

| | | |
|---|---|---|
| 1. Mr. Narong Chuprakob | M.Sc. | Eco.6 |
| 2. Mr. Winai Tayyaitieng | M.Sc. | Eco.5 |
| 3. Mr. Chammong Vathana | M.Sc. | Eco.4 |
| 4. Mr. Aran Ruangswang | B.S. | Eco.3 |
| 5. Miss Amporn Ruayruen | B.S. | Temporary Employee |
| 6 Mr. Chumlong Sukdidee | M.Sc. | Eco.4 |
| 7. Miss Sirinud Pranmontree | B.S. | AID Trainee |
| 8. Mr. Jumnong La-oeid | B.S. | Eco.4 |
| 9. Miss Supranee Tiragananta | M.Sc. | AID Trainee |
| 10. Mr. Prasit Itharattana | M.Sc. | Eco.4 |
| 11. Mr. Preda Imdee | B.S. | Agr.4 |
| 12. Mr. Banteang Masaeng | M.Sc. | Eco.4 |

| Name | Degree | Grade |
|---|---|---|
| **D. Economic Zones** | | |
| 1. Mr. Sudhep Indhapanya | M.Sc. | Agr.4 |
| 2. Mr. Yong Hengtrakoon | M.Sc. | Eco.5 |
| 3. Mr. Narong Chatbupa | B.S. | Eco.4 |
| 4. Mr. Nikorn Keograsem | B.S. | Agr.4 |
| 5. Mr. Somboon Suton | M.Sc. | Eco.4 |
| 6. Mr. Narong Pangsapa | B.S. | Eco.4 |
| 7. Mr. Siri Maniboon | B.S. | Eco.4 |
| 8. Mr. Pramote Jooltaworn | B.S. | Eco.4 |
| 9. Mr. Sumpao Sodjan | B.S. | Eco.4 |
| 10. Mr. Manas Tanawattana | B.S. | Agr.4 |
| 11. Mr. Suebsin Kowitangkoon | B.S. | Agr.4 |
| 12. Mr. Tana Tanomsakyut | B.S. | Agr.4 |
| 13. Mr. Supachai Nimkrut | B.S. | Eco.4 |
| 14. Mr. Chakkrit Damrak | B.S. | Eco.4 |
| 15. Mrs. Boonart Krissanasap | B.S. | Eco.4 |
| **E. Farm Management** | | |
| 1. Mr. Chamrus Ungkappla-ong | M.Sc. | Eco.6 |
| 2. Mr. Chalong Maneekul | M.Sc. | Agr.5 |
| 3. Mr. Banlu Puthigorn | M.Sc. | Eco.5 |
| 4. Mr. Sakol Ooraikul | M.Sc. | Agr.4 |
| 5. Mrs. Ladda Bhisalbutra | M.Sc. | Eco.4 |
| 6. Mrs. Yowarate Bandhukul | M.Sc. | Eco.4 |
| 7. Miss Sugunya Sooksai | B.S. | Eco.4 |
| 8. Mrs. Somnuk Shosivaskul | B.S. | Eco.4 |
| 9. Miss Chintana Sudaivong | B.S. | Eco.4 |
| 10. Miss Chumsri Desudchit | B.S. | Eco.4 |
| 11. Mr. Amnaj Somgmoung | B.S. | Eco.4 |
| 12. Mr. Thalerngsok Snitwongse | B.S. | AID Trainee |
| 13. Mr. Nipont Dilokkunanant | B.S. | Agr.4 |

| Name | Degree | Grade |
|---|---|---|
| 14. Mr. Supat Viratpong | B.S. | Agr.4 |
| 15. Mr. Surasak Tongpian | B.S. | Agr.4 |
| 16. Mr. Wiwat Thientosapol | B.S. | Agr.4 |
| 17. Mr. Suwit Prasomsuk | M.Sc. | Agr.4 |
| 18. Mr. Boon Wong Na-Tukuatoong | Vocational | Agr.3 |

E. Production

| | | |
|---|---|---|
| 1. Mr. Dusit Sirirojana | B.S. | Agr.5 |
| 2. Mr. Narongchai Keoka | B.S. | Eco.4 |
| 3. Mrs. Rassamee Masang | B.S. | Agr.4 |
| 4. Mr. Kaneung Srikeo | B.S. | Eco.4 |
| 5. Mr. Chao Tiantong | B.S. | Agr.4 |
| 6. Mr. Boonmee Chantrawong | M.Sc. | Eco.4 |
| 7. Mr. Kasem Sirisukhodom | B.S. | Eco.4 |
| 8. Mrs. Malinee Thorangkul | B.S. | Agr.4 |
| 9. Miss Orawan Ongkananantlert | M.Sc. | Eco.4 |
| 10. Mr. Supote Dachadete | M.Sc. | Agr.5 |
| 11. Mr. Jumrush Intachaisri | M.Sc. | Agr.5 |
| 12. Mr. Narong Soytong | B.S. | Agr.5 |
| 13. Mr. Suthat Supinacharoen | B.S. | Eco.4 |
| 14. Mr. Pinit Kulmonkon | B.S. | Eco.4 |
| 15. Mr. Vichien Vanchinavin | B.S. | Eco.4 |
| 16. Miss Arporn Kongsavat | B.S. | Eco.4 |
| 17. Mrs. Prajaub Lievchalermvong | B.S. | Agr.4 |
| 18. Mr. Manoch Piyavaranont | B.S. | Agr.4 |
| 19. Mr. Panom Tabtimsri | B.S. | Agr.5 |
| 20. Mr. Anunt Mutarais | M.Sc. | Eco.4 |
| 21. Mr. Chalauy Pantien | B.S. | Agr.4 |

# WORK PLAN JULY 1976 - JUNE 1977

## Determinants of the Future of Agricultural Sector Analysis (ASA)

Three factors or general categories of variables have been identified as being critical to the feasibility and future direction for ASA. The first of these factors is issues or problems. The future of any stage or form of ASA depends heavily on the emergence and recognition of researchable issues and problems. The primary qualification or constraint on the selection among issues is based on their researchability which is largely determined by the second determinant, that is, research capability. Research capability is defined to include human capacity in terms of numbers, training, experience, competency, interest and access to qualified consultants, facilities including space, equipment, computer, library, data base, and funding from both internal and external sources.

The third determinant or category is called situation. Situation describes the social-political-economic environment in which interesting issues and capability are united and flourish or wither. In a sense, "situation" can serve as the medium to support ASA, the catalyst which ignites it, or as its executioner.

## Selected Agricultural Sector Issues in Thailand

The Thailand Agricultural Sector Analysis Project faces many issues which are similar to those faced in other developing countries. Thailand is concerned about income disparity between rural and urban people, among regions and between the agricultural sector and the rest of the economy.

Thailand is also concerned with the potential for expanding production to insure adequate food supplies and to earn foreign exchange. Export expansion and import substitution are recurring topics. Thailand has an unusually large agricultural sector both in terms of production and population. Thailand has continued to be a major rice exporter and still has met the food demand of a fast-growing population. This has been accomplished primarily by land extensive methods which cannot be relied upon to meet future needs.

Thailand faces unique political and economic challenges in several rural areas where poverty and insurgency are common. There is motivation to explore the potential of expanding irrigation and to push for greater participation in multiple cropping. Underemployment is a serious problem for agricultural laborers. A high rate of immigration from the low income rural areas of the Northeast contribute to the problems of congestion and unemployment in Bangkok.

Research topics which can be distilled from these conditions include the following:

1) Price and income situation for major agricultural commodities including demand analysis and commodity supply response;
2) Land and irrigation expansion potential and alternative intensive methods which expand productivity (new varieties, fertilizer);
3) Analysis of alternative varieties, and fertilizer use for upland crop production;
4) Resource utilization and capital for labor substitution (labor, capital, machines);

5) Agricultural marketing and transportation;

6) Distributional impacts of national programs on agriculture and of agriculture on the national economy; and

7) The relationship between the retail price of selected food, foreign exchange earnings and farm income.

Research Capability in DAE

It may be stated that capability to conduct agricultural sector analysis research consists of the following:

1) Human capacity in terms of numbers, training, experience competency, interest and access to qualified consultants;

2) Facilities including space, equipment, computer, library and data bank;

3) Funding adequacy from both internal and external sources.

Human capacity in DAE currently includes approximately 800 persons. Included in this number are 293 people with professional degrees comprised of four Ph.D degrees, 69 M.S. degrees, and 220 B.S. degrees. Since 1973, numbers of total persons with professional degrees have increased only by 26, but Ph.D. and M.S. degrees were increased by 40. When people currently enrolled in graduate programs are finished, the number of post-graduate degrees will increase by another 35 persons including 11 Ph.D. degrees. Interest in research is strong and job commitment is unusually high. It is not unusual to find several of the research officials delivering considerable amount of uncompensated extra time work. Access to outside consultants is adequate and improves as new Ph.D.s return from abroad and larger numbers of foreign advisors gain long-term experience with the project.

Facilities are adequate and equivalent to the average in Thai bureaucracy. More important than floor space is proximity to decision making and the center of government. Present facilities have the benefit of good proximity to the Ministry and to the national government. Computer access has been very good on an IBM 1130, but current work loads are queuing even with 24-hour operation. Larger capacity must be secured in the near future. Library facility includes virtually all published statistical information on Thailand and selected journals in technical areas of agricultural economics and statistics. The computer-based data bank of agricultural data is maintained by the DAE. It contains an extensive biannual farm survey. Numerous other special surveys have been conducted including farm record (monthly), agricultural processing, and rice transport, marketing and processing.

Funding is obtained from both inside and outside Thailand, however, more than half of a budget ranging between 27 and 45 million Baht (1,350,000 $ US. to 2,250,000 $ US.) in the past five years has come as a line item from The Royal Thai Government. This high percentage provides evidence of strong government commitment to DAE. Since 1973, funds and staff have been augmented by US/AID to cover five Ph.D.-level positions for foreign scientists. This "outside" support accounted for only 23 percent of the total budget in 1976 and the balance of about 20 percent was derived from other assistance programs and international agencies.

Future directions for ASA

The process for identifying, defining, and reevaluating research topics has not been formalized at DAE. However, as a matter of principle, ideas

are circulated and reviewed by a substantial group of people. The ideas and scheduled research activities presented in this report represent the particular thinking of no one person but are an edited amalgam from several sources. The three determinants discussed above were fully operative in this selection process. There was a certain "inertia" based on past experience, tested models, and further applications which can be made easily with only very small additional cost; there was a pull to new issues which have emerged in recent months not all of which can be treated within the limits of our capability or what we expect it to be within the next 12 to 24 months, and finally we anticipate encountering an element of "situation" based on the necessity of making some trade-off of time and more compulsive focus on academically interesting objectives to gain credibility and support from potential users of the research product.

Areas of analysis and research support activity

Five major areas of activity have been identified in our current program of ongoing and future ASA. These activity areas include the following:

1) National and regional agricultural models and related analyses;
2) Macroeconometric and impact models for national and regional analyses;
3) Special studies;
4) Data bank maintenance and general survey and statistical support activities; and
5) Staff development.

Figure 9 describes the three levels of linear programming analysis which are a part of ASA at DAE. These include a national agricultural model, 4 regional agricultural crop models, 19 zone models, and a potential of more than 100 zone/farm level models. These models may vary substantially in size depending on the amount of detail required, however, typical national and regional models contain more than 400 real activities and zone models approximately 100. Zone/farm level model work is only getting underway, but it is anticipated that it will contain a somewhat smaller number of elements than the zone models. Expected applications and anticipated outputs for these models are discussed in the next section.

The second area shown in Figure 10, macroeconomic and regional models and analysis, contains the national macroeconomic model and regional multiplier and interindustry models. Initial estimates of two versions of the macro model have recently been completed. These models contain 45 and 55 equations in their present form. However, it is anticipated that the amount of disaggregation will be increased as much as possible in subsequent versions to facilitate linkage with other models. Regional multipliers are being estimated for each of the four planning regions and the nineteen agroeconomic zones. The interindustry analysis is also new. At this time it is anticipated that a national table and four regional tables will be developed from a primary data base.

Figure 9. National and regional agricultural models and related analysis

| Model, Activities, and Anticipated Change in Capability (product) | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| National Agricultural Model (NAM) | | | |
| A. Modifications and input for model improvement | | | |
| 1. Revise input cost data | X | | |
| 2. Develop demand projection program | X | | |
| 3. Complete check on Type IV land resource | X | | |
| 4. Complete check (reestimation) of labor and capital resources | | X | |
| 5. Add livestock activities | | X | |
| 6. Add agricultural processing activities | | X | |
| 7. Add new technology activities | | X | |
| B. Capacility and expected focus of research application | | | |
| 1. Examination of alternative rice price policies and supply response | X | | |
| 2. Evaluation of long-term potential food demand (capacity) | | X | |
| 3. Examination of the relationship between rice price policy, farm income and international balance of payment | | X | |
| 4. Update on national agricultural sector plan alternatives | | | X |
| Regional Agricultural Model(s) (RAM) | | | |
| A. Modifications and input for model improvement | | | |
| 1. Update consistent with current version of NAM | X | | |
| 2. Add new technology activities | | X | |
| 3. Add new livestock activities | | X | |
| 4. Add agricultural processing | | X | |
| 5. Add multiple crop and poly-period crop activities | | X | |

Figure 9. (continued)

| Model, Activities, and Anticipated Change in Capability (product) | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| B. Capability and expected focus of research application | | | |
| 1. Evaluation of agricultural sector plan alternatives at region and zone level | X | | |
| 2. Farm level supply response for upland crops (price policy) | X | | |
| 3. Evaluation of potential shifts in irrigation/land policy among regions | | X | |
| 4. Update on national agricultural sector plan alternatives at region and zone level | | | X |
| Zone/Farm Models[a] | | | |
| A. Input for model construction | | | |
| 1. Select zone for pilot study | X | | |
| 2. Identify activities to be included from farm records and from general farm survey | X | | |
| 3. Select typical or representative farm types | | X | |
| 4. Assemble coefficient and resource data | | X | |
| 5. Obtain initial solutions for testing and evaluation against known conditions and revise | | X | |
| 6. Extend to other zones and to fuller representation of farm types | | | X |

[a]It is assumed that only activities A-6 and B-4 will extend beyond the pilot study.

Figure 9. (continued)

| Model, Activities, and Anticipated Change in Capability (product) | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| B. Capability and expected research application | | | |
| 1. Evaluation of resource utilization and the efficiency of resource | | X | |
| 2. Evaluate potentially important new activities suggested by studies conducted at regional and zone levels | | X | |
| 3. Simulated management response to changes in input and output prices | | X | |
| 4. Initital solutions from other zones | | | X |

Figure 10. Macroeconometric and impact models for national and regional analysis

| Model, Activities and Anticipated Change in Capability | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| National Macroeconometric Model (MEM) | | | |
| A. Modification and inputs | | | |
| 1. Further disaggregation to facilitate linkage | X | | |
| 2. Reestimation with new data | | X | |
| B. Capability and expected research application | | | |
| 1. Annual projection of Thailand national economy | X | | |
| 2. Projection of Thailand national economy with input from NAM | | X | |
| 3. Projection of Thailand's national economy with re-estimated models | | X | |
| 4. Full linkage with NAM | | | X |
| Interindustry Models (I/O) | | | |
| A. Inputs | | | |
| 1. Assemble data for ag. sector and selected ag. proc. and input industries | X | | |
| 2. Assemble current national and regional I/O coefficients | X | | |
| 3. Test and develop capability to manipulate existing I/O models | X | | |
| 4. Assemble coefficients for combined agricultural-nonagricultural sector, final demands primary inputs and intermediate industries for regions and the nation | X | X | X |
| 5. Test the national model | | X | |
| 6. Estimate I/O mul. at national level | | X | |
| 7. Test first regional models | | X | |

Figure 10. (continued)

| Model, Activities, and Anticipated Change in Capability | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| B. Capability and expected research application | | | |
| 1. Use coefficients to facilitate linkage of NAM and MEM | | X | |
| 2. Evaluate for consistency, the implied changes in demand on other industries indicated in solutions of MEM and NAM models which are consistent with policy | | | X |
| 3. Evaluate for consistency the regional impact changes in demand implied with national plan alternatives in one region | | | X |
| Multiplier Analysis | | | |
| A. Inputs | | | |
| 1. Assemble industry specific data on employment and product for regions, zones Changwats | X | | |
| 2. Impact multipliers based on minimum requirements and average requirement | X | | |
| B. Capability and expected research application | | | |
| 1. Provide cross sectional estimate of potential impact associated with charge in regional exports | X | X | |
| 2. Provide estimates of regional level impact of national agricultural sector plan alternatives | X | | |

Figure 10. (continued)

| Model, Activities, and Anticipated Change in Capability | Near Term 3-6 mo. | Intermediate Term 6-12 mo. | Next Generation 12-24 mo. |
|---|---|---|---|
| 3. Provide estimates of zone level impact of national agricultural sector plan alternatives | | X | |

NOTE: Research applications are contingent upon close cooperation and success of joint data assembly efforts by DAE and the National Economic and Social Development Board. It is anticipated that substantial amounts of data on I/O coefficients will be available before model construction is completed.

## SEMINARS

The DAE-ISU sector analysis team held two public seminars during fiscal year 1976. The first seminar was sponsored by the Agricultural Development Council (ADC) in Bangkok. The papers presented at the two-day seminar (July 29 and 30, 1975) were:

| | |
|---|---|
| Dr. Somnuk Sriplung | Role of the DAE in Agricultural Development Planning |
| Mr. Prasit Supradit | Income Elasticity of Demand for Foods |
| Mr. Thongchai Petcharatana | Agricultural Demand Analysis |
| Dr. Dennis Conley and Mr. Chamnong Vatana | Effects of Transporation Cost Charges on Rice Agriculture |
| Dr. Arthur Stoecker and Mr. Kanok Khatikarn | National Crop Model |
| Mr. Prasit Itharattana | Northeast Crop Model |
| Mr. Chamlong Sakdidee | Zone Crop Models for the Central Region |
| Dr. James Stephenson | Macroeconomic Model |

An extreme debt of gratitude is owned to Dr. Shao-er Ong (Regional ADC representative) for organizing and promoting this seminar.

The second seminar on the Fourth Five-Year Plan was sponsored by DAE. The seminar was held to present the major results of the DAE-ISU research for the Fourth Five-Year Agricultural Development Plan. The seminar was held June 22 in the United Nations Asia FAL Conference Room in Bangkok. The program included an opening address by Mr. Adul Niyomviphat,

Deputy-Under Secretary of State for Agriculture and Cooperatives. Dr. Somnuk Sriplung discussed the current situation of Thai agriculture. The national crop model used to access the development alternatives was presented by Khun Khatikarn (DAE) and Art Stoecker (ISU). The policy implications were presented and discussed by Khun Winai Tayyaitieng (DAE) and Charles Framingham (ISU).

The evaluations of plan research given above were presented by Dr. Olarn Nipravat, Bank of Thailand; Dr. Narongchai Akrasanee, Thammasart University; and Mr. Tweesackdi Sesawetch, Department of Agricultural Extension.

The conference was attended by more than 58 representatives from NESDB, the Thai Universities, NIDA, and relevant government ministries outside the Division of Agricultural Economics. An additional 49 representatives from the DAE also attended.

The ISU group wishes to thank the leaders who planned the conference, chaired the sessions, and discussed the papers. The officers and clerical staff worked long hours preparing the publications are very much appreciated.