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NORTHEAST THAILAND

ECONOMIC DEVELOPMENT STUDY

FINAL REPORT

VOLUME II
APPENDIX

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I. SUMMARY OF NEED PROBLEMS, RECOMMENDATIONS FOR FUTURE ACTIVITIES, AND WORK METHODS

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Problems

The major problems encountered by NEED/PAG on the operational level during its period of activity in Thailand were:

1. Lack of clear job definition. The role of the NEED/PAG was not interpreted the same way by all interested parties until August, 1970. Up until that time, USOM saw the NEED/PAG role as advisory, while the Royal Thai Government saw it as performing the actual planning function.

2. Very few sector "working groups" meetings were held due largely to the many responsibilities and activities of the working group members which limited the amount of their time available for these meetings. Without working group meetings, it was exceedingly difficult for the NEED/PAG to get feedback on its efforts and proposals.

3. Insufficient full-time counterpart staff available. Each member of NEED/PAG had at least one counterpart. However, some of their counterparts had many responsibilities and functins to perform and, as a result, had little time available for NEED/PAG activities. This meant that, in many cases, there was limited advisor-counterpart interaction.

4. There was very little reaction by the RTG to the different stage reports. Without a reaction, it was difficult for the NEED/PAG to know how its work was being accepted and whether or not the work could be utilized.

The above-mentioned problems were overcome to the extent possible by each NEED/PAG member continuing to do his job as he interpreted it and developed working relationships with various people--not just official counterparts.

No insurmountable work problems occurred during the contract period. Initially, data location and data reliability were problems, but one of the first NEED/PAG activities was to assist in improving data collection, processing and storing techniques. This is discussed in Section II. It is critical that proper data collection, processing and storing continue in the future. Other work procedures, such as field trips, analysis and recommendations, were performed without difficulty. If the four major problems mentioned above could have been alleviated, work could have been carried out more quickly, and more impact could have been made on Thai counterparts and RTG operating agencies.

Recommendations for Future Activities

The NEED/PAG assisted in developing the first overall regional development plan. The goal was not only to prepare a plan, but to assist in developing planning capabilities within the appropriate government agencies. To further assist in the latter during future years, various specialists could be required for different periods of time. To be most effective, these people should be attached directly to the division with which they will work, and the assignment should be clearly defined and understood by all people involved--particularly, the division chief. Full-time counterpart staff should be available with no responsibilities conflicting with the responsibilities involved in working with the specialist.

Prior to the assignment of any specialists, the RTG should assess its own regional planning capabilities, define its problems and determine in what areas or categories specialists are needed. These are the categories in which specialists should be sought.

Work Methods

A complete summary of the methods of work used is contained in Section II, NEED Team Background and Activities.

II. NEED TEAM BACKGROUND AND ACTIVITIES

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THE CONCEPT OF NEED (Northeast Economic Development)

Starting in the mid 1960's, the Royal Thai Government (RTG) and the United States invested considerable resources into infrastructure for the Northeast Region of Thailand in an effort to bring the remote inhabitants closer in touch with the Thai Government in Bangkok. This was in addition to the large direct U.S. investment in the military bases established in the Northeast during the same period. In order to assure a more systematic approach to planning and resource allocation and to identify projects and programs, the NEED concept was developed by the RTG and USAID.

It was recognized then that infrastructure construction (mostly roads and dams) alone would not achieve spontaneous growth in the lead sector of agriculture.*

The NEED program was initiated in 1968 by the Royal Thai Government with the assistance of USAID. The control of NEED was put directly into the hands of the Prime Minister's Office, and the National Economic Development Board was joined by the Louis Berger, Inc./Systems Associates, Inc., Planning Advisory Group (NEED/PAG) to help to execute the program under the following contract terms:

A. Advising and assisting in the development of an overall plan:

The first order of business will be to determine the resource requirements and goals for the development of Northeast Thailand, and the relationship of these goals to economic conditions of the Kingdom as a whole. The final decisions on these goals will be made by the RTG and not by the Contractor. The Contractor's principal task will be to advise the Northeast Economic Development Subcommittee on the formulation and implementation of plans to attain the above set goals. In develop-

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*If a starting point for the NEED Program can be defined, it was during a tour of the region when Khun Prayad Buranasiri, the late Secretary General of NEDB, expressed concern to USAID officials how little conventional development expenditure has helped to improve the way of life of the rural farmer, and how superficial was the development that was apparent.

ing this capability, the Contractor will work directly with the sector "working groups" of the Subcommittee. The Contractor, in his technical assistance, will consider and evaluate the counter-insurgency impact of the overall plan as well as programs and projects within the plan.

B. Providing continuous technical planning advice to the sector "working groups" and to the overall planning working group:

The working groups are in the sectors of Agriculture-Agribusiness, Water Resources, Transportation, Manpower and Vocational Education, and Social Services and General Education, as well as the overall planning working group in the integration of the plan, and are composed of high level officials of nearly all the ministries in the Thai Government, as well as USOM representatives. The general methodology for technical assistance to the working groups will be to devise methods for the implementation of RTG-set objectives for the Northeast. The technical assistance to these working groups is intended to generate projects and policy alternatives and to integrate them into the overall Northeast Economic Development Plan. Technical assistance in the respective fields will be furnished to the six sectoral working groups, and the general development planning capability will be attached to the overall planning working group.

These sectoral working groups will need a catalyst not only to develop their own programs, but also to integrate programs with other sectoral groups. The Contractor will also be responsible for devising methods of encouraging private sector participation in this development effort. Also included in the Contractor's responsibilities will be development of alternate financing methods for plan implementation, including foreign and domestic sources by specific projects with trade-offs between projects in the Northeast and those in other regions.

C. Construction of a system which uses data as a basis for evaluating priorities and which can develop a continuing RTG capability for regional development planning:

Since this plan is the first of its kind, evaluation will need to be made of the on-going ministry projects and how they will fit into the new planning effort. The Contractor must develop a system for arranging both the existing statistics and the new projects. This will also be important in integrating the various sectoral plans into the overall Northeast Economic Development Plan. Furthermore, it should

develop within the RTG a capacity to carry on regional economic development planning in other areas in the future.

D. Assistance to Thai officials in the formulation and implementation of plans and projects:

The NEED Plan will be composed of projects originating at two distinct levels:

1. central government planning, primarily for infrastructure projects;

2. planning at the local level in the provinces, districts and villages, for local development programs.

The Contractor will be expected to provide assistance and advice to local officials in developing projects for the plan, and to assist at the Bangkok level integrating locally-developed projects into the overall plan.

E. Construction of a micro-economic model of Northeast Thai villages suitable for testing the feasibility of proposed projects under the Plan:

1. The first step in constructing the model will be to review all existing and planned projects and information which could relate to a village economy. Much work in this field has already been done. After the review of existing data is complete, and all persons and agencies interested in contributing have been involved in the study, the type of data which are not available should be identified. The Contractor will then need to collect this data by field enumeration and study.

2. Depending upon the availability of resources, a selection of a sample of villages or market centers, representing the major types of economic activity in the Northeast, should be made. The primary objective of the micro-village model will be to identify the type of resource inputs conducive to development, how they can be introduced, and what results can be expected. An identification of priorities must also be included. The general methodology used in the micro model should be an input-output approach with alternative inputs yielding different outputs. Illustrative examples of specific problems which could serve as inputs to the model include:

a. new crop potential

b. rural credit expansion

c. cooperative

d. price changes, and

e. large infrastructure projects; with the alternative reactions and responses to these inputs shown. The bottlenecks to development must be identified whether they are cultural, political or economic. The plan must address itself to circumventing these bottlenecks.

3. The micro-model should be sufficiently representative of the Northeast to assist in "bridging the gap" between the micro-plan and the village-level projects which will be incorporated into the plan.

4. The Contractor shall provide the USOM with a report outlining the micro-model.

The project agreement between USAID and the RTG was broadly in these terms, but the words "advising and assisting" that appear in paragraph A of the contract terms are not included in the PRO-AG, which suggests a RTG understanding that the Planning Advisory Group would be more directly involved in developing the plan, rather than being just advisers. In the contract revision of August 1970, changes were made which explicitly gave responsibility to the Planning Advisory Group for preparing the draft plan which would be evaluated by NEDB and operating ministries.

The revised NEED/PAG scope of work for the final year of the contract September 1970 to August 1971 included the following:

> "Submission (to NEDB for appropriate ministries) of proposed projects,programs and policy alternatives based on (i) the collective findings of the consultants and their counterpart staff, (ii) evaluation of ongoing and proposed programs by other agencies with all proposals to be tested against the regional framework for benefits (e.g. impact on gross regional product). The foregoing will consider basic budget requirements and allocation of projects and programs within the region based on known requirements (e.g. mitigation of intra-regional income disparities, soils capabilities, manpower availability, etc.)."

THE NEED PLANNING ADVISORY GROUP

The following were appointed to be members of NEED/PAG to undertake the tasks indicated and serve for periods of varying length, as indicated:

Dr. C.E. Stonier	Chief of Party	December 1968-May 1971
Mr. J. W. Fay	Chief of Party	May 1971-August 1971
Dr. A. Barber	Deputy Chief of Party	October 1968-Aug. 1971
Dr. G. Hill	Adviser, Agriculture	January 1969-April 1971
Dr. W. Wallace	Adviser, Transportation	November 1968-Aug.1970
Mr. R. Larson	Adviser, Manpower	December 1968-June 1970
Dr. G. Windham	Adviser, Social Services	May 1969-November 1970
Mr. R. Hill	Adviser, Water Resources	September 1969-Dec.1970
Mr. A. Mutsaers	Village Model Development	July 1969-November 1969
Mr. P. Adler	Adviser, Changwat Planning (With Accelerated Rural Development Dept.)	January 1969-Aug. 1969
Mr. D. Jelinek	Adviser, Marketing	January 1970-June 1971
Mr. D. Sherman	Adviser, Infrastructure	August 1970-Feb. 1971
Dr. W. DeRafols	Adviser, Agribusiness	May 1971-August 1971

In addition to the above, the consultants provided considerable Home Office Supporting Assistance.

THE REGIONAL PLANNING MODEL

INTRODUCTION

Prior to 1968, there was very little data developed on a regional basis. There was no regional planning model, nor was there a regional development organization to apply a plan.

There was a broad idea of the National, Regional, Changwat planning concept, and it was appreciated that a successful planning system required a reasonably accurate data base. In consequence, the following organization steps were planned:

1. Establish the data base by establishing:

   a. Data services for the Regional Planning Unit in the National Statistical Office; and

   b. Regional Accounts Unit, within the National Accounts Division of N.E.D.B.

2. Establish Northeast Regional Planning Units by establishing:

   a. Regional Planning Unit in Social and Economic Planning Division of N.E.D.B.; and

   b. Regional Planning Center, a Branch of N.E.D.B. in the town of Khon Kaen in the Center of the Northeast Region.

Planned Functions of Units

The Regional Planning Unit, NEDB

The main coordinating unit, a Regional Planning Unit in NEDB supported by NEED/PAG, was established and was made responsible for:

1. Devising the overall planning model and organizational framework and procedures for applying it;

2. Coordination with people working on National development planning to ensure compatibility;

3. Analysis of the development potential of the region including past economic performance and investment. Description of the social, geographic and resources background. Determination of the regional share of the national economy and consideration of the problems of the equity; and

4. Writing the first regional five-year development plan as an integral part of the Third National Five Year Development Plan 1971-1976.

The Regional Planning Center, Khon Kaen

The Regional Planning Center in Khon Kaen was to be the regional branch of the regional Planning Unit in NEDB/Bangkok. It was to be responsible for the following:

1. Drafting a Changwat Planning Manual to be used by planners in the 15 changwats in drawing up individual development plans. Each provincial governor, as a part of the NEED project, was to be given a special allocation of funds to finance programs reflecting the wants of the people. The development of each province would not be solely dependent on these local program ideas, but would be based substantially on development ideas coming from the central government ministries.

2. Assisting the changwats to develop their planning capabilities to produce their own development plans. This involves coordination between various government departments, particularly the Department of Local Administration which runs the Changwat Administration.

Data Services for Regional Planning Unit, National Statistical Office

The Data Services for Regional Planning Unit in the National Statistical Office was to be set up to collate and up-date all socio-economic data relevant to regional and changwat planning. Its responsibilities were to be:

1. Compile and up-date Planning Handbooks for each of the 15 changwats and an aggregation for the Northeast Region. Each Planning Handbook comprises a loose leaf Data Book and a Map Book with overlays;

2. Determine the data content for the Planning Handbooks and revise as indicated by feedback from users; and

3. Determine the form of a Regional Data bank and initiate it.

The Regional Accounts Section of the National Accounts Division, NEDB

The Regional Accounts Section of the National Accounts Division of NEDB was to be set up with the following responsibilities:

1. To prepare Northeast Gross Regional Production Tables as integral parts of the Gross National Production Tables already prepared annually by the division;

2. To examine the practicability and value of preparing individual changwat Gross Domestic Production Tables; and

3. To prepare Gross Regional Production Tables for the North, Central and South regions of Thailand.

Land Development Department, Land Capability

In addition to the above, under the requirement for special studies, funds were made available to the Land Development Department to prepare Land Capability maps for those changwats in the Northeast in which soil surveys had been made. Maps of soil capability for rice production and upland crop production were prepared for 10 changwats under this program.

The above planned organization and responsibilities were formalized in the Regional Planning Model, Diagram B, Page 29 of the NEED Stage I Planning Report, dated July 1, 1969.

All of the organizational steps planned were put into effect except the establishment of the Regional Planning Unit in NEDB. One officer of NEDB assisted NEED/PAG in making contacts with counterparts, but there was no regional planning unit. As a result, the system of sectoral coordinating working groups associated with the NEED Sub-committee never really functioned as was intended.

NEED/PAG worked closely with the Data Services for Regional Planning Unit in the National Statistical Office and the Regional Accounts Unit in the National Accounts Division of NEDB, and as a result, the Data Services for Regional Planning Unit basically met its responsibility in regard to items (1) and (2), the compilation of changwat planning books and their revision. The list of statistical contents in the Changwat Handbooks was detailed in Appendix 4-B to Stage 2, Planning Report. The Regional Accounts Unit completed items (1) and (2) of its responsibility and computed a set of Northeast Gross Regional Product tables, on which the NEED/PAG production forecast targets were based. They also produced changwat gross products for the region. They are currently working on the determination of gross regional products for the other regions. The

chiefs of these two units have done excellent work in establishing this data base which is essential for the development of planning at the regional level.

PLANNING SCHEDULE

A schedule of the specific tasks was drawn up initially which emphasized the following stages:

Stage 1	Preliminary Regional Objectives and Strategy Guidelines for the Plan
Stage 2	Interim Regional Objectives, Strategy and Targets
Stage 3	Interim Regional Sector Programs
Stage 4	Draft Third Regional Plan
Stage 5	Revised Draft Third Regional Plan

In meeting these target dates, NEED/PAG published reports as follows:

Stage 1 July 1, 1969	Planning Report. A basic Framework for Planning Strategies in Northeast Thailand.
Stage 2 Feb. 15, 1970	Planning Report. Profile of Northeast Thailand and Regional Objectives. (With Appendix)
Stage 3. August 1, 1970	Planning Report. Northeast Thailand Sector Growth Rates and Targets. (With Appendix including revised plan methodology market analysis, and maintenance requirements)
March 31, 1971	Third Development Plan, Northeast Thailand. (Draft Working Paper)
DRAFT Stage 4 May 31, 1971	Recommended Development Budget and Foreign Assitance.Projects 1972-1976 (Draft)
Stage 4 July 1, 1971	Recommended Development Budget and Foreign Assistance Projects 1972-1976.
Stage 5	Final Development Plan

The publications above were backed up by position papers written by the various advisers. These were as follows:

Date	Subject
1969 Feb. 4	Transportation Sectoral Goals and Strategy A Reappraisal (Includes 4 Appendices)
Feb. 7	Prerequisites to Effective Sectoral Strategy
Feb. 19	Initial Consideration for Improving NEDB Technical Planning Capability
Feb. 24	General Work Program for Northeast Development Plan (Preliminary Draft)
Mar. 10	Some Elementary Guidelines for A Strategy of Training Program in Agriculture
(Revised June 1)	A Basic Framework for Planning Strategies in Northeast Thailand
Apr. 15	Regional Economic Indicators
May 2	Policies to Cushion Eventual U.S. Military Cutbacks.
May 15	Preliminary Report on Manpower Training in the Northeast
May 19	Organizational Structure and Functioning Process of Agricultural Agencies
May 29	Pilot Study Program for the Purpose of Establishing a Trade Promotion and Research Center (Ministry of Economic Affairs)
June 15	The Economic Cost of Management and Labor for RTG in-house Highway Construction in N.E. Thailand.
May 19	(Draft) Establishment of a Trade Promotion & Research Center
July 15	Set of Planning Organization Visual Aids
Aug. 29	Suggested Tasks: T&CP-NEDB Joint Task Force
Sept. 4	Rural Model Methodology
Sept. 17	Notes on the Data Base for Regional Development Planning (Initially Northeast Thailand)

Date	Subject
1969	
Sept. 19	Suggested Task Force Work Programs (Five Sectors)
Aug. 19	Community Development
Sept. 15	Suggested Routing of Project/Program Proposals & Plan Integration
Oct. 3	Rural Model Methodology
Oct. 15	Summary of NEED/PAG Activities July-Sept. 1969 and Proposal for Livestock Promotion
Nov. 5	Social and Cultural Factors in Developmental Planning for the Northeast
Nov. 5	Activity Report on Village Modeling
Nov. 6	Regional Planning Model
Nov. 3	Proposed Market Research Work Program
1970	
Feb. 10	The Agricultural Extension Service as An Adult Educational Institution and Its Application in Northeast Thailand
Feb. 16	Fodder Development in Northeast Thailand
	Cultura da Palma Forrageira (Supplement to Spineless Cactus Proposal)
Feb.	Market Research Work Program
Feb.	NEEDAC, Village Model (Four Parts)
Apr. 15	The Agricultural Sector (General Briefing)
June 1	Northeast Agricultural Vocational Schools
June 24	Northeast Thailand's Transport Network as a Constraint to Economic Development
June 29	Migration Policy
June 29	Training Programs for Northeast Development
Aug. 15	Regional Market Surplus-Deficit Analysis

Date	Subject
1970	
Oct. 19	Market Research Unit
Nov. 15	Preliminary Project/Program Recommendations Northeast Thailand
Dec. 4	Highway Improvement Threshold Analysis
Dec. 4	Status Report on Agricultural Strategy and Programs
Dec. 4	Institutionalization of Agricultural Development
Dec. 4	Water Resources Development
Dec. 4	The Role of Marketing
Dec. 4	Agri-Business Promotion in the Northeast
1971	
Jan. 13	Northeast Thailand Highway Sufficiency Study
Jan. 15	Capital Projects Summary
Feb.-Mar.	Individual Northeast Agricultural Commodity Analysis: Complete Production and Market Analysis for Ten Commodities.
Feb. 16	Summary of NEED Plan 1972-1976 (Preliminary Draft)
Mar. 5	Structural Change and Economic Growth Northeast Thailand 1960-1969
Mar. 9	Land Tenure
Mar. 9	Upland Crops
Mar. 10	Project Summary Sheets
Mar. 12	Agricultural Credit
Mar. 18	Farmers' Associations
Mar. 23	Agricultural Research & Experimentation
Aug. 6	Livestock Development Program

PLANNING TECHNIQUES

To help in the introduction of development planning, NEED/PAG during 1968 and 1969 experimented with the use of various planning techniques for the units which had been established. The Program Evaluation and Review Technique, PERT, was examined as a method of control of data acquisition and evaluation, project and program proposals, and scheduling for plan preparation, but even in a very simplified form was found to be over sophisticated for the situation. However, simple scheduling techniques were successfully introduced by the Data Services for Regional Planning, the Regional Accounts and the Khon Kaen Centre for changwat planning. These were based on the regional planning schedule determined by NEED/PAG.

COMPOSITE ECONOMIC INDEX

As an aid to regional planning, the Regional Accounts Unit was requested to establish the basis for a Composite Economic Index. The index was intended to be a weighted average of a number of statistics available regionally at frequent intervals, and as such would give some indication of changing economic conditions more quickly than the Regional Accounts.

The index included:

1. Number of construction permits.
2. Number of commercial vehicle registrations.
3. Power consumption.
4. Railway Freight Loadings.
5. Commercial bank deposits.
6. Number of telephones in use.
7. Business Taxes.
8. Personal Income Taxes.

Base data for the Composite Index 1960-1968 are given in Appendix 2-C to the Stage 2, Planning Report.

REGIONAL MACRO ECONOMY

The computation of the Gross Regional Product 1961-1969 was completed by Regional Accounts Unit in April, 1970, and revised twice during the following year. It included the following:

Section I

Table 1	Gross Domestic Product at Current Price.
Table 2	Gross Domestic Product at Constant 1962 Prices.
Table 3-30	G.D.P. originating in all the sectors at Current Price and Constant 1962 Prices.
Table 31	Indexes of Gross Domestic Product
Table 32	Selected price indexes
Table 33	Percent Annual change of NE-G.D.P. at current price.
Table 34	Percent Annual change of NE-G.D.P. at constant 1962 prices.
Table 35-48	Percentage distribution tables.
Table 49	G.N.P. at current price.
Table 50	G.N.P. at constant 1962 prices.

Section II

Regional Gross Domestic Product by Changwat.

a. Gross Domestic Product at current prices.

b. Gross Domestic Product at Constant 1962 prices.

c. Percentage Annual Change of G.D.P.

d. Percentage Distribution of G.D.P.

Each of the above is presented in Tables 1-15 for the 15 changwats of the Northeast. No consumption expenditure tables, neither private nor government, were compiled because of the lack of adequate data, though this may become available as a result of current studies. Because of the

uncertainty about the movement of both goods and money into and out of the region, a complete Regional Account could have been grossly inaccurate, and it was decided to concentrate effort mainly on regional production.[1/]

In conjunction with NEED, Dr. Richard S. Cowan, Jr. and Dr. James A. Chalmers,* used a modified shift and share technique to analyze the changing relationships in the distribution between the Northeast and the Rest of the Kingdom, in their study entitled, "Economic Growth and Structural Change in Northeast Thailand" 31 March 1971. This macro-economic approach gave results which are reasonably consistent with NEED projections of growth determined by the methods described in the Methodological Appendix A, Target Forecasting.

CHANGWAT DOMESTIC PRODUCTS

It was the intention of NEED to study intra-regional problems as a guide to the geographical distribution of

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1/ It may be noted that according to some recent data gathered by the Bank of Thailand, there is a net flow of private capital out of the Northeast of Thailand. The data, compares total deposits in each changwat to total loans made in each changwat in the years 1967, 1968 and 1969. In 1967, loans equalled 43 percent of deposits; in 1968, they were 46 percent; and in 1969, 45 percent.

Even after allowing for a minimum reserve requirement, it appears that there is a substantial cash outflow from the Northeast as it is unlikely that banks are allowing cash to lay unused in bank vaults. It can be assumed that cash is flowing to those areas where there is the greatest demand for it, and in the case of Thailand, the area is probably Bangkok.

While public funds and international grants and loans are flowing into the Northeast in the form of public construction and various programs, there is a net outflow of private capital.

*Dr. Chalmers is Visiting Professor of Economics at Thammasat University and Dr. Cowan is a Captain in the U.S. Army currently assigned to USOM.

development programs. The changwat domestic product tables gave broad indications of the relative performance of the 15 changwats of the Northeast. Based on these tables, Wichet Petsuwan* made a short study entitled, "An Analysis of the Prosperity of the Individual Changwats of the Northeast, Thailand." This analysis shows that there is a two-to-one disparity between the most prosperous changwat on a per capital basis, Nong Khai, and the least prosperous Sisaket. That is 2084 baht per capita per annum compared with 1070. The changwats of the southeastern part of the northeastern region are poor because of low agricultural productivity and lack of communications. The latter will, to some extent, be rectified during the Third Five Year Plan, but problems of land productivity have not yet been tackled systemmatically. Though the land classification maps have been prepared, they have not yet been applied to help in resource allocation.

MICRO-ECONOMIC MODEL OF A NORTHEAST THAI VILLAGE

During the middle and latter part of 1969, the framework of a village model, which was called NEED/PAG was developed with the objective of determining and evaluating alternative courses of action for improving the conditions of life in villages in Northeast Thailand. The model considers village (or small area) human resources, production activities, constraints on production, and infrastructive with a view to determining output from given project inputs.

Computation could be by hand or by computer, but with either method,it was considered to be too complicated for the situations to which it would be applied.

SUGGESTED REQUIREMENTS FOR THE CONTINUATION OF REGIONAL PLANNING DEVELOPMENT

During the course of the NEED project, a basis for planning at the regional level has been established, but in order to make further progress, emphasis must be placed on improving the organization which allocates resources, (programs and projects) regionally within total National resources. This involves the Regional Planning unit in NEDB, with the

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*Wichet Petsuwan, an officer of the Department of Local Administration,Ministry of Interior, was attached to NEED/PAG for three months prior to going to the U.S. for further study.

advisory assistance as appropriate. The Regional Planning Unit must be an integral part of National planning.

At the changwat level, there is a need for further education of the changwat planning officials, because it will only be possible for NEDB to have a nucleus of planners in each region. The Department of Local Administration must take responsibility eventually for all appropriate development planning at the local level.

The data services units necessary to meet these requirements exist, but will require advisory assistance in helping them to provide data more quickly to the planner. At present, data is often out of date by the time it is available for use.

III. STUDY METHODOLOGY AND TARGET FORECASTING TECHNIQUES

FOREWORD

This appendix describes, in detail, the background information and the method used in preparing Chapter I, Planning Strategy of the Recommended Development Budget and Foreign Assistance Projects, 1972-1976, Northeast Thailand.

STUDY METHODOLOGY AND TARGET FORECASTING TECHNIQUES

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Wholesale & Retail Trade	III-108
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Non-Agricultural Sectors	III-110
Northeast Regional Production	III-111

NORTHEAST THAILAND

HISTORIC PRODUCTION
1960 - 1969

AGRICULTURE

	Value Added At Constant 1962 Prices Million Baht										Historical Growth Rate 1/ 1960-1969	Analyst's Estimate of Current Trend 1969
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969		
Paddy	2442	2459	3231	3463	3186	3852	4026	2490	3455	3829	3.4	Same as historic
Coconut	31	34	34	48	48	49	45	43	44	45	3.8	Constant Production
Sugarcane	93	74	56	89	92	60	50	47	54	61	-5.3	Small revival
Maize 2/	110	54	48	46	45	53	65	88	103	122	2.1	About 14%
Groundnuts	91	75	57	83	71	77	73	69	69	79	-0.7	Tendency to revive
Beans 3/	44	38	34	35	35	30	29	22	22	25	-7.0	Production fall stopped
Cassava	14	13	14	21	23	38	29	35	47	50	17.4	About 25%
Tobacco	159	132	73	108	87	107	122	128	124	137	1.0	Growth rate increasing
Cotton	74	43	42	39	45	46	50	60	72	84	4.5	About 20%
Kenaf	333	423	246	386	562	904	1225	936	360	706	10.4	Constant Production
Kapok	70	65	52	80	83	83	61	52	55	56	-1.6	Production fall stopped
Sesame	22	16	9	8	8	12	11	6	6	6	-11.0	Production fall stopped
Garlic (etc.)	148	213	196	244	175	172	181	172	181	197	-0.1	Recent revival
Vegetables	38	39	49	71	73	74	112	120	132	144	18.9	About 9%
Fruit	650	702	599	693	513	556	505	611	648	691	0	About 5%
All Crops	4311	4379	4740	5419	5046	5200	6655	4879	5372	6232	3.4	Constant Production
Cattle 4/	323	329	379	407	385	383	426	426	445	466	3.7	Slightly Reduced
Swine	156	170	188	219	180	169	236	256	278	281	6.5	Same as historic
Hens, Ducks	266	271	281	290	301	309	320	331	342	353	3.3	Same as Historic
Eggs	198	208	192	195	205	213	214	221	230	236	2.0	Increasing
Others	10	9	9	9	8	11	12	13	13	13	4.9	Same as historic
Livestock	953	987	1048	1120	1079	1085	1208	1247	1308	1349	3.8	Same as historic
Timber	65	72	94	121	123	155	185	200	213	185	14.2	Reduced to 5%
Charcoal	235	252	281	291	278	271	277	251	262	271	0.5	Same as historic
Forest (etc.)	58	63	68	69	112	95	57	66	95	124	5.5	Same as historic
Forestry	358	387	443	482	513	521	499	517	570	580	4.9	Increased to 6%
Fishing	153	156	176	168	189	256	276	268	290	313	9.3	Reduced to 5%
Agriculture	5775	5909	6417	7190	6827	7062	8338	6911	7540	8474	3.77	1 or 2%

1/ Least square fit of exponential $y = ab^x$. 2/ With Sorghum. 3/ Mung, Castor, Soy. 4/ With buffalo.

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NORTHEAST THAILAND
FIVE YEAR DEVELOPMENT PLAN
1972 - 1976
PLANNED GROWTH RATES AND TARGETS
AGRICULTURE

1970	1971	PLAN PERIOD 1972	1973	1974	1975	1976	Growth Rate 1971-1976	
3409	3567	3666	3769	3874	3983	4094	2.8	Paddy
45	45	45	45	45	45	45	0	Coconut
60	60	62	64	66	68	69	2.8	Sugarcane
127	132	176	190	206	224	245	13.0	Maize & Sorghum
79	79	79	81	83	86	88	2.2	Groundnuts
35	41	42	45	48	53	60	8.0	Beans (Mung, Castor, Soy)
52	54	55	57	59	61	63	3.1	Cassava
144	151	159	167	175	184	193	5.0	Tobacco
89	95	106	118	130	143	156	10.4	Cotton
636	629	657	676	679	719	740	3.0	Kenaf
57	59	61	63	65	67	69	3.2	Kapok
9	10	10	11	12	13	14	7.0	Sesame
204	210	217	224	232	239	247	3.3	Garlic (Etc.)
154	166	179	194	210	228	247	8.2	Vegetables
710	741	772	801	830	857	884	3.6	Fruit
5870	6039	6200	6505	6732	6970	7214	3.6	All Crops
484	504	524	545	567	600	633	4.6	Cattle & Buffalo
301	322	379	402	427	454	482	8.4	Swine
365	377	389	402	415	428	441	3.3	Hens & Ducks
244	253	262	271	280	290	300	3.5	Eggs
14	14	15	16	17	17	18	5.1	Others (incl. Dairy)
1408	1470	1569	1636	1706	1789	1874	4.9	Livestock
204	224	246	271	298	325	360	10.0	Timber
279	288	297	306	316	325	336	3.1	Charcoal & Fire wood
131	139	148	157	166	176	186	6.0	Other Forest Products
614	651	691	734	780	828	882	6.2	Forestry
329	346	364	383	403	424	446	5.2	Fishing
8221	8506	8910	9258	9621	10011	10416	4.1	Agriculture

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TABLE (Cont.)

MINING, QUARRYING, CONSTRUCTION, MANUFACTURES

	Value Added At Constant 1962 Prices Million Baht										Historical Growth Rate 1960-69	Analyst's Estimate Of Current Trend 1969
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969		
Mining	1	1	1	0	0	0	0	0	0	0	0	0
Quarrying	17	17	21	28	52	62	134	198	219	246	42.4	10.0
Construction (Private)	390	399	434	511	544	651	623	648	705	720	7.8	Reduced to 6%
Construction (Public)	22	27	40	61	198	291	508	725	750	895	60.2	Reduced to 15%
All Construction	412	426	474	572	742	942	1131	1373	1455	1624	18.9	About 10%
Slaughter Houses	92	95	129	137	111	116	129	120	100	100	2.6	Constant Production
Rice Mills	345	373	423	519	510	417	441	526	424	502	3.7	Same as historic
Sugar Mills	8	11	10	6	11	22	18	16	13	13	3.7	Constant Production
Other Food	44	44	46	47	51	52	58	54	62	64	4.6	Same as historic
All Food Manufactures	459	523	608	711	683	607	646	716	599	759	3.6	1 or 2%
Distilleries	14	27	40	43	42	44	50	44	31	42	7.4	Constant Production
Soft Drinks	12	13	13	13	14	14	15	15	35	36	11.5	Reduced to 3%
Tobacco	56	67	48	67	60	45	56	52	56	61	-0.5	Increased to 5%
Wearing Apparel	43	46	46	49	52	65	68	75	78	84	9.0	Same as historic
Cotton Processing	19	18	19	22	23	32	43	40	42	46	12.9	Reduced to 3%
Gunny Bags	9	12	23	29	66	87	78	95	92	106	32.8	Reduced to 7%
Silk	85	86	91	94	97	101	104	108	111	115	3.5	Same as historic
Mats	30	31	33	34	35	36	37	38	40	41	3.4	Same as historic
Other Textiles	20	16	11	13	25	39	35	18	19	24	5.4	Constant Production
All Textiles	163	183	177	192	246	295	297	299	304	332	9.4	Reduced to 6%
Wood & Cork	48	60	76	76	120	152	192	243	307	389	26.2	Same as historic
Furniture	6	7	9	12	15	19	25	37	32	34	24.2	Reduced to 3%
Other (Machine Shops etc.)	23	29	30	33	36	39	38	42	49	54	8.6	Increased to 13%
All Manufactures	824	935	1047	1216	1268	1280	1387	1523	1491	1791	7.9	Same as historic

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TABLE (Cont.)

MINING, QUARRYING, CONSTRUCTION, MANUFACTURES

1970	1971	PLAN PERIOD 1972	1973	1974	1975	1976	Growth Rate 1971-1976	
0	0	0	10	20	30	40	30%	Mining
251	243	249	265	283	303	325	3.0%	Quarrying
776	829	885	945	1010	1078	1152	6.0%	Construction (Private)
800	700	681	724	772	827	891	5.0%	Construction (Public)
1576	1529	1566	1669	1782	1905	2043	6.0%	All Construction
104	119	166	212	350	424	561	33.0%	Slaughter Houses
613	555	571	587	603	620	637	2.0%	Rice Mills
21	22	23	24	26	27	28	4.9%	Sugar Mills
67	70	73	76	79	83	86	4.3%	Other Food
805	766	833	899	1058	1154	1312	11.0%	All Food Manufactures
42	45	48	51	55	59	63	7.0%	Distilleries
36	36	48	65	69	74	79	17.0%	Soft Drinks
62	65	68	143	147	152	163	20.0%	Tobacco
90	96	102	109	116	123	131	6.5%	Wearing Apparel
49	53	56	60	65	115	165	25.0%	Cotton Processing
120	139	146	153	160	168	177	4.9%	Gunny Bags
126	137	149	163	177	193	210	9.0%	Silk
43	44	45	47	48	50	52	3.4%	Mats
26	29	32	35	39	43	47	10.0%	Other Textiles
364	402	420	458	489	569	651	10.0%	All Textiles
420	454	490	529	572	617	667	8.0%	Wood & Cork
37	41	45	50	55	60	66	10.0%	Furniture
62	71	82	94	109	125	144	15.0%	Other (Machine Shops etc.)
1918	1976	2144	2398	2670	2933	3276	10.0%	All Manufactures

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TABLE (Cont.)

ELECTRICITY AND WATER, TRANSPORT & COMMUNICATIONS, TRADE, BANKING, INSURANCE AND REAL ESTATE SERVICES, DWELLINGS AND PUBLIC ADMINISTRATION AND DEFENCE.

	Value Added At Constant 1962 Prices Million Baht										Historical Growth Rate 1960-1969	Analyst's Estimate of Current Trend
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969		
Electricity	11	15	18	20	26	34	52	77	144	185	37.5	About 60%
Water	2	2	4	4	5	7	10	14	17	25	13.3	About 32%
Electricity & Water	13	17	22	24	31	41	62	91	161	210	36.2	About 50%
Transport (Private)	240	303	347	354	300	459	514	579	646	703	11.9	Same as historic
Transport (Public)	57	65	88	84	82	73	72	85	94	95	4.0	Increased to 10%
Communication	11	12	13	12	15	22	30	38	39	41	18.7	About 9%
Transport & Comms.	316	380	448	450	477	554	616	702	779	839	11.0	Same as historic
Trade of Import Intermediate Goods	49	47	37	37	37	27	27	36	39	44	-2.2	Recovered to 15%
Trade of Import Capital Goods	97	119	140	174	200	230	330	423	454	543	21.6	Reduced to 14%
Trade of Import Consumer Goods	384	430	434	479	526	548	591	666	703	753	7.3	Same as historic
Trade of Domestic Agriculture	464	445	373	475	484	555	535	644	506	626	5.2	Reduced to Zero
Trade of Mining and Manufactures	213	241	278	292	279	290	385	427	447	475	9.2	Reduced to 6%
Whole Sale & Retail Trade	1207	1291	1320	1457	1535	1650	1976	2201	2220	2441	8.7	Reduced to 6%
Banking	22	27	33	37	42	52	64	80	94	104	19.2	Reduced to 17%
Insurance & Real Estate	9	9	10	11	11	13	19	26	28	34	17.8	Same as historic
Banking, Ins. R.E.	31	36	43	48	53	65	83	106	122	138	18.7	Reduced to 17%
Education	301	328	355	387	419	446	460	508	555	632	8.1	Increased to 10%
Medical & Health	70	75	84	88	96	105	119	134	140	156	10.1	Increased to 11%
Recreation & Entertainment	40	47	57	65	72	80	93	111	130	157	15.7	Increased to 19%
Domestics	62	63	66	62	71	73	76	70	81	83	3.4	Same as historic
Hotels & Restaurants	136	147	159	180	201	223	249	289	361	406	13.1	Increased to 19%
Laundries, Barber Shops etc.	56	58	60	64	67	71	75	82	96	100	6.8	Increased to 12%
Religious, etc.	111	134	162	190	217	254	282	314	335	361	14.0	Reduced to 8%
All Services	776	851	942	1042	1143	1251	1360	1515	1709	1909	10.3	Same as historic
Ownership of Dwellings	250	254	257	264	272	279	287	295	304	312	2.6	Same as historic
Public Admin. & Defence	444	468	488	532	547	591	591	647	743	810	6.5	Increased to 12%

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TABLE (Cont.)

ELECTRICITY AND WATER, TRANSPORT AND COMMUNICATIONS, TRADE, BANKING, INSURANCE AND REAL ESTATE, SERVICES, DWELLINGS, PUBLIC ADMINISTRATION AND DEFENCE.

1970	1971	PLAN PERIOD 1972	1973	1974	1975	1976	Growth Rate 1971-1976	
203	224	253	274	291	308	325	7.8%	Electricity
31	42	54	71	93	121	157	30.0%	Water
237	266	312	345	384	429	482	12.6%	Elec. & Water
780	868	961	1067	1185	1315	1460	11.0%	Transport (Private)
105	110	116	110	105	110	116	1.0%	Transport (Public)
45	50	55	61	67	74	82	10.4%	Communication
930	1028	1132	1238	1357	1499	1658	10.0%	Transport & Comms.
49	54	60	67	74	82	91	11.0%	Trade of Import Intermediate Goods
570	621	677	738	805	877	956	9.0%	Trade of Import Capital Goods
800	849	902	958	1017	1080	1147	6.2%	Trade of Import Consumer Goods
607	657	711	769	832	900	974	8.2%	Trade of Domestic Agriculture
525	580	641	708	783	865	955	10.5%	Trade of Mining and Manufactures
2551	2761	2991	3240	3511	3804	4123	8.4%	Whole Sale & Retail Trade
115	130	146	164	183	205	230	12.0%	Banking
39	45	52	59	68	79	90	14.9%	Insurance & Real Estate
155	175	198	223	251	284	320	12.8%	Bank, Ins. R.E.
706	743	795	851	910	974	1042	7.0%	Education
184	205	227	252	280	310	345	11.0%	Medical & Health
169	182	196	212	229	249	269	8.1%	Recreation & Entertainment
88	94	99	106	112	119	126	6.1%	Domestics
439	473	511	552	597	646	701	8.1%	Hotels & Restaurants
107	115	123	131	141	151	161	7.0%	Laundries, Barber Shops etc.
383	407	432	459	488	518	550	6.2%	Religious, etc.
2078	2219	2380	2563	2757	2967	3194	7.5%	All Services
327	342	358	375	393	411	431	4.8%	Ownership of Dwellings
901	1002	1114	1239	1377	1531	1703	11.2%	Public Admin. & Defence

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TABLE (SUMMARY)

	Value Added At Constant 1962 Prices Million Baht										Historical Growth Rate 1960-1969	Analyst's Estimate of Current Trend
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969		
Agriculture	5775	5009	6417	7190	6327	7002	8030	6911	7540	8474	3.77	1 or 2%
Mining	1	1	1	0	0	0	0	0	0	0	0	0
Quarrying (Construction)	17	17	21	28	52	82	134	198	219	246	42.4	About 13%
Construction	412	426	474	572	742	942	1131	1373	1455	1624	18.9	About 10%
Manufactures	324	335	1147	1213	1268	1280	1307	1523	1491	1791	7.9	Same as historic
Electricity & Water	13	17	22	24	31	41	62	91	161	210	36.2	About 50%
Transport & Comms.	316	350	448	450	477	554	616	732	779	839	11.0	Same as historic
Trade	1297	1291	1320	1457	1535	1653	1979	2201	2229	2441	8.7	Reduced to 6%
Banking, Ins. R.E.	31	30	43	48	53	65	83	108	122	138	18.7	Reduced to 17%
Services	776	851	942	1042	1143	1251	1360	1515	1709	1909	10.3	Same as historic
Dwellings	250	254	257	264	272	279	287	295	304	312	2.6	Same as historic
Admin. & Defence	444	468	488	532	547	591	591	647	743	810	6.5	Increased to 12%
Northeast G.R.P.	10066	10585	11480	12823	12947	13797	15265	15562	16752	18794	7.0	Reduced to 5.7%

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TABLE (SUMMARY)

1970	1971	PLAN PERIOD 1972	1973	1974	1975	1976	Growth Rate 1971-1976	
8221	8506	8910	9258	9621	10011	10416	4.1%	Agriculture
0	0	0	10	20	30	40	30%	Mining
251	243	249	255	283	303	325	6.0%	Quarrying (Construction)
1576	1529	1565	1660	1782	1905	2043	6.0%	Construction
1918	1976	2144	2398	2670	2933	3276	11.0%	Manufactures
237	266	312	345	384	429	482	12.7%	Electricity and Water
939	1026	1132	1238	1357	1499	1658	10.0%	Transport & Comms.
2551	2761	2991	3240	3511	3804	4123	8.4%	Trade
155	175	198	223	251	284	320	12.8%	Banking, Ins. & R.E.
2078	2219	2388	2563	2757	2967	3194	7.5%	Services
327	342	358	375	393	411	431	4.8%	Dwellings
901	1082	1114	1239	1377	1531	1703	11.2%	Admin. & Defence
19145	20045	21362	22823	24406	26107	28011	6.9%	Northeast G.R.P.

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III. STUDY METHODOLOGY AND TARGET FORECASTING TECHNIQUES

PRODUCTION TARGET FORECASTING

The method adopted for determining the growth rate of the Northeast region during the course of the Third Plan is essentially "micro". That is, forecast production and growth rate are determined individually for a large number of items and these are related to give an overall Gross Regional Product. The forecasts are extensions of GRP for the Northeast for the years 1960 to 1969, and are presented in constant 1962 prices. It was decided to use constant price rather than current price because of the direct relation which exists between production and value added at constant price. The Northeast economy is still mainly on a subsistence level which means much of the agricultural production is not monetized, and the important factor in the analysis is a knowledge of the level of production achieved.

The Third Plan production target forecasts in terms of value added are given in the detailed table which starts this section.

The table is broadly self-explanatory. The productive activities (line items in the table), are some of those used in calculating the gross regional product, but not all. Those included have one or more of the following characteristics:

1. Are of significant value;
2. are individual and can be planned individually;
3. compete for resources with other activities;
4. are individually dependent on another individual activity;
5. are individually important because of equity considerations or other social and policital reasons; and
6. cannot be excluded because they are aggregates of individual activities.

The starting point for the analysis is the National Income of Thailand 1960-1969, and its regional breakdown, Gross Domestic Product, Northeast Thailand, 1960-1969.1/

1/ Regional Account and Data Analysis Unit, National Account Division, National Economic Development Board.

The basic explanation of the calculation of the GNP and GRP tables, and the accounts as a whole, is given in the publication by the National Accounts Division, NEDB, entitled, "Explanation-Revised National Income Accounts, dated April 1970 (Thai language publication). The explanation of the methods used in allocating regional value added as a proportion of the national figure has been largely written but not yet published. The National Accounts Division has to contend with great difficulties in reconciling conflicting data; this applies particularly to consumption in the Northeast region where much of the agricultural production is consumed on the farm. Reliance is placed on the Household Expenditure Survey, taken by the National Statistics Office, for all such items, but the 1962 survey is the most recent that has been published. The latest survey which was taken more than a year ago is still waiting computer processing. It is parodoxical that it is the computer which is causing the delay. Because N.S.O. has a computer, the Household Expenditure Survey was made very comprehensive and difficult to process manually. Unfortunately, the processing of the 1970 Census has absorbed virtually all of the time of the computer programmers and so the Household Expenditure Survey has had to wait. Increasing the number of programmers is not believed to be the whole answer to the problem. Examination of the survey questionnaires suggests that they follow too ridiidly the pattern of similar surveys in more developed countries (the census also may err in this manner) by asking questions not relevant to the populace, such as how much money was spent on shoe cleaning material. Again, this oversophistication is not the whole problem, and it has been proposed to N.S.O. that they should request assistance in finding the causes of the problem and suggest ways to overcome them.

In the initial stages of the analysis of Northeast production (when the first draft of the Gross Regional Product tables was produced by NEDB in the Spring of 1970), the analysis was to determine what relationships were significant in the past and necessary for the projections to forecast production targets.

A matrix figure X-X, which is called the Correlation Matrix, was produced to indicate those lines in the table which were interrelated. On the horizontal axis, the matrix included also other relevant correlating factors such as population demand, the whole Kingdom production, Thai institutions, product quality and so on. In the first instance, this matrix was qualitative, but as the analysis proceeded, distinct types of numerical relationships emerged, and their existence is indicated in the matrix.

The lines of the Gross Regional Product table can be grouped into three groups depending on the method used for projection. The groups are:

1. Primary: The production forecast is made independently and is not numerically dependent on another line or lines. However, qualitative consideration of the values of other lines may have been given as indicated in the correlation matrix. The group comprises all the individual agricultural products, some of the manufacturers, those lines which are directly controlled by budget allocation and also two individual lines, "Electricity & Water" and "Mining" see Table A.1.

2. Dependent: These are items for which numerical dependence on another line was determined by analysis of previous production or by assumption. See Table A.2, which has been extracted from the Correlation Matrix. In practice, there are a few lines which are partly primary and partly dependent.

3. Aggregated: Thirteen of the lines are aggregates of other lines and their components are indicated on the Correlation Matrix.

FORECASTING PROCEDURE

The Regional Production Forecasts which start this Appendix were developed over a period of about a year; (through several revisions necessitated by new data and modifications in the relationships used to make the forecast). It is now relatively simple to update the forecasts in line with new data as it becomes available, or the relationships used appear to need modification. The procedure is purely mechanical and, in detail, is particular to the item concerned. As an aid to working the regional production model, which being micro needs a great deal of data readily available, a worksheet was drawn up which showed numerically and graphically the value added for each production item in the Northeast and the Whole Kingdom, the relation between them and their growth rates, historic and current. Also on the worksheet were the qualitative and quantitative relationships which were determined to exist with other line items.

NORTHEAST THAILAND.

FIVE YEAR DEVELOPMENT PLAN.

1972 - 1976.

FIGURE A-1.

CORRELATION MATRIX.

✓ QUALITATIVE CORRELATION

■ DEPENDENT

● AGGREGATES

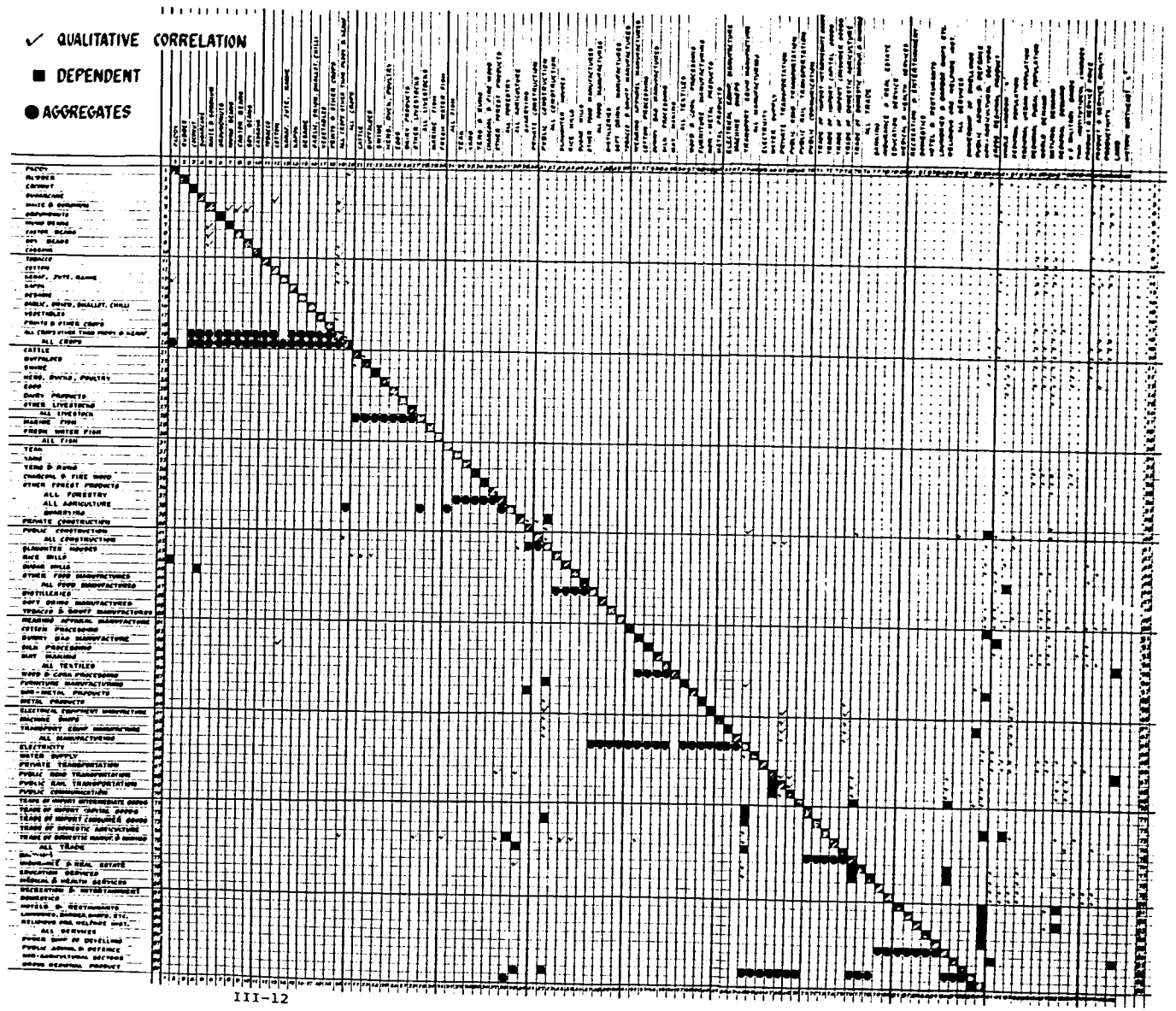

TABLE A.1

LIST OF PRIMARY, DEPENDENT AND AGGREGATED PRODUCTION ITEMS

PRIMARY	DEPENDENT	AGGREGATED
Paddy	Others (incl. Dairy) Livestock	All Crops (excl. Paddy, Kenaf)
Coconut	Other Forest Products	All Crops
Sugarcane	Rice Mills	Livestock
Maize & Sorghum	Sugar Mills	Forestry
Groundnuts	Other Food	All Agriculture
Beans (Mung, Castor, Soy)	Quarrying (construction)	All Construction
Cassava	Construction (private)	All Food Manufactures
Tobacco	Wearing Apparel	All Textiles
Cotton	Mats	All Manufacturers
Kenaf	Other Textiles	Wholesale and Retail Trade
Kopok	Furniture Wood Manufacturers	All Services
Sesame	Other (Machine Shops, etc.)	Non-Agricultural Sectors
Garlic (etc.)	Transport (Private)	Northeast Region Product
Vegetables	Transport (Public)	
Fruit & Others	Communication	
Cattle & Buffalo	Trade of Import Intermediate Goods	
Swine	Trade of Import Capital Goods	
Hens & Ducks	Trade of Import Consumer Goods	
Eggs	Trade of Domestic Agriculture	
Timber	Trade of Mining and Manufactures	
Charcoal & Fire Wood	Banking	
Fishing	Insurance & Real Estate	
Education	Recreation and Entertainment	
Medical & Health	Domestics	
Public Administration and Defense	Hotels and Restaurants	
Construction (Public)	Laundries, Barber Shops, etc.	
Slaughter Houses	Religious, etc.	
Distilleries	Ownership of Dwellings	
Soft Drinks		
Tobacco		
Cotton Processing		
Gunny Bags		
Silk		
Electricity & Water		
Mining (Non-construction)		

TABLE A.2

DEPENDENCE MATRIX

		1 Paddy Production	4 Sugarcane Production	38 All Agricultural Production	39 Quarrying	40 Private Construction	42 All Construction	56 All Textile Manufactures	64 All Manufactures	67 Private Transportation	76 Wholesale and Retail Trade	86 All Services	89 Non-Agricultural Sectors Production	90 Gross Regional Product	- Regional Population	- U.S. Military Bases	- Whole Kingdom "X"	- Historic Northeast "X"
Other (Incl. Dairy) Livestock	26																	■
Other Forestry Products	36																	■
Quarrying	39						■											
Construction (Private)	40													■				
Rice Mills	44	■																
Sugar Mills	45		■															
Other Food Manufactures	46														■			
Wearing Apparel Manufactures	51													■				
Mat Making	55																	■
Other Textiles	-							■										
Wood Manufactures	57						■											
Furniture Manufactures	58					■												
Machine Shops, etc.	63												■					
Transport (Private)	67																	■
Transport (Public)	69									■								
Communications	70										■	■						
Trade of Import Intermediate Goods	71								■									
Trade of Import Capital Goods	72						■		■									
Trade of Import Consumer Goods	73													■	■			
Trade of Domestic Agriculture	74			■														
Trade of Mining and Manufactures	75				■				■									
Banking	77										■	■						
Insurance and Real Estate	78										■	■						
Recreation & Entertainment	81													■		■		
Domestics	82													■				
Hotels & Rest urants	83													■		■		
Laundries Barber Shops, etc.	84													■				
Religious, Etc.	85													■				
Ownership of Dwellings	87																■	■

The worksheets were included in a special file used by the analyst throughout the planning period. The descriptions of the method used for forecasting future value-added for all the individual production lines given later in this appendix are the worksheets formalized for presentation here. Reference can be made to them when considering the two following examples of a revision of the GRP tables.

1. The simplest case is that of the production of a specific crop. Because of changed market conditions, the demand may fall and lead to less production requiring a revision of the targets forecast for the coming years. Changing the appropriate line in the production table will alter the aggregates for crops, agriculture and GRP. The next step is to examine the "x" axis of the Dependence Matrix to see what items are dependent on those which have been changed. For the crop, unless it was paddy or sugarcane, no other items are considered to be dependent. 1/ None are dependent on the aggregate of crops. Trade of Domestic Agriculture is directly related to agricultural production and so will require adjustment.

   There are eight items related to GRP, but none with an elasticity of greater than one, which means that for most, except the very largest, the change resulting is negligible.

   In theory, it could be necessary to reiterate the calculation of the dependent items as the GRP or other items are changed, but in practice, this will occur when major changes, such as budget changes, are made.

   This procedure is not lengthy, and to determine the time,a hypothetical case of an increase in the demand for cassava was calculated. Using a normal electronic desk calculator, it took minutes. The calculation included one reiteration though it was known that this was not really necessary.

   Besides calculating these arithmetic changes, it is necessary to refer to the Correlation Matrix (as apart

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1/ This is not strictly correct. For example, if the production of cassava changes, it may affect the processing plant at Pimai which is lumped with other processing. The difference is, however, insignificant.

from the Dependence Matrix) which considers qualitative relationships, and must be examined to determine whether there may be some effect not directly quantifiable which should be taken into account. In the cassava example considered above, the Correlation Matrix suggests two relationships; first, with all crops, except paddy and kenaf; secondly, with Demand which has already been taken into account The only decision required is whether the farmer is assumed to grow some other crop instead of cassava.

2. A much more complicated recalculation is involved, for example, if a reallocation of budget for Education occurs. Examination of the worksheet for Education, which appears in this Appendix, shows the need to determine the composition of the revised budget in terms of salaries, facilities and stores. The latter is a comparatively minor category. Teachers' salaries, deflated to 1962 level and corrected for an assumed additional percentage (eight percent) of private school teachers, give the new value added forecast for education.

   The budget for facilities is considered under the Public Construction Item. The value added under Public Construction is directly dependent on the percentage of the budget which is used for wages and salaries. For school buildings, a percentage of 44 is assumed. The Public Construction value added is adjusted to take into account changes in school building or maintenance. Several of the aggregate items will be affected by the new values for Education and Public Construction. They are All Construction, All Services, Non-agricultural Sectors and GRP. The Dependence Matrix shows that Quarrying, Wood Manufactures, Trade of Import, Capital Goods, Machine Shops, Communications, Banking and Insurance are dependent on these aggregates and need reevaluation (plus those dependent on GRP which were considered above). Changing the forecast value-added for Quarrying also will require a change in Trade of Mining and Manufactures.

In sum, depending on the magnitude of the budget change, it may be necessary to reiterate those items depending on the aggregates Wholesale and Retail Trade, All Services, Non-agricultural Sectors and GRP. The number of iterations required is unlikely to be more than two. The overall accuracy of forecasting would not warrant an attempt to get closer approximations.

BASIS FOR TARGETS & VALUE ADDED CALCULATIONS FOR AGRICULTURAL CROPS

The most important of the line items independently forecasted are the agricultural crops. The method employed was to forecast the production and to multiply this by an average value-added per ton (in constant 1962 prices). This was assessed from previous performance and adjusted for any likely changes in intermediate cost or composition of the total production (e.g. different varieties, improved quality). The production forecasts were made taking into account regional consumption, national consumption and export demand. However, some targets developed in this manner were subject to limitation of production potential through low productivity and lack of resources. These aspects are discussed in more detail in the Agricultural Appendix.

The table below, which is ranked in order of value-added, summarizes production, value added per ton and value added. It is followed by some notes about individual crops. The basis of these are the worksheets used during analysis.

	Northeast Thailand Agricultural Crop Production				
	Production in Ton (1,000,000)		Value Added Per Ton at Constant 1962 Prices Baht	Value Added Million Baht	
	1971	1976		1971	1976
1. Paddy (1)	4.318	4.956	826	3567	4094
2. Fruit (18)	0.463	0.553	1600	741	884
3. Kenaf (13)	0.328	0.386	1915	628	740
4. Vegetables (17)	0.332	0.494	500	166	247
5. Garlic(etc.)(16)	0.042	0.049	5000	210	247
6. Maize & Sorghum (5)	0.188	0.350	700	132	245
7. Tobacco (11)	0.020	0.026	7500	151	193
8. Cotton (12)	0.033	0.054	2880	95	156
9. Groundnuts (6)	0.036	0.040	2180	79	88
10. Kapok (14)	0.104	0.121	570	59	69
11. Cassava (10)	0.235	0.274	230	54	63
12. Sugarcane (4)	0.750	0.869	80	60	69
13. Beans(7,8,9)	0.021	0.030	2000	41	60
14. Coconut (3)	0.076	0.076	590	45	45
15. Sesame (15)	0.003	0.005	3000	10	14

PADDY

The Northeast Rice Balance Sheet developed by the National Accounts Division NEDB is given in Table A-3 and is the basis for the assessment of value added per ton at constant 1962 prices. The first line of the balance sheet needs some particular explanation as it is derived from the series reported annually by the Rice Department, Ministry of Agriculture, but modified by the National Statistical Office Crop Cutting Survey which is taken annually but which only commenced in 1966. The production before 1966 has been adjusted to take account of the knowledge acquired in 1966 and later years. The series given is probably the best that can be estimated at the present time, but some of the variations evident in derivatives from the series may be the result of its mixed composition.

It seemed reasonable to assume that the value-added (at constant 1962 prices) per ton would only be a function of intermediate costs and the composition of the crop, (i.e., different varieties or different quality). In assessing the relationship with four factors used in the rice balance sheet, that is time, current rice price estimated intermediate costs and area planted were investigated. The figures are plotted in Figure A-2, from which it can be seen that for six of the ten years, there is a recognizable trend, towards a lower value-added per ton. Such a trend can be rationalized by associating it with the expansion of rice cultivation into land which is less suitable. The proposed Third Plan program stabilizes the area of land used for rice growing, at about 20 million rai, and, in consequence, the current value added per ton (at 1962 prices), 826 baht,should be a minimum, and this figure is used in calculating the projected value added. Implicit in this is an assumption that the current production ratio between glutinous and non-glutinous varieties will continue and that quality will not be changed significantly.

TABLE A.3 NORTHEAST THAILAND

RICE BALANCE SHEET

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1. Paddy Production (Ton)	2,456,548	2,748,710	2,819,167	3,740,450	3,981,743	3,267,720	2,697,043	4,394,645	2,636,190	4,121,600	4,636,800
2. Damage & animal feed 3% of (1)(Ton)	73,696	83,541	84,575	112,213	119,452	98,091	80,911	131,839	79,085	123,648	139,100
3. Seed requirement (Ton)	119,524	125,341	144,203	139,017	126,135	125,441	160,183	115,019	145,850	164,730	164,780
4. Paddy reserved for farmers' consumption (Ton)	1,814,808	1,852,710	1,891,418	1,930,200	1,969,782	2,010,184	2,051,419	2,093,501	2,136,447	2,180,272	2,224,900
5. Paddy channeled through markets(1)-(2)-(3)-(4)(Ton)	448,520	723,118	598,271	1,599,020	1,736,374	1,034,004	404,536	2,054,286	274,808	1,652,950	2,1[illegible],970
6. Paddy price on the farm (฿ Ton)	618.34	670.23	811.96	782.52	663.88	595.12	824.90	1,011.00	1,031.16	1,085.24	927.80
7. Farmers' income sales of paddy(5) x (6)(฿)	277337857	484655377	585988121	1251265130	1177959403	615356461	333703306	2076883146	283371017	1793847458	1955774566
8. Value of paddy consumed by farmers. (4) x (6)	1222168379	1241741823	1535755759	1510420104	1313608220	1196300702	1692215533	2166529511	2203018689	2366118385	2064262220
9. Cost of rice milled (the mediam mill and large mill) (Baht)	24,425,670	24,542,340	24,646,620	24,719,820	24,791,620	24,833,670	24,875,250	24,907,920	24,931,020	24,946,170	24,952,700
10. Value of rice consumed by the farmer	1524665272	1728388950	2045472078	2021707472	1991511434	2250420480	2772055352	3055666654	2948840500	3007817310	3067972,700
11. Surplus of((10)-(8)-(9))	378071223	462104787	485069699	486567548	643121594	1029286108	1054964579	864229223	720890791	616752755	978758780
12. Imputed Income of farmer (Baht)	-	378071223	462104787	485069699	486567548	643121594	1029286108	1054964579	864229223	720890791	6167527 50

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NORTHEAST

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	
1. Paddy channeled through markets(Ton)	723,110	698,271	1,599,020	1,756,374	1,034,004	404,538	2,054,236	274,808	1,652,950	2,107,973	fm 1
2. Ex-farm Price(฿/Ton)	670.23	811.96	782.52	666.88	595.12	824.90	1,011.00	1,031.16	1,085.24	937.83	fm 2
3. Farmer's income from sales of paddy (Baht)	484,655,377	566,968,121	1251,265,130	1177,959,493	615,356,461	333,703,396	2076,883,146	283,371,017	1793,847,458	1955,945,937	
4. Value of paddy consumed by farmers(Baht)	1241,741,823	1535,755,759	1510,420,104	1313,608,220	1196,300,702	1692,215,533	2166,529,511	2203,018,689	2366,118,385	2064,526,505	fm 1
5. Imputed Income of farmers (Baht)	378,071,223	462,104,787	485,069,699	436,567,548	643,121,594	1029,286,108	1054,964,579	364,229,223	720,890,791	616,752,755	fm 1
6. Total Value (3)+(4)+(5) (Baht)	2104,468,424	2564,828,667	3246,754,933	2978,135,261	2454,778,757	3055,205,037	5298,377,236	3350,618,929	4880,856,634	4637,225,247	
7. Rice planted area (Rai)	14,557,360	15,408,209	17,820,343	18,969,687	15,470,618	15,331,585	19,629,913	14,095,456	17,873,785	20,187,474	fm 2
8. Total fertiliser value (Baht)	12,222,359	12,936,732	14,961,962	21,834,108	30,788,238	46,908,517	92,543,603	66,667,278	84,537,641	95,490,696	fm 3
9. Value of insecticide & pesticide(฿)	304,249	522,032	972,445	641,454	1,062,831	1,908,782	4,430,471	3,181,344	4,034,113	4,556,313	fm 3
10. Intermediate Cost-(8)+(9) (Baht)	12,526,608	13,558,764	15,934,408	22,525,562	31,843,169	48,817,299	97,274,071	69,848,622	88,571,754	100,037,009	
NE Paddy Value Added (current)(Baht)	2091,941,816	2551,269,903	3230,820,525	2955,609,699	2422,935,588	3006,387,738	5201,103,165	3280,770,307	4702,284,380	4537,188,236	
		+21.95	+26.63	-8.52	-18.03	-24.08	+73.00	-36.93	+46.07	-5.33	
NE Paddy Price Index	85.65	103.76	100.00	85.22	76.05	105.42	129.26	131.77	138.69	118.51	
NE Value Added at Constant 1962 price	2442,430,608	2458,818,333	3230,820,525	3468,211,334	3185,077,104	2851,019,140	4025,621,344	2490,070,286	3455,393,236	3828,527,751	
		+0.67	+31.39	+7.34	-8.14	-10.49	+41.15	-38.16	+38.78	+10.79	
WK Value Added(current)฿	6879,864,000	8735,076,000	9586,099,000	8878,576,000	7985,687,000	10860,101,000	16152,530,000	13150,202,000	12206,991,000	12837,163,000	
		+26.98	+9.73	-7.38	-10.06	+36.35	+48.85	-18.59	-4.89	+3.43	
% NE/WK current	30.40	29.20	33.70	33.28	30.34	27.61	32.19	24.94	38.31	35.07	
% NE/WK 1962 price	30.26	29.16	33.70	33.52	33.21	29.99	34.77	25.95	32.42	33.24	

Seed Weight and Computing Exfarm Price

(NORTHEAST PADDY)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Total rice planted area (Rai)	15,421,432	14,557,360	15,408,209	17,820,346	16,969,687	15,470,616	15,331,505	19,629,913	14,095,456	17,873,785	20,187,474	20,187,474
Area of transplanted rice (rice)	15,187,002	14,174,237	15,148,742	17,527,768	16,582,268	15,174,398	14,935,045	19,237,314	13,813,343	17,516,309	19,783,724	19,783,724
Seed for transplanted rice(Ton)(8 kg./rai)	121336,016	113393,896	121139,936	140222,144	132496,144	121395,184	119464,360	153898,512	110506,358	140130,472	158269,792	158269,792
Area of broadcasted rice (Rai)	254,430	383,123	259,467	292,578	407,419	296,218	348,540	392,599	281,913	357,476	403,750	403,750
Seed for broadcasted rice (16 kg/rai) (Ton)	4,072,880	6,129,968	4,151,472	4,681,248	6,518,704	4,739,488	5,578,640	6,281,584	4,513,550	5,719,616	6,460,000	6,460,[illegible]
Total weight of seed	125408,896	116523,864	125341,408	144903,392	139016,848	126134,672	125441,000	160180,096	115018,908	145850,088	164729,792	164729,792

Source: Total areas - Rice Department.
Transplanted areas of NE, 1959-1965 - Rice Department.
From 1966-69 the transplanted areas were 96% of the total areas according to the Rice Department's average.
1970 figures are based on 1969, as 1970 figures were not reported yet.

Northeast Paddy Ex-farm Price

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
WK Ex-farm Price (Baht/Ton)	634.88	720.68	873.07	841.42	717.07	639.91	866.69	1,105.00	1,140.0[illegible]	1,006.01	964.93
NE Ex-farm Price* (Baht/Ton)	618.34	670.23	811.96	782.52	666.30	595.12	824.90	1,011.00	1,031.15	1,065.24	927.66

* Based on 1966-1968 rice prices in the Agricultural and Economic News and average weighted by glutineous and non-glutineous ($\frac{1}{3}$ / $\frac{2}{3}$).
The other years were adjusted by using 93%, which was the ratio of NE/WK.
The 1969 average prices of glutineous and nonglutineous rice were reported by NE farmers' groups.

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The Calculation of the Fertilizer, and Weed Killer Costs

(Northeast Paddy)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Resources
1. Fertilizer cost per ton of paddy (Baht)	-	-	4.00 1/	-	-	-	21.00 2/	-	-	-	1/The 1962 figures are from the cost survey of the MOA. The 1966 figures are from NEDB
2. Paddy yield per rai (kg)	-	-	209.9	-	-	-	225.7	-	-	-	
3. Fertilizer cost per rai(1) x(2) (Baht)	-	-	0.8396	-	-	-	4.7297	-	-	-	2/The 1966 figures are from NEDB.
4. The average cost by the compound interest method $\frac{4.7297}{0.8396}$ =5.6333 or 54.022% per year	0.8396	0.8396	0.8396	1.2896	1.9896	3.0596	4.7297	4.7297	4.7297	4.7297	For calculation refer to work sheet No. 4
5. Rice Planted areas (Rai)	14,557.360	15,403,209	17,020,346	16,969,687	15,470,916	15,331,585	19,629,913	14,095,456	17,873,735	20,187,474	
6. Total cost of fertilizer (4) x (5)	12,222,359	12,936,732	14,961,963	21,884,108	30,788,338	46,908,517	92,843,600	66,667,278	84,537,641	95,480,596	
7. The cost of insecticide and weed killer per ton of paddy (Baht)	-	-	0.10 3/	-	-	-	1.00 4/	-	-	-	3/Ibid 1/ 4/Ibid 2/
8. Cost of insecticide and weed killer per rai(Baht) (7)x(2)	-	-	0.0209	-	-	-	0.2257	-	-	-	
9. Average additional rate by the compound interest method = $\frac{0.2257}{0.0209}$ =10.7990 or 81.2394% per year	0.0209	0.0209	0.0209	0.0379	0.0587	0.1245	0.2257	0.2257	0.2257	0.2257	For calculation refer to work sheet No. 4
10. Cost of insecticide and weed killer (9) x (5)	304,249	622,032	972,445	641,454	1,082,831	1,908,782	4,430,471	3,181,344	4,034,113	4,556,313	
11. Total cost of fertilizer, insecticide and weed killer (6) + (10) (Baht)	12,526,608	13,558,764	15,934,408	22,525,562	31,843,169	48,817,299	97,274,071	69,848,622	88,571,754	100037,009	

Computation of the Fertilizer, Insecticide and Weed Killer Costs
(NORTHEAST PADDY)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Yield per rai (Kg)			$\frac{3,740,450}{17,820,346}$ = Yield / Planted area = 209.9				$\frac{4,394,645}{19,477,000}$ = Yield / Planted area = 225.7			
Find the average additional rate by the compound interest method. $\frac{4.7297}{0.8396} = 5.63327$ 5.6333 referring to the compound interest table, we find that the figure is between 50% to 55% 5.06250 - 5.77201 The method of finding 5.6333 = ? per year 5.63327 - 5.06250 = 0.57077 5.77201 - 5.06250 = 0.70951 Compare 0.70951 differs = 5% (55% - 50% - 5%) 0.57077 differs = $\frac{5 \times 0.57077}{0.70951}$ = 4.022 50% + 4.022 = 54.022% ∴ $\frac{4.7297}{0.8396}$ = 5.63327 or = 54.022% per year	0.8396	0.8396	0.8396	1.2896	1.9896	3.0596	4.7297	4.7297	4.7297	4.7297
			+54.022	+54.022	+54.022	+54.022	+54.022			
Find the average additional rate by the compound interest method. $\frac{0.2257}{0.0209} = 10.7990$ 10.7990 refering to the compound interest table, we find that the figure is between 80% to 85% 10.4976 - 11.7135 The method of finding 10.7990 = ? per year 10.7990 - 10.4976 = 0.3014 11.7135 - 10.4976 = 1.2159 Compare 1.2159 differs = 5% (85% - 80% = 5%) 0.3014 differs = $\frac{5 \times 0.3014}{1.2159}$ = 1.2394 80% + 1.2394 = 81.2394% ∴ $\frac{0.2257}{0.0209}$ = 10.7990 or 81.2394% per year	0.0209	0.0209	0.0209	0.0379	0.0687	0.1245	0.2257	0.2257	0.2257	0.2257
			+81.2394	+81.2394	+81.2394	+81.2394	+81.2394			

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Computation of Number of Farmers in the NE Region

(NORTHEAST PADDY)

	Total	North	Northeast	South	East	Central
% of farmers in each region (From agricultural census 1962)	100.00	23.3	42.4	12.3	5.7	16.0
Number of farmers engaged in rice production	16,763,690					
Number of farmers as a percentage of regional population		3,956,231	7,107,805	2,061,934	955,530	2,681,190

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Number of farmers in the NE according to the percentages given by the 1962 agricultural census.				7,107,805								
Base on the 1962 agricultural census, the estimation of the 1959-1965 number of farmers = 42% (according to the prody production report page 25.)	6,689,806	6,826,336	6,965,540	7,107,805	7,249,962	7,394,960	7,542,859	7,693,716	7,847,590	8,004,541	8,164,632	8,327,925

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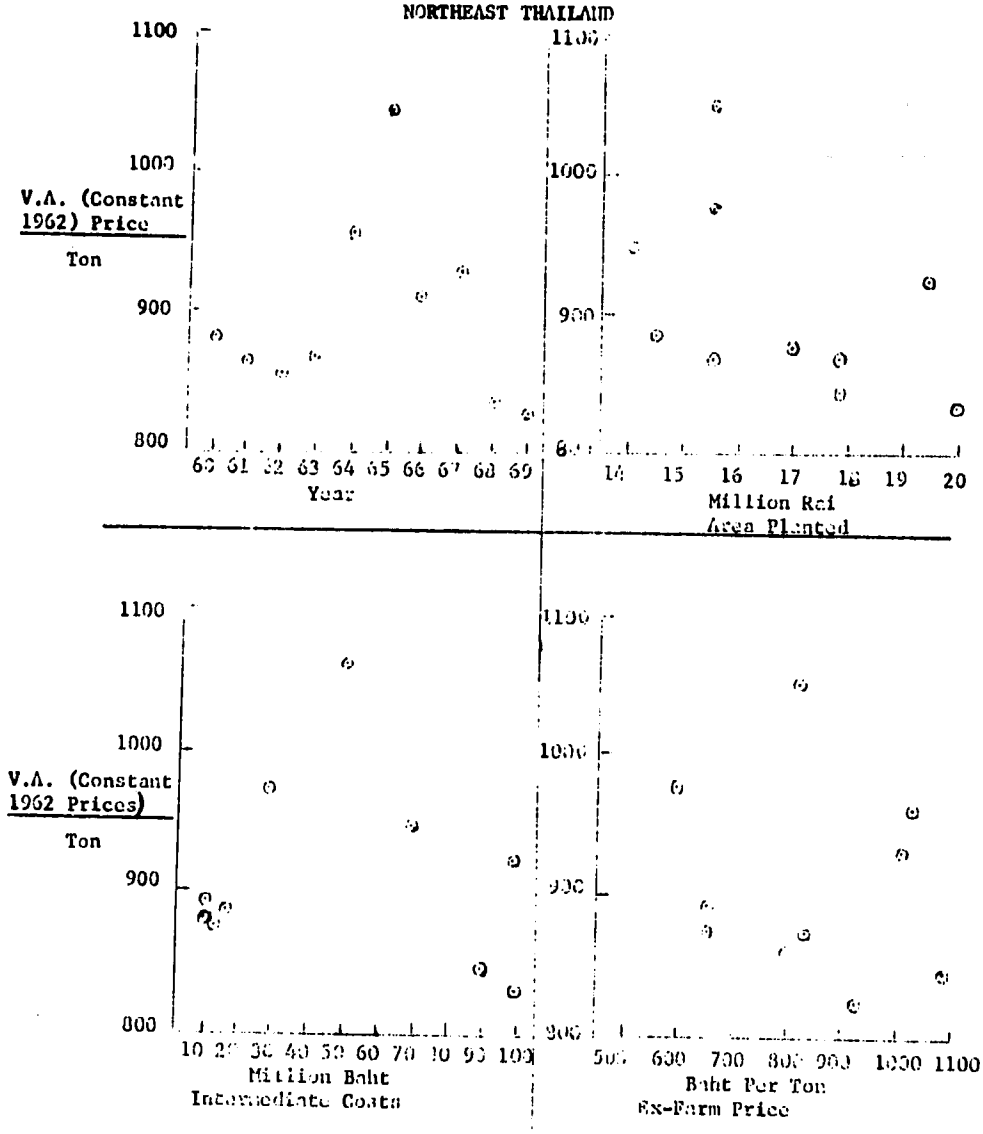
FIGURE A.2

DISCUSSION OF THE DETERMINATION OF VALUE ADDED PER TON (AT CONSTANT 1962 PRICES) FOR RICE PRODUCTION IN NORTHEAST THAILAND



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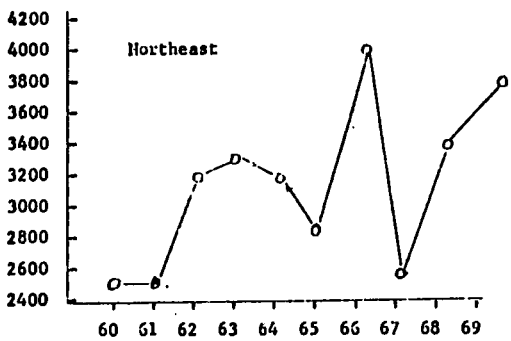
PADDY	1

Value Added Per Ton	826 Baht

60	61	62	63	64	65	66	67	68	69	YEAR
2442	2459	3231	3463	3186	2852	4026	2490	3455	3829	Northeast Production Value Added
8072	8433	9586	10345	9890	9508	11578	9594	10659	11518	Whole Kingdom Production Value Added
30.2	29.1	33.7	33.4	32.2	29.9	34.7	26.0	32.4	33.2	% N.E./W.K.

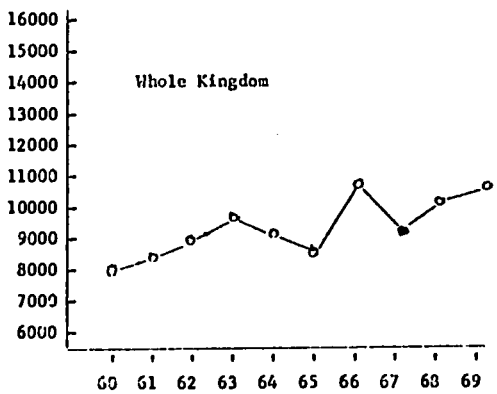


Historic Growth Rate 3.4

Current Trend Historic

Exponential $y = ab^x$

$y = 2661(1.034)^x$



Historic Growth Rate 3.4 percent

Current Trend Historic

Method of Forecasting Future Value Added

1970	1971	1972	1973	1974	1975	1976	
4.200	4.318	4.438	4.563	4.690	4.822	4.956	Production in million metric tons

Value added per ton (at constant 1962 prices). = 826 baht

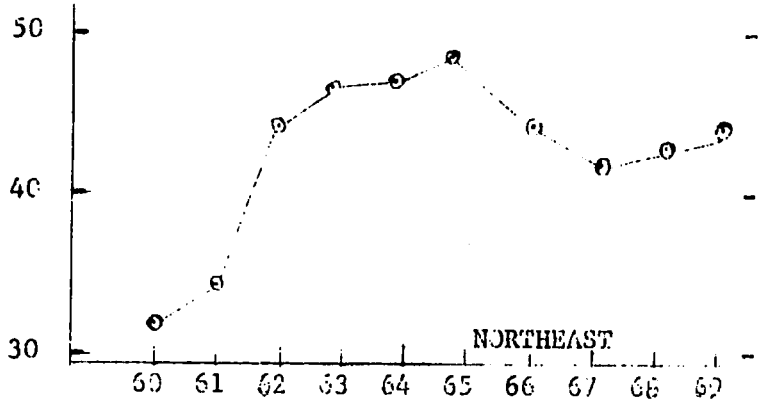
Value Added in Million Baht

1970	1971	1972	1973	1974	1975	1976
3469	3567	3666	3769	3874	3983	4094

COCONUT	3

Value Added Per Unit	74 Stangs

60	61	62	63	64	65	66	67	68	69	Year
31	33	44	48	48	49	45	43	44	45	Northeast Production Value Added M. Baht
257	258	266	277	265	284	256	240	246	254	Whole Kingdom Production value-added
12.1	12.8	16.5	17.3	16.1	17.3	17.6	17.9	17.9	17.7	% N.E./W.K

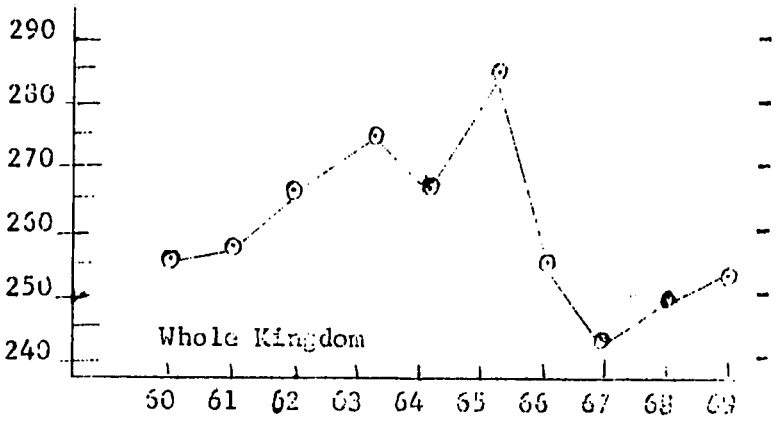


Historic Growth Rate 3.8%

Current Trend 1966-69 1.1%

Exponential $y = ab^x$

$y = 35(1.033)^x$



Historic Growth Rate - 0.7%

Current Trend 0.8%

Method of Forecasting Future Value Added

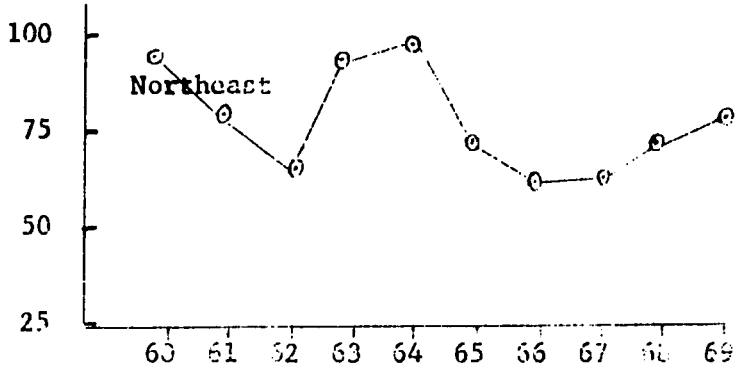
The Northeast is not well suited to coconut production and for the plan period, it is unlikely to increase. A constant production of 60.8 million coconuts at 74 Satangs per coconut to give a value added of 45 million baht has been assumed.

The production of coconuts has been considered more fully at the National level where it is more significant.

SUGARCANE	4

Value Added Per Ton	80 Baht

60	61	62	63	64	65	66	67	68	69	Year
93	74	55	89	92	60	50	47	54	51	Northeast Production, Value Added M. Baht
478	349	274	414	443	392	333	340	390	440	Whole Kingdom Production value-added
19.5	21.2	20.4	21.5	20.8	17.3	15.0	13.8	13.8	13.9	% N.E./W.K.

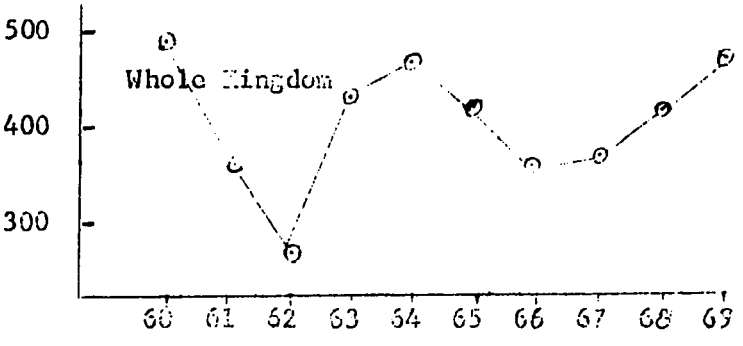


Historic Growth Rate: -5.3

Current Trend 1966-69: +9.0

Exponential $y = ab^x$

$y = 34.6(0.947)^x$



Historic Growth Rate: +3.1%

Current Trend: +11.0%

Method of Forecasting Future Value Added

Sugarcane production was assessed to increase at the same rate as the population, and the value added at constant 1962 prices was obtained by assuming a value added of 80 baht a ton in line with the historical value.

Production in Million Metric tons

1970	1971	1972	1973	1974	1975	1976
0.748	0.750	0.773	0.796	0.820	0.844	0.869

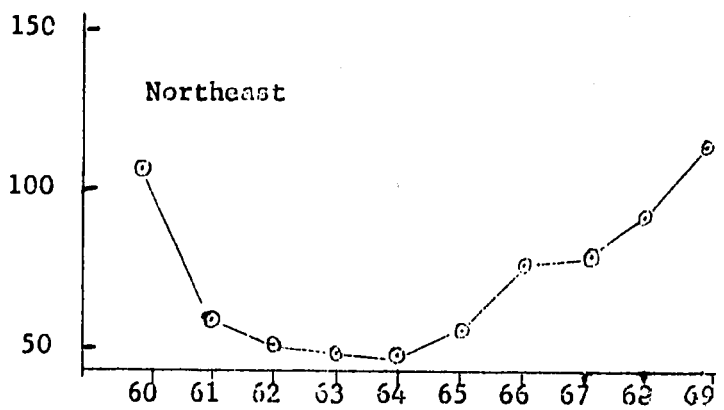
Value added per ton (at constant 1962 prices) 80 baht.
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
60	60	62	64	66	68	69

MAIZE + SORGHUM	5

Value Added Per Ton	700 Baht

60	61	62	63	64	65	66	67	68	69	Year
110	54	48	46	45	53	85	88	103	122	Northeast Production Value Added M. Baht
360	396	440	538	632	724	819	887	934	1165	Whole Kingdom Production value-added
30.6	13.6	10.9	8.1	7.1	7.3	10.4	9.9	11.0	10.5	% N.E./W.K.

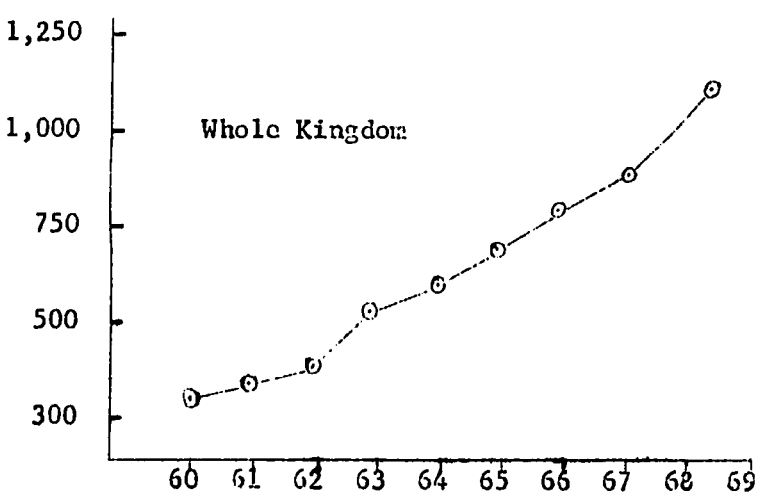


Historic Growth Rate: +2.1%

Current Trend 1966-69: +14.0%

Exponential $y = ab^x$

$y = 50.6\ (1.021)^x$



Historic Growth Rate: +5.9%

Current Trend: +11%

Method of Forecasting Future Added

Maize and Sorghum production is forecast to grow at 13 percent, per annum, through the plan period. The value-added in constant 1962 price has been about ฿700 per ton. Some intermediate costs, such as fertilizer and new seed, may be increased, but most production will be obtained under the same conditions as in the past and, consequently, ฿700 has been assumed as the value added per ton of production.

Production in million metric tons:

1970	1971	1972	1973	1974	1975	1976
0.181	0.190	0.251	0.272	0.295	0.320	0.350

Value-added per ton (at constant 1962 prices) = ฿700

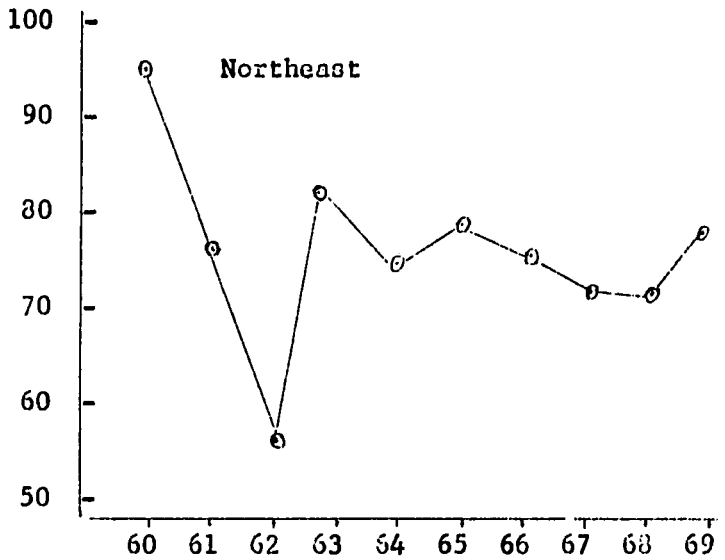
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
127	132	176	191	206	225	245

GROUNDNUTS	6

Value Added Per Ton	2180 baht

60	61	62	63	64	65	66	67	68	69	Year
91	75	57	83	71	77	73	69	69	79	Northeast Production Value Added M. Baht
313	222	213	233	247	269	455	310	270	302	Whole Kingdom Production value-added
29.1	33.8	26.8	35.6	28.7	28.6	16.0	22.3	25.6	26.2	% N.E./W.K

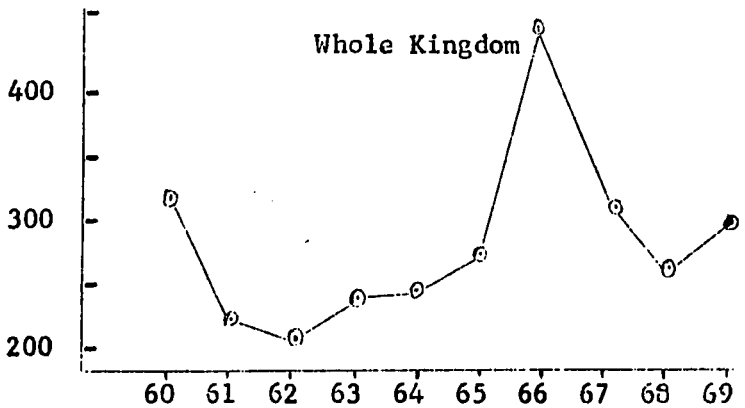


Historic Growth Rate -0.4%

Current Trend 1966-69 2.1%

Exponential $y = ab^x$

$y = 76.4(0.993)^x$



Historic Growth Rate 2.4%

Current Trend -1.3%

Method of Forecasting Future Value Added:

Groundnuts, which are grown, by and large, as a 'catch' crop to be harvested if the crop can be sold, were assessed at a three percent growth rate and a value-added per ton of 2180 baht, which is in line with the historical value added.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.035	0.035	0.036	0.037	0.038	0.039	0.041

Value added per ton (at constant 1962 prices) = ฿2180

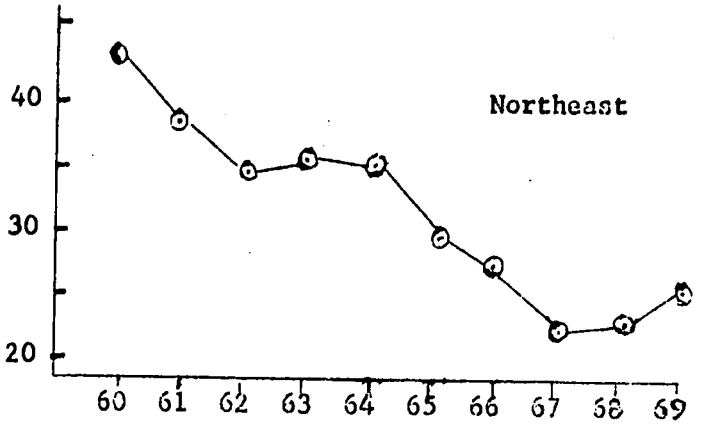
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
79	79	79	81	83	86	88

BEANS (MUNG, CASTER, SOY)	7,8,9

Value Added Per Ton	2000 baht

60	61	62	63	64	65	66	67	68	69	Year
44	38	34	35	35	30	29	22	22	25	Northeast Production
240	179	234	394	361	362	424	420	462	518	Value Added M. Baht Whole Kingdom Production V-A
18.3	21.2	14.5	8.9	8.3	8.3	6.8	5.2	4.8	4.8	% N.E./W.K.

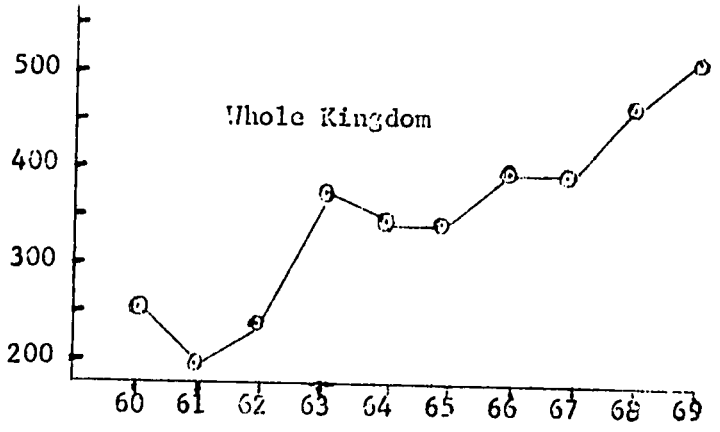


Historic Growth Rate: -7.7%

Current Trend 1966-69: -4.2%

Exponential $y = ab^x$

$y = 42.3\ (0.931)^x$



Historic Growth Rate: 11.5%

Current Trend: 8.0%

Method of Forecasting Future Value Added

Because of the program to increase the production of soybeans in the Northeast, the composition of bean production between caster, mung and soy will change. The value-added per ton which was between ฿1700 and ฿1800 per ton will increase and a value of ฿2000 per ton has been assumed in calculating value-added from bean production. The growth rate of 8.0% is, of course, the resultant growth rate of the combined bean crop.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.0175	0.0205	0.021	0.0224	0.0243	0.0267	0.0299

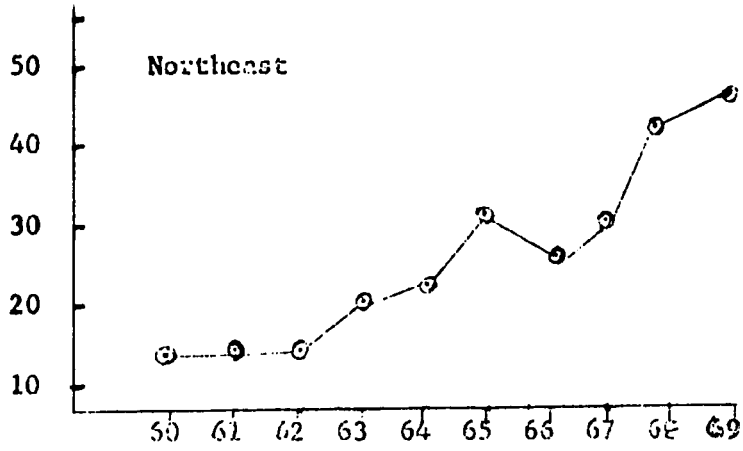
Value added per ton (at constant 1962 prices) = ฿2000
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
35	41	42	45	48	53	60

CASSAVA	10

Value Added Per Ton	230 Baht

60	61	62	63	64	65	66	67	68	69	Year
14	13	14	21	23	38	29	35	47	50	Northeast Production Value Added M. Baht
307	519	624	634	468	443	553	541	551	615	Whole Kingdom Production V-A
3.8	2.5	2.2	3.3	4.9	8.6	5.1	6.5	8.5	8.1	% N.E/W.K

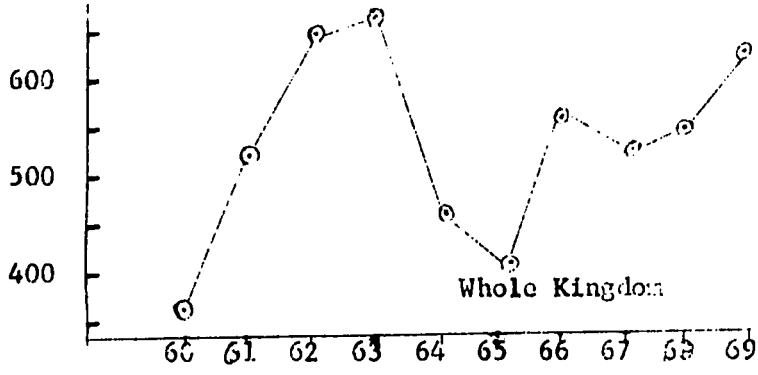


Historic Growth Rate 18.2%

Current Trend 1966-69 25%

Exponential $y = ab^x$

$y = 12.3\ (1.174)^x$



Historic Growth Rate 1.8%

Current Trend 3.5%

Method of Forecasting Future Value Added

For cassava the value-added was assessed as ฿230 per ton. There has recently been an increase in the quantity of cassava grown in the Northeast and a modest growth is forecast to continue at a rate of 3.1%.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.226	0.235	0.239	0.248	0.257	0.265	0.278

Value added per ton (at constant 1962 prices) = ฿230

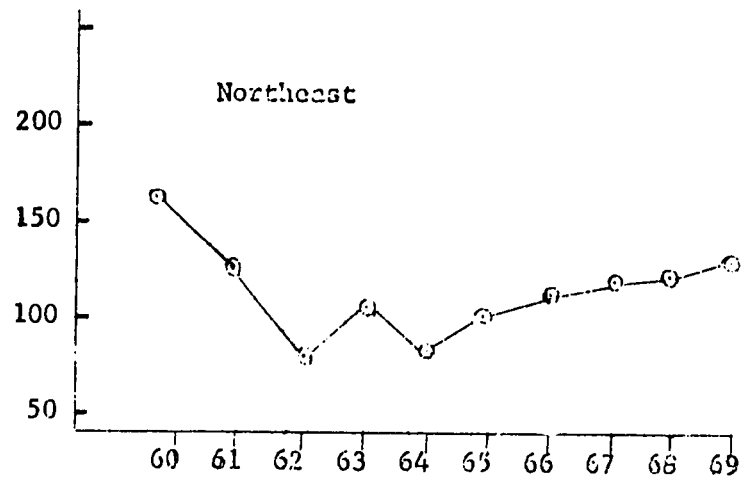
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
52	54	55	57	59	61	64

TOBACCO	11

Value Added Per Ton	7500 Baht

60	61	62	63	64	65	66	67	68	69	Year
159	132	73	108	87	107	122	128	129	137	Northeast Production
704	454	449	435	588	642	761	750	795	825	Value Added M. Baht Whole Kingdom Production Value-added
22.6	29.1	16.3	24.8	14.8	16.7	16.0	17.1	16.2	16.6	% N.E./W.K.

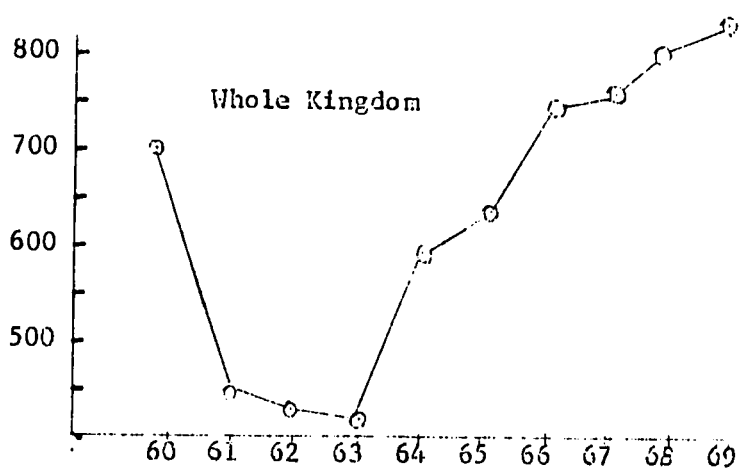


Historic Growth Rate 1.2%

Current Trend 1966-69 3.2%

Exponential $y = ab^x$

$y = 110\ (1.010)^x$



Historic Growth Rate 5.7%

Current Trend 5.0 %

Method of Forecasting Future Value Added

An increase in the growth rate of tobacco production from the current 3.2% to 5% per annum is forecast. The value-added per ton of tobacco production in the Northeast was assessed on the basis that the ratio of local varieties to the total would decrease a little and be no more than 90%. This assumes that Virginia and Turkish varieties will make-up about 10%. The value-added at 1962 prices was assessed as 7.5 baht per kilo.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.019	0.020	0.021	0.022	0.023	0.025	0.026

Value added per ton (at constant 1962 prices) = ฿7500

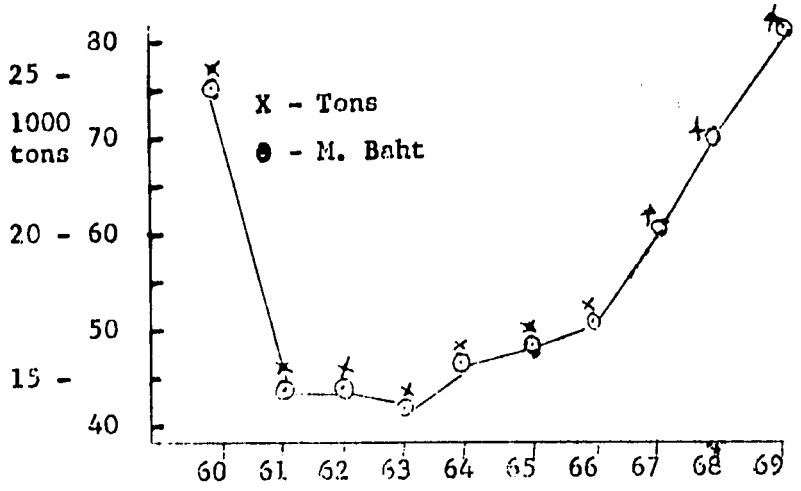
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
144	151	159	167	175	184	193

COTTON	12

Value Added Per Ton	2880 Baht

60	61	62	63	64	65	66	67	68	69	Year
74	43	42	39	45	46	50	60	72	84	Northeast Production (Value Added M. Baht
128	107	116	136	138	168	250	226	268	273	Whole Kingdom Production Value-Added
57.8	40.2	36.2	28.7	32.6	27.4	20.0	26.5	26.9	30.8	% N.E./W.K.

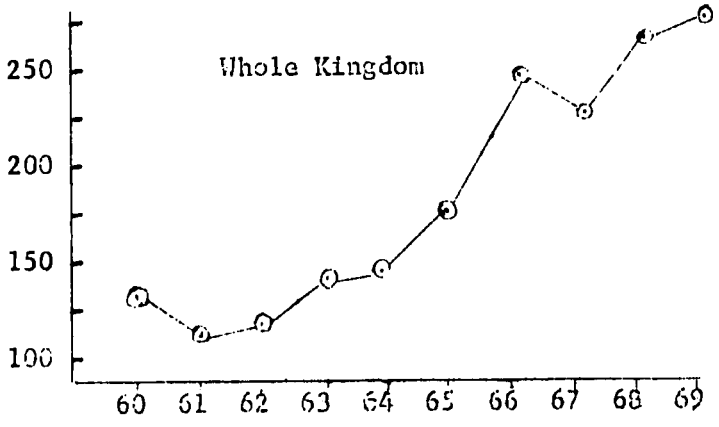


Historic Growth Rate 4.5%

Current Trend 1966-69 19%

Exponential $y = ab^x$

$y = 43.9\ (1.045)^x$



Historic Growth Rate 11.8%

Current Trend 6.5%

Method of Forecasting Future Value Added

The value added per ton of cotton was assessed as ฿2880 at 1962 prices. This is dependent on the amount of agrochemicals required, and it may prove to be high. The assumption as regards growth rate of cotton production is that the programs proposed will take away much of the risk and lead to a steady high growth rate of 10%.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.031	0.033	0.037	0.041	0.045	0.050	0.054

Value added per ton (at constant 1962 prices) = ฿2880

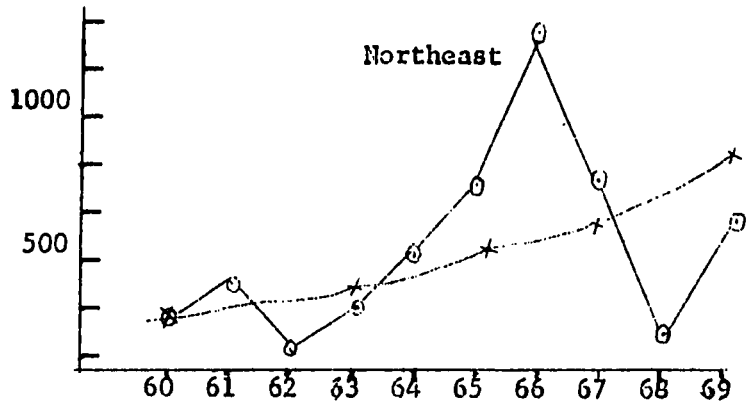
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
89	95	106	118	130	143	156

KENAF	13

Value Added Per Ton	1916 Baht

60	61	62	63	64	65	66	67	68	69	Year
333	423	246	386	562	984	1225	936	360	706	Northeast Production Value Added M. Baht
343	450	253	399	571	994	1234	950	364	717	Whole Kingdom Production V-A
97.1	94.0	97.2	96.7	98.4	99.0	99.3	98.5	98.9	98.5	% N.E./W.K.



Historic Growth Rate 10.4%

Current Trend 1966-69 -32%

Exponential $y = ab^x$

$y = 346.6\ (1.104)^x$

Historic Growth Rate 9.9%

Current Trend -

Method for Forecasting Future Value-Added

Some success in improving the quality of Thai kenaf has been achieved and this will affect the value added in two ways; first, it will increase and re-establish growth in kenaf production, and second, the farmer will obtain a higher price for his higher quality kenaf. The average value-added per ton was increased by 1 1/2%, from 1888 to 1916, to take account of the quality improvement combined with a production growth rate of 3.0%, this gives a value added growth rate of 3.4% over the plan period.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.337	0.333	0.343	0.353	0.364	0.375	0.386

Value added per ton (at constant 1962 prices) = ฿1916.

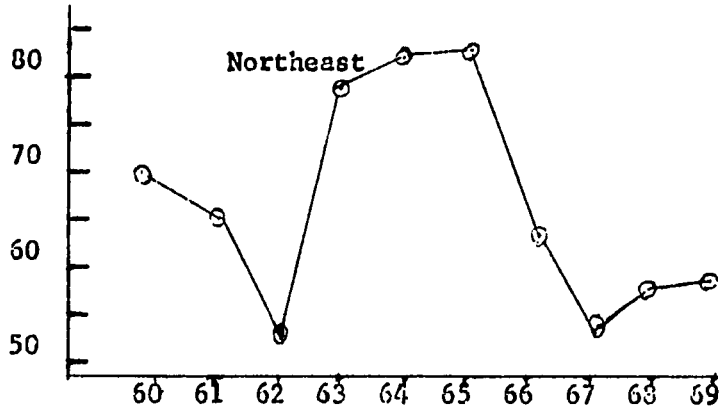
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
646	638	657	676	697	719	740

KAPOK	14

Value Added Per Ton	570 Baht

60	61	62	63	64	65	66	67	68	69	Year
70	65	52	80	83	83	62	52	55	56	Northeast Production Value Added M. Baht
249	142	176	174	189	190	167	159	160	160	Whole Kingdom Production V-A
28.1	45.8	29.5	46.0	43.9	43.7	37.1	32.7	34.4	35.0	% N.E./W.K.

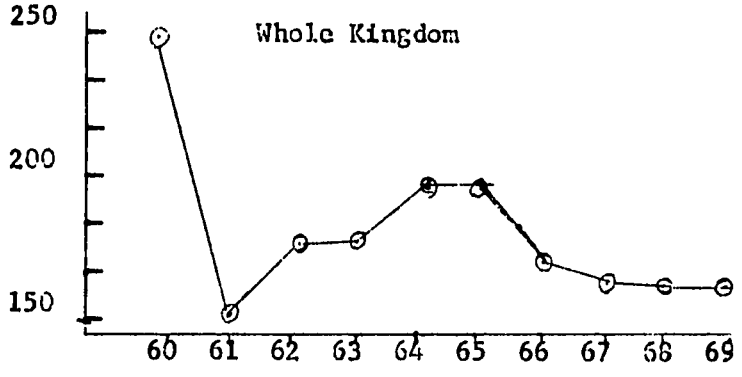


Historic Growth Rate: -2.0%

Current Trend 1966-69: -1.1%

Exponential $y = ab^x$

$y = 66.2(0.984)^x$



Historic Growth Rate: -2.4%

Current Trend: -

Method for Forecasting Future Value Added

There is a steady demand at the present time for Kapok fibre and a small growth rate of 3% has been assumed. The value added is assumed to be ฿570 per ton.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.100	0.104	0.107	0.111	0.114	0.118	0.121

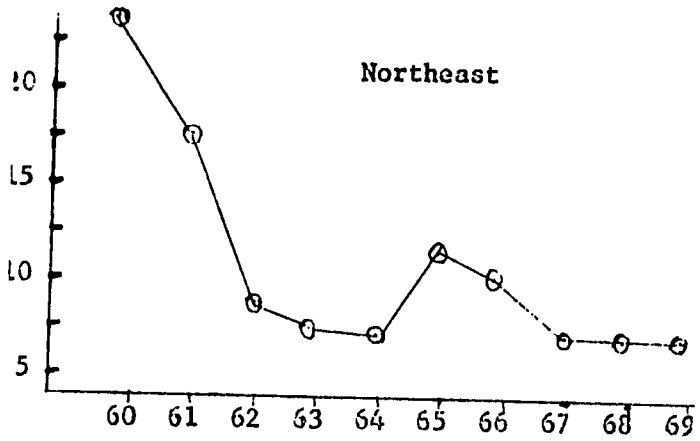
Value added per ton (at constant 1962 prices) = ฿570.
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
57	59	61	65	65	67	69

SESAME	15

Value Added Per Ton	3000 Baht

60	61	62	63	64	65	66	67	68	69	Year
22	16	9	8	8	12	11	6	6	6	Northeast Production Value Added M. Baht
55	37	48	48	39	55	59	63	68	63	Whole Kingdom Production V-A
39.3	43.2	18.8	16.7	20.5	21.8	18.6	9.5	8.8	9.5	% N.E./W.K.

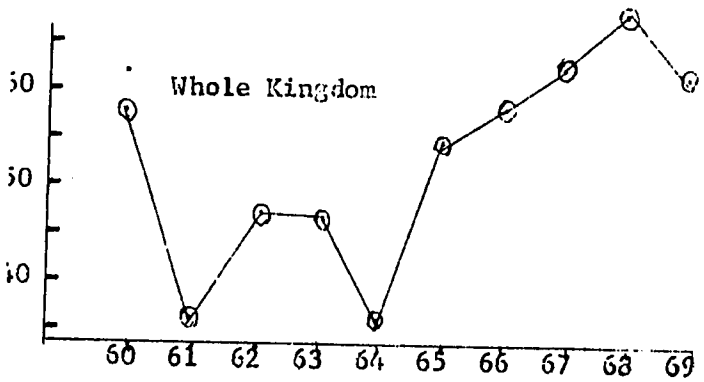


Historic Growth Rate -15.0%

Current Trend 1966-69 -16.0%

Exponential $y = ab^x$

$y = 16\ (0.89)^x$



Historic Growth Rate 4.8%

Current Trend -

Method for Forecasting Future Value Added

Sesame production has dropped to a very low level, but will increase during the plan period. The value added per ton is assumed to be ฿3000.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.003	0.003	0.003	0.004	0.004	0:004	0.005

Value added per ton (at constant 1962 prices) = ฿3000

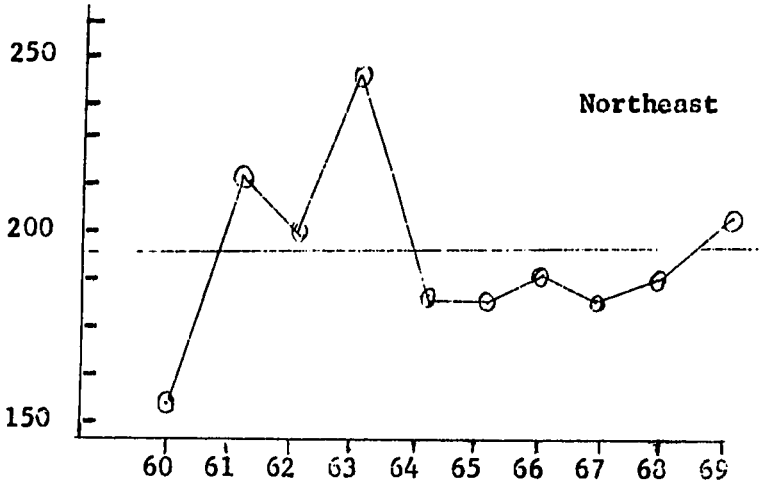
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
9	10	10	11	12	13	14

GARLIC (ETC.)	16

Value Added Per Ton	5,000 Baht

60	61	62	63	64	65	66	67	68	69	Year
148	213	196	244	175	172	181	172	180	197	Northeast Production Value Added M. Baht
414	617	611	622	581	604	811	788	834	883	Whole Kingdom Production V-A
35.7	34.5	32.1	39.2	30.1	28.5	22.3	21.8	21.6	22.3	% N.E./W.K.

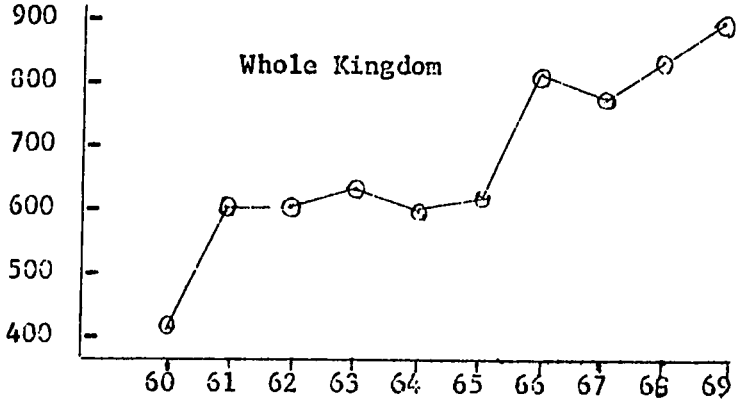


Historic Growth Rate: 0

Current Trend 1966-69: 3.3%

Exponential $y = ab^x$

$y = 187\ (0.999)^x$



Historic Growth Rate: 6.2%

Current Trend: 3.5%

Method for Forecasting Future Value Added

Garlic, shallot, onion and chili are included in this group. In line with recent regional (and National) production, a continuing growth rate of 3.3% is assumed. No change in the relative importance of the four crops is expected and a value added of ฿5000 per ton is assumed.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.041	0.042	0.043	0.045	0.046	0.048	0.049

Value added per ton (at constant 1962 prices) = ฿5000

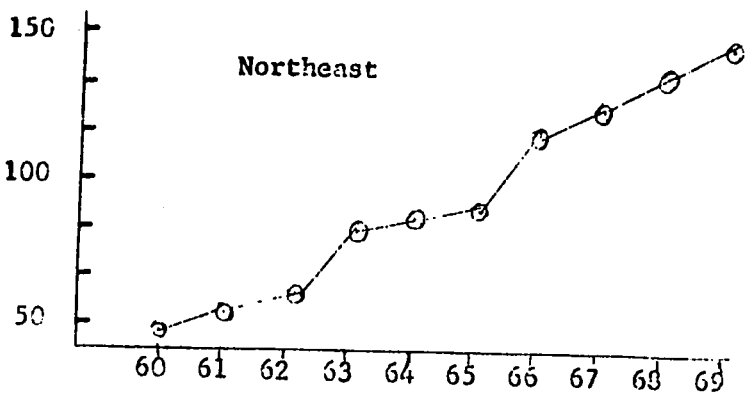
Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
204	210	217	224	232	239	247

VEGETABLES	17

Value Added Per Ton	500 Baht

60	61	62	63	64	65	66	67	68	69	Year
30	39	49	71	73	74	112	120	132	144	Northeast Production
247	300	362	504	443	482	733	765	808	835	Value Added M. Baht Whole Kingdom Production Value-Added
12.1	13.0	13.5	14.1	16.5	15.4	15.3	15.7	16.5	17.2	% N.E./W.K.

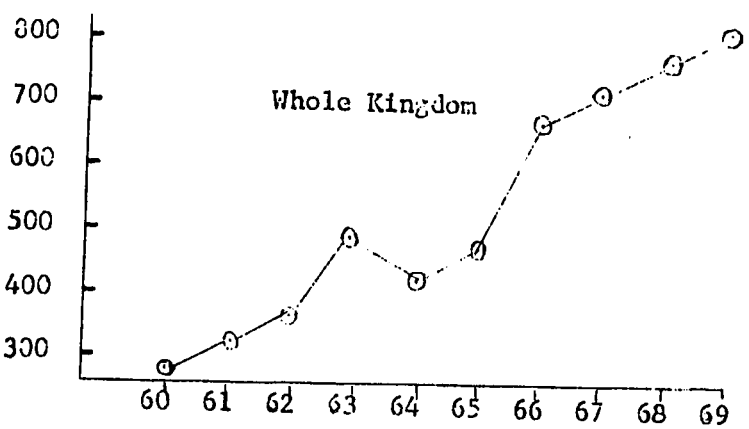


Historic Growth Rate 18.9%

Current Trend 1966-69 9.3%

Exponential $y = ab^x$

$y = 34.5(1.19)^x$



Historic Growth Rate 14.9%

Current Trend 4.5%

Method for Forecasting Future Value Added

Vegetables includes many different types and the value-added per ton is dependent on the composition of production. There is particularly a problem with vegetables of determining the quantity of production of a crop grown on comparatively small patches of land. For these two reasons, it is only possible to determine a nominal value added and this was estimated to be ฿500 a ton. Vegetable production has enjoyed a very high growth rate during the 1960's, but the forecast used for the Third Plan period is that it will be modified downwards to 8.1% which is still high.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.308	0.332	0.358	0.388	0.420	0.456	0.494

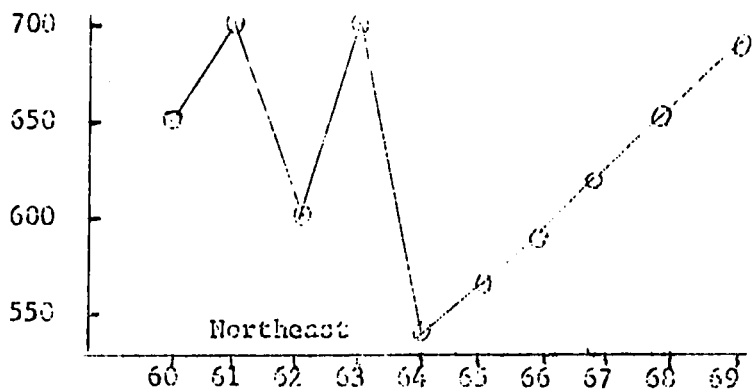
Value added per ton (at constant 1962 prices) = ฿500.

Value added in million baht.

1970	1971	1972	1973	1974	1975	1976
154	166	179	194	210	228	247

FRUIT & OTHERS	13	Value Added Per Ton	1,600 Baht

60	61	62	63	64	65	66	67	68	69	Year
650	702	599	694	513	555	585	611	647	691	Northeast Production Value Added M. Baht
2502	2599	2701	2793	2887	3021	3184	3258	3358	3483	Whole Kingdom Production Value-Added
26.0	27.0	22.2	24.8	17.8	18.4	18.4	18.8	19.3	19.8	% N.E./W.K.

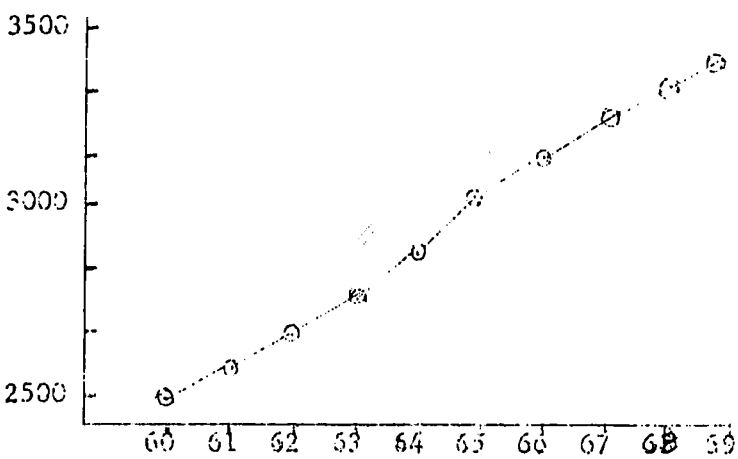


Historic Growth Rate -0.00%

Current Trend 1966-69 5.5%

Exponential $y = ab^x$

$y = 628(1.00)^x$



Historic Growth Rate 3.7%

Current Trend 3.0%

Method for Forecasting Future Value Added

The production of fruit in the Northeast comprises 50% bananas, 30% watermelon and a mixture of other minor fruits. There appears to be no potential for processing these fruit and none is planned. Consequently, the annual growth rate of production will gradually decline over the plan period and average 3.8% compared with 5.5% between 1966 and 1969. The value added is a weighted average for bananas and watermelon and is assumed to be ฿1600 a ton.

Production in million metric tons.

1970	1971	1972	1973	1974	1975	1976
0.447	0.463	0.483	0.501	0.519	0.536	0.553

Value added per ton (at constant 1962 prices) = ฿1600

Value added in million baht.

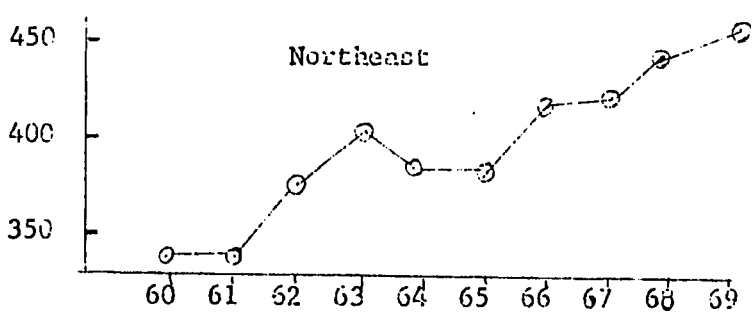
1970	1971	1972	1973	1974	1975	1976
710	741	772	801	830	857	884

Basis for Targets and Value Added Calculations for Livestock

The forecasting of future production of cattle, buffalo and swine is dependent on several factors and each is, consequently, considered referately. The growth of poultry products, however, appears likely to follow recent trends and is treated as such.

CATTLE & BUFFALO	21+22	Value Added Per Head	1,140 Baht

60	61	62	63	64	65	66	67	68	69	Year
323	329	379	407	385	383	426	426	445	456	Northeast Production Value Added M. Baht
892	919	928	933	981	1008	1026	1040	1039	1056	Whole Kingdom Production Value-added
36.2	35.8	40.8	43.6	39.2	38.0	41.5	41.0	42.8	44.1	% N.E./W.K.

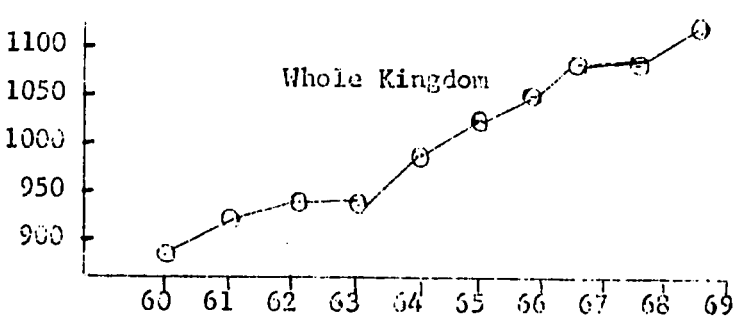


Historic Growth Rate: 3.8%

Current Trend 1966-69: 3.4%

Exponential $y = ab^x$

$y = 334\ (1.038)^x$



Historic Growth Rate: 2.0%

Current Trend: 0.7%

Method of Forecasting Future Value Added

The production of cattle and buffalo over the plan period was considered to be mainly a function of per capita income growth (an elasticity of one), together with an export of quality beef in the last years of the plan. Per capita income growth was assumed to be 4%. The value added in 1969 was used as basis for the production increase based on local demand, and a very low value of export (10 million baht)was assumed up to 1975, with a growth rate of 10% in later years. This gives the following equation for year 'n' after 1969.

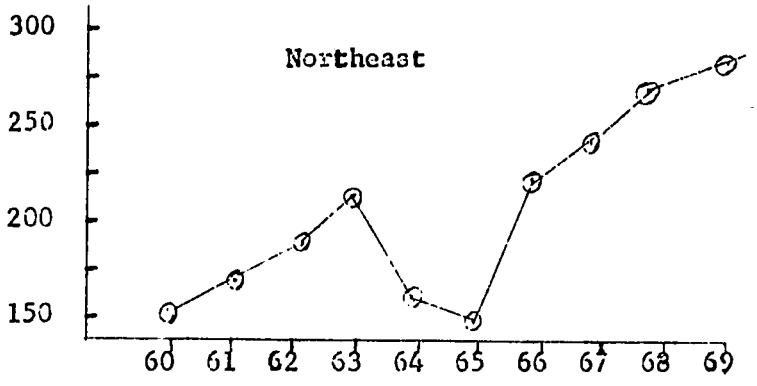
$$Cattle_n = 466(1.04)^n + 10 + 10\ (1.10)^{n-6}$$

Current value added was determined by a reconciliation of three sets of statistics, first, the difference of inventory, as reported by the Livestock Department, the production of hides, and slaughtering. The value added depended primarily on carcass value. Intermediate costs were not considered to be significant.

SWINE	23

Value Added Per Head	320 Baht

60	61	62	63	64	65	66	67	68	69	Year
156	170	188	219	180	169	236	256	278	281	Northeast Production Value Added M. Baht
750	784	851	877	856	873	990	1039	1091	1119	Whole Kingdom Production Value-Added
20.8	21.7	22.1	25.0	21.0	19.6	23.8	24.6	25.5	25.1	% N.E./W.K.

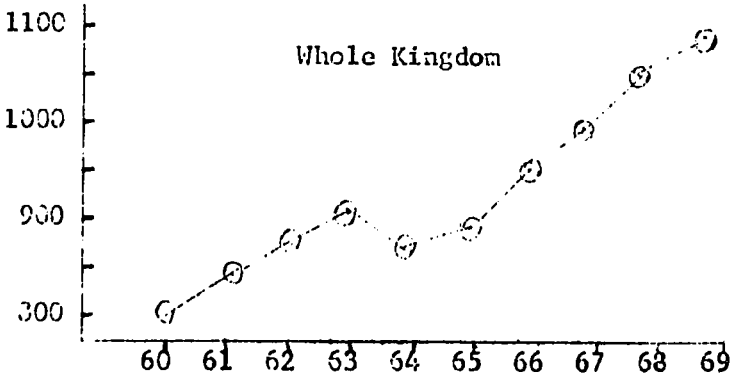


Historic Growth Rate: 6.5%

Current Trend 1966-69: 6.6%

Exponential $y = ab^x$

$y = 157\ (1.065)^x$



Historic Growth Rate: 4.5%

Current Trend: 4.4%

Method of Forecasting Future Value Added

The potential for pig production in the Northeast is high both for local consumption and export to Bangkok. The increased growth rate is dependent on some institutional changes which can reduce pig prices and on the increase of regional per capita income. The relationship developed are complicated.

Up to 1971, production is forecast to increase at the recent growth rate. For 1972, this will be increased by 10 percent because of institutional changes considered elsewhere. From 1973 onwards, there will be a new growth rate. This is assumed to be a function of the per capita income growth rate which will be increased by a factor of 1.72 because of the decrease in the price of pork to the consumer without lowering the price received by the farmer. (Institutional changes should cause this change in the price structure as present distortions in the distribution and processing systems are eliminated.)

The growth rates resulting are applied to the 1962 value added which was calculated from slaughtering data multiplied by a correction factor of 2.77 to take into account those pigs not slaughtered in registered slaughter houses. Intermediate costs depend on feed and wages. An average figure of 40 percent of market price is assumed.

The following equations give the swine production forecast:

Up to 1971: $\text{Swine}_n = 281(1.07)^n$

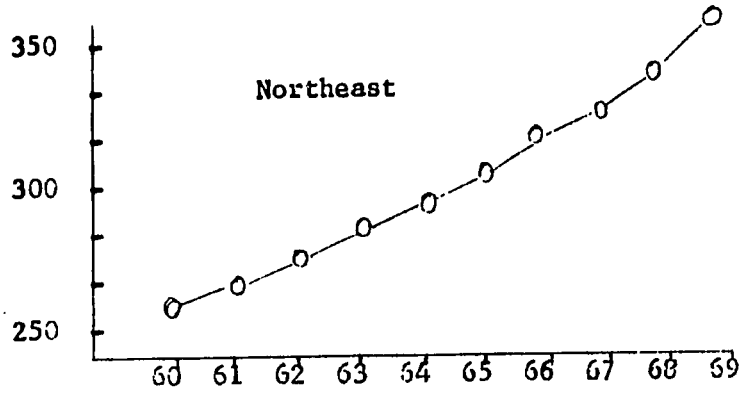
1972: $\text{Swine}_{1972} = (1.07)(1.10)$

1973 Onwards: $\text{Swine}_n = \text{Swine}_{1972}(1.062)$

HEN & DUCKS	24

Value Added Per Ton	7,800 Baht

60	61	62	63	64	65	66	67	68	69	Year
266	271	281	290	301	309	320	331	342	353	Northeast Production Value Added M. Baht
715	730	757	782	808	831	862	892	921	951	Whole Kingdom Production Value Added
37.2	37.1	37.1	37.1	37.3	37.2	37.1	37.1	37.1	37.1	% N.E./W.K.

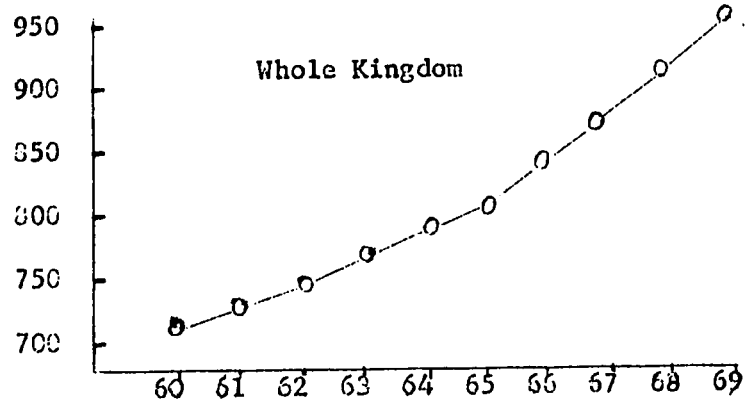


Historic Growth Rate 3.3%

Current Trend 1966-69 3.3%

Exponential $y = ab^x$

$y = 264\ (1.033)^x$



Historic Growth Rate 3.3%

Current Trend 3.3%

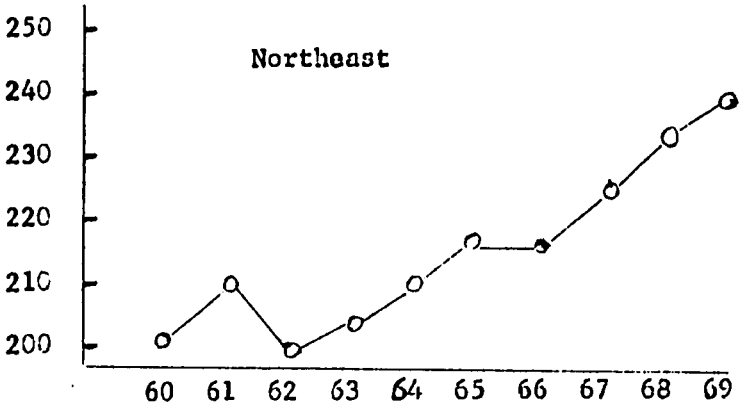
Method of Forecasting Future Value Added

The quantity of production of hens and ducks in the region is very uncertain. The method used for determining value added was to reconcile the 1962 Agricultural Census figures with the Household Expenditure Survey consumption figures and then to estimate production increase in line with population increase. Intermediate costs for table birds (as apart from egg layers) were considered to be 19.2% of farm price. Although the population increase may decline to 2.9%, it was decided to forecast a continued growth rate of 3.3% because of the likelihood of increased demand from Bangkok as its population grows.

EGGS	25

Value Added Per 1,000	350 Baht

60	61	62	63	64	65	66	67	68	69	Year
193	208	192	195	205	213	214	221	230	236	Northeast Production Value Added M. Baht
561	586	540	548	578	599	599	620	645	666	Whole Kingdom Production Value-Added
35.3	35.5	35.6	35.6	35.5	35.6	35.7	35.6	35.7	35.4	% N.E./W.K.

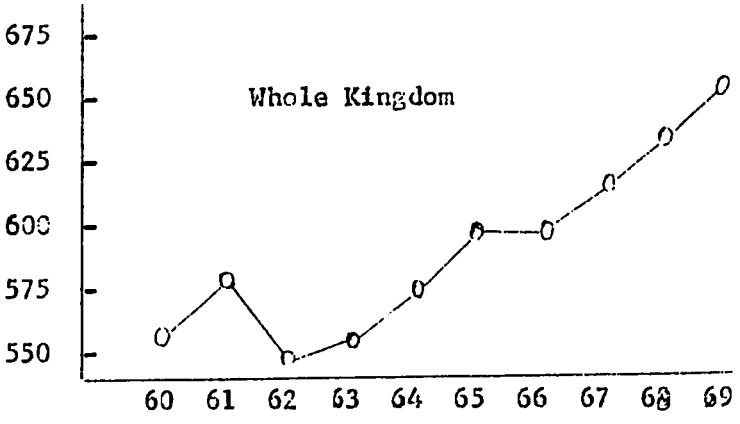


Historic Growth Rate 2.0%

Current Trend 1966-69 3.5%

Exponential $y = ab^x$

$y = 193(1.02)^x$



Historic Growth Rate 2.0%

Current Trend 3.6%

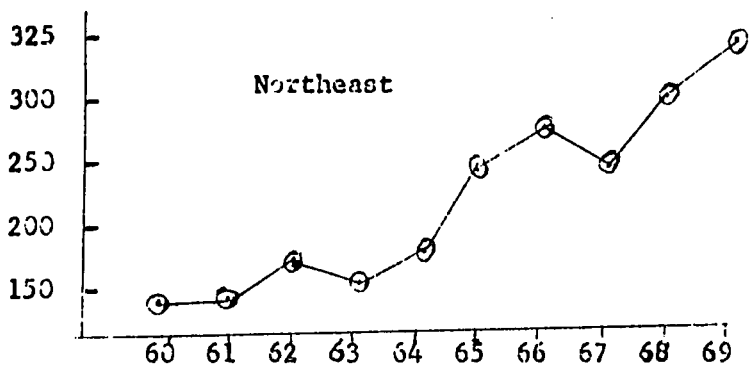
Method for Forecasting Future Value Added

For similar reasons to those given for poultry production, a continuing 3.5% growth rate was assessed. The intermediate costs for eggs were considered to be 31.4%.

FISHING	30 + 31

Value Added Per Ton	4,000 Baht

60	61	62	63	64	65	66	67	68	69	Year
153	156	176	168	189	256	276	268	290	313	Northeast Production Value Added M. Baht
731	831	969	1242	1511	1683	1952	2186	2776	3588	Whole Kingdom Production Value-Added
20.9	18.8	18.2	13.5	12.5	15.2	14.1	12.3	10.4	8.7	% N.E./W.K.

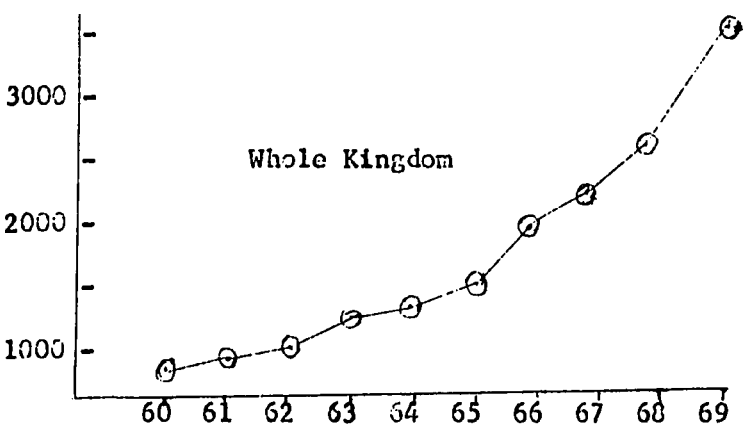


Historic Growth Rate 9.3%

Current Trend 1966-69 5.2%

Exponential $y = ab^x$

$y = 145(1.093)^x$



Historic Growth Rate 18.9%

Current Trend 25%

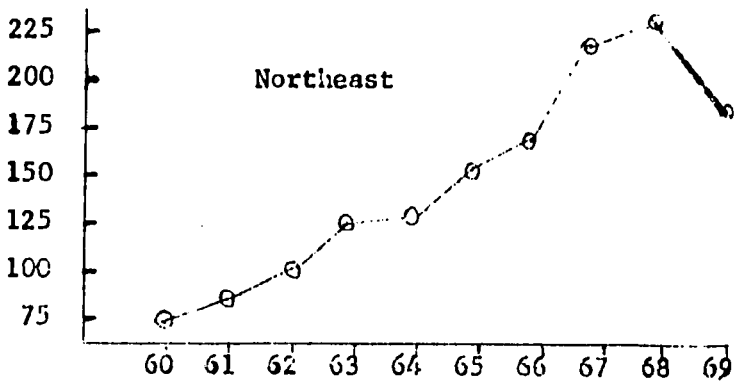
Method of Forecasting Future Value Added

Because of its importance as a diet item, the production of fish in the Northeast will be stimulated as much as is possible in the Third Plan period. The determination of fish production and its value added is still not satisfactory because little fish caught in the Northeast goes to a market. (Except for small quantities of dried and cured fish which reaches local markets.) The Northeast region is taken with the country as a whole in balancing production and consumption, but the calculation leaves much to be desired. The water area in the Northeast will continue to expand a combined with the proposed programs for fresh water fishing, this should enable the Northeast fish production to continue to grow at its recent rate through the plan period.

TIMBER	32+33+34

Value Added Per Cubic Metre	280 Baht

60	61	62	63	64	65	66	67	68	69	Year
65	72	94	121	123	155	165	200	213	185	Northeast Production Value Added M. Baht
505	438	480	583	613	863	677	785	959	1030	Whole Kingdom Production Value-Added
12.9	16.4	19.6	20.0	20.1	18.0	24.4	25.5	22.3	18.0	% N.E./W.K.

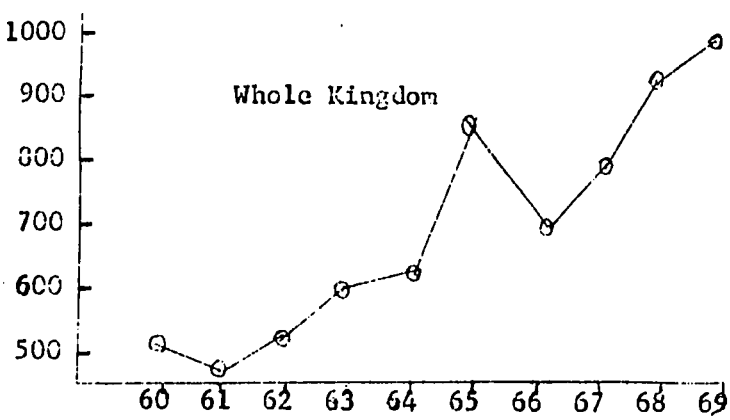


Historic Growth Rate 14.5%

Current Trend 1966-69 4.4%

Exponential $y = ab^x$

$y = 71(1.145)^x$



Historic Growth Rate 10.0%

Current Trend 16%

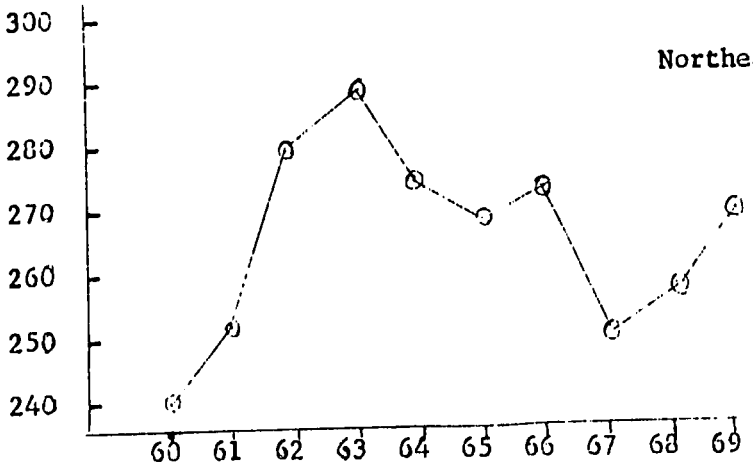
Method of Forecasting Future Value Added

The growth rate of the forestry sector is almost certain to decline in the next decade in the Northeast. Firstly, because of forestry depletion, it will become harder to find timber to cut. Secondly, it is hoped that institutional changes will be introduced to control cutting more closely than in the past. A growth rate has been estimated which is below the historic rate that is 10% compared with 14.5%. The current value added was determined by multiplying the cubic feet of timber cut, according to the Forestry Department Statistics, by the Bangkok wholesale price. Intermediate costs include cutting and transportation. Overall account is taken of reforestation costs by subtracting budget costs of the program.

CHARCOAL & FIRE WOOD	35

Value Added Per Cubic Metre	130 Baht

60	61	62	63	64	65	66	67	68	69	Year
235	252	281	291	278	271	277	251	262	271	Northeast Production Value Added M. Baht
1118	1163	1217	1252	1276	1315	1353	1406	1449	1496	Whole Kingdom Production Value-Added
21.0	21.7	23.1	23.2	21.8	20.6	20.5	17.6	18.1	18.1	% NE/WK

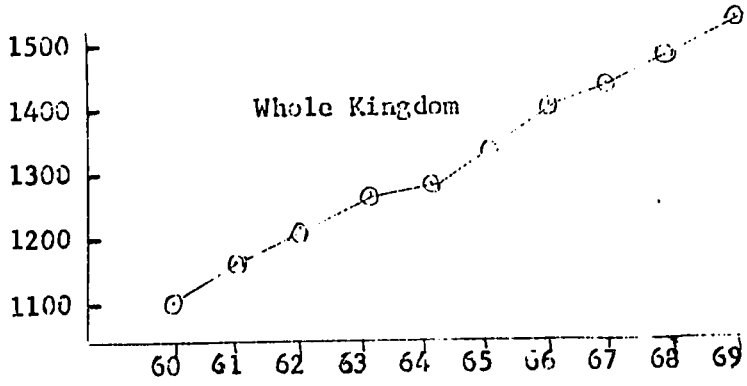


Historic Growth Rate 0.5%

Current Trend 1966-69 0.4%

Exponential $y = ab^x$

$y = 261(1.005)^x$



Historic Growth Rate 3.1%

Current Trend 3.3%

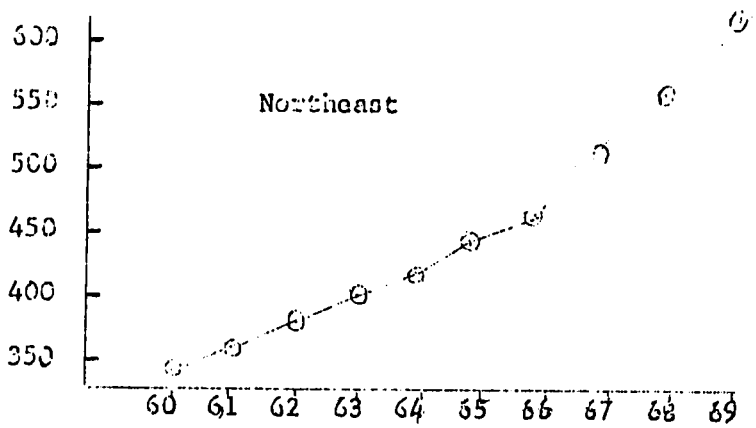
Method of Forecasting Future Value Added

Charcoal production in the Northeast has been relatively static during recent years, probably because of the import of competing fuels to the region. However, there continues to be a demand in the central region, including Bangkok and Thonburi and it seems likely that the Northeast will become increasingly competitive. As a result, the production rf charcoal was assigned to a growth rate, which arbitrarily was given a value of 3.1%. The current value added of charcoal was determined broadly from the Household Expenditure Survey, together with estimates of exports from check point surveys on the highway. Intermediate costs are estimated at a fixed percentage.

Basis for Targets and Value Added Calculations for Budget Items

EDUCATION	79

60	61	62	63	64	65	66	67	68	69	Year
301	328	355	387	419	446	468	508	555	632	Northeast Production Value Added M. Baht
1364	1417	1558	1617	1695	1737	1875	1977	2302	2449	Whole Kingdom Production Value-Added
22.1	23.1	22.8	23.9	24.7	25.0	25.0	25.7	24.1	25.8	% N.E./W.K.

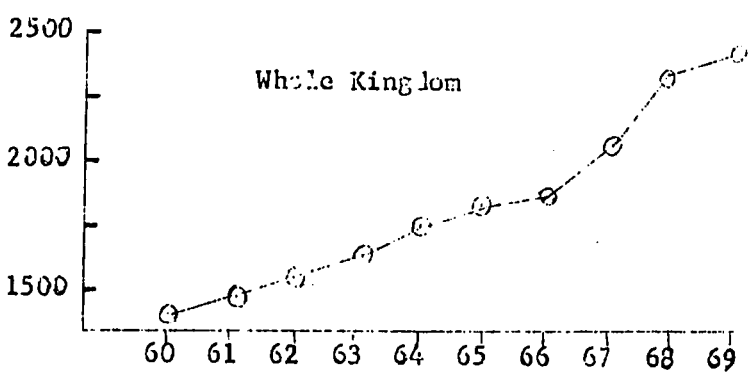


Historic Growth Rate: 8.1%

Current Trend 1966-69: 10.0%

Exponential $y = ab^x$

$y = 303(1.03)^x$



Historic Growth Rate: 6.5%

Current Trend: 11.0%

Method of Forecasting Future Value Added

Education in the Northeast is 92% based on the Government Service, and calculation of value added is based on the budget allocation proposed for teachers' salaries in the Third Plan. The education budget includes also the cost of facilities, but value added from their construction is included under "Public Construction".

The education budget comprises elementary, secondary and others, and the portions of these budgets allocated to teachers' salaries and facilities are the basis for calculating value added. The "other" category which includes higher education and numerous other programs was considered to be allocated two thirds to teacher salaries and one third to facilities. On this basis, the following were the budget allocations for 1972 and 1976.

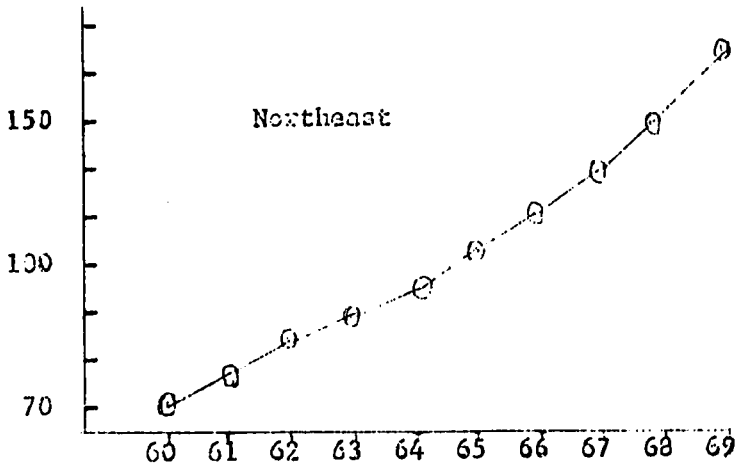
		Total Million Baht	Salaries	Facilities
1972	Elementary Education	786	588	198
	Secondary Education	173	81	92
	Others	208	138	70
		1167	807	360
1976	Elementary Education	1209	899	310
	Secondary Education	292	187	105
	Others	263	160	103
		1764	1246	518

The salaries budget must be deflated to 1962 constant price, and increased by eight percent to take account of private school teacher salaries.

	1972	1973	1974	1975	1976
Deflator	1.22	1.25	1.27	1.30	1.33
Proposed Salaries Budget, M. Baht	807	925	1001	1104	1246
Value Added, M. Baht	719	824	891	984	1119

MEDICAL & HEALTH	80

60	61	62	63	64	65	66	67	68	69	Year
70	75	84	89	96	105	119	134	148	166	Northeast Production Value Added M. Baht
389	414	439	4[illegible]	503	540	573	629	721	818	Whole Kingdom Production Value-Production
18.0	18.1	19.1	18.8	19.1	19.4	20.8	21.3	20.5	20.3	% N.E./W.K.



Historic Growth Rate: 10.1%

Current Trend 1966-69: 11%

Exponential $y = ab^x$

$y = 67.7\ (1.101)^x$

Historic Growth Rate: 8.3%

Current Trend: 13%

Method of Forecasting Future Value Added

As for education, value added for Medical and Health depends solely on salaries, though the budget includes salaries, other operational costs and facilities. The proportions are:

Salaries	40 percent
Other Operational Costs	20 percent
Facilities	40 percent

Public medical and health are only a part of the services available in the Northeast. Private services have been considerably larger in parts than the Government Service (more than three times larger in 1960), but the latter have grown at a great rate. During the Third Plan period, it is anticipated that the Government Services will be 40 percent of the total. Consequently, the following simple relation exists.

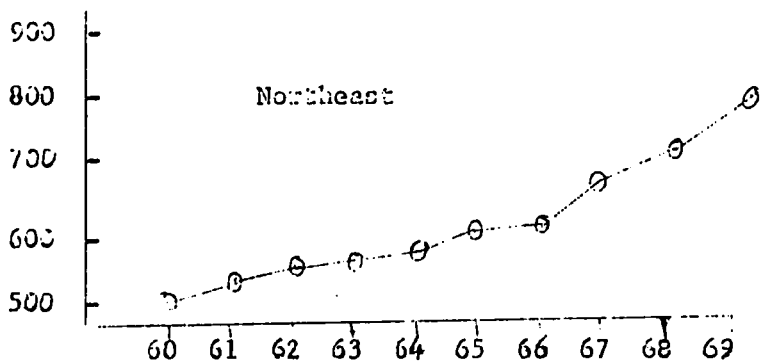
Value Added = Government doctor and nurse salary budget.

The 40 percent salary portion of the budget equalizes the 40 percent proportion of government to private medical services. The value added is deflated to constant 1962 prices, as for education.

	1972	1973	1974	1975	1976	
Value Added	268	288	323	341	356	Million Baht.

PUBLIC ADMIN. & DEFENCE	88

60	61	62	63	64	65	66	67	68	69	Year
444	468	438	532	547	591	591	647	743	810	Northeast Production Value Added M. Baht
2586	2714	2848	3211	3208	3458	3542	3827	4363	4765	Whole Kingdom Production Value-Added
17.3	17.2	17.1	16.6	17.1	17.1	16.7	16.9	17.0	17.0	% N.E./W.K.

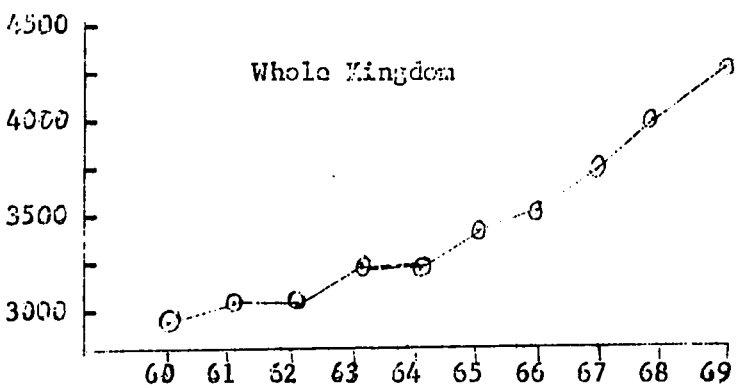


Historic Growth Rate 6.5%

Current Trend 1966-69 12%

Exponential $y = ab^x$

$y = 433\ (1.065)^x$



Historic Growth Rate 7.0%

Current Trend 11.2%

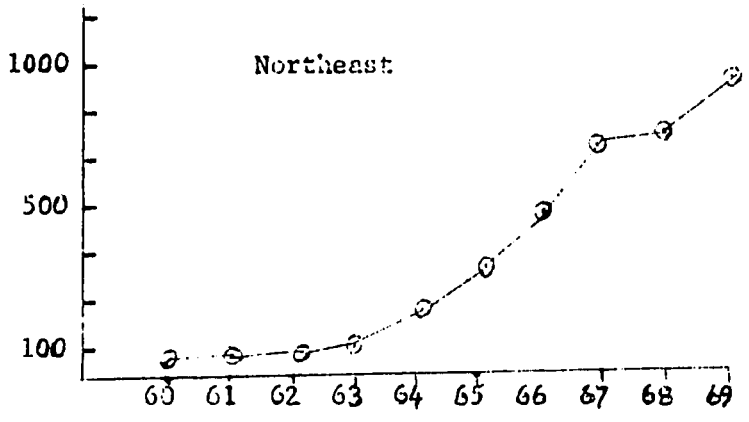
Method of Forecasting Future Value Added

It has been assumed that there is still a need for rapidly expanding government administration defense in the Northeast. It is proposed to continue the level at about 17% of the Whole Kingdom, which will result in the following value-added.

	Million Baht				
	1972	1973	1974	1975	1976
Value Added at Constant 1962 prices:	1114	1239	1377	1531	1703

CONSTRUCTION (PUBLIC)	41

60	61	62	63	64	65	66	67	68	69	Year
22	27	40	61	198	291	508	725	750	895	Northeast Production Value Added M. Baht
634	671	852	1157	1383	1679	2327	3096	3291	3027	Whole Kingdom Production Value-Added
3.5	4.0	5.0	5.3	14.3	17.3	21.8	23.4	22.8	29.6	% N.E./W.K.

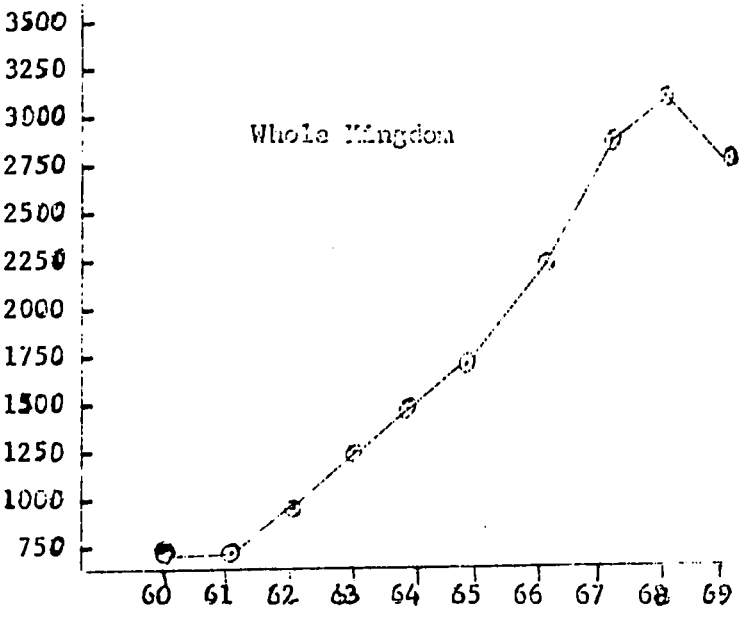


Historic Growth Rate 60.0%

Current Trend 15%

Exponential $y = ab^x$

$y \quad 20.4\ (1.60)^x$



Historic Growth Rate 22.9%

Current Trend 7.7%

Method of Forecasting Future Value Added

The value added is calculated from the government budget for construction in all sectors, both civil and military. The main components are school, hospitals, government offices, roads, dams, power, irrigation and military installations. The value added is a percentage of the budget, depending on the part of the budget used for wages and salaries. The more equipment required, the lower

is the percentage, as follows:

Type of Construction	% of Contract Value
Road Repair (Manual)	52%
Offices	51%
Residential and Other Private	45%
School	44%
Hospital	44%
Dams	37.5%
Roads and Bridges	31%
Runways and Airports	30%

DEVELOPMENT BUDGET FOR CONSTRUCTION

(Million Baht)

	1972	1973	1974	1975	1976
Schools	360	399	439	479	518
Hospitals	67	72	81	85	89
Roads	800	840	880	920	960
Irrigation	163	173	183	193	203
Power	65	70	75	80	85
Total Development Budget Construction	1455	1554	1658	1757	1855

(Value Added in Million Baht)

	1972	1973	1974	1975	1976
Schools X 0.44	158	176	193	211	228
Hospitals X 0.44	29	32	36	37	39
Roads X 0.31	248	260	273	285	298
Irrigation X 0.375	61	65	69	72	76
Power X 0.030	20	21	23	24	26
Total	516	554	594	629	667

The element of the non-development budget used for construction is difficult to determine because it involves consideration of the political and security situation in the region. However, reconciliation between development budgets, which have a clearly defined construction element, and the non-development budget in regard to the value added for the government services and public construction suggests that currently construction accounts for between 10 and 15 percent of the non-development budget. Therefore, a figure of 12 1/2 percent has been assumed for 1972.

	1972	1973	1974	1975	1976
Non-Development Budget 1/	5746	6216	6771	7389	8122
Non-Development Construction	718	777	846	924	1015
Value Added 2/	316	342	372	407	447
Total Value Added	832	896	966	1036	1114
This is at current price and is deflated to constant 1962 prices to give Value Added:	682	717	761	797	838

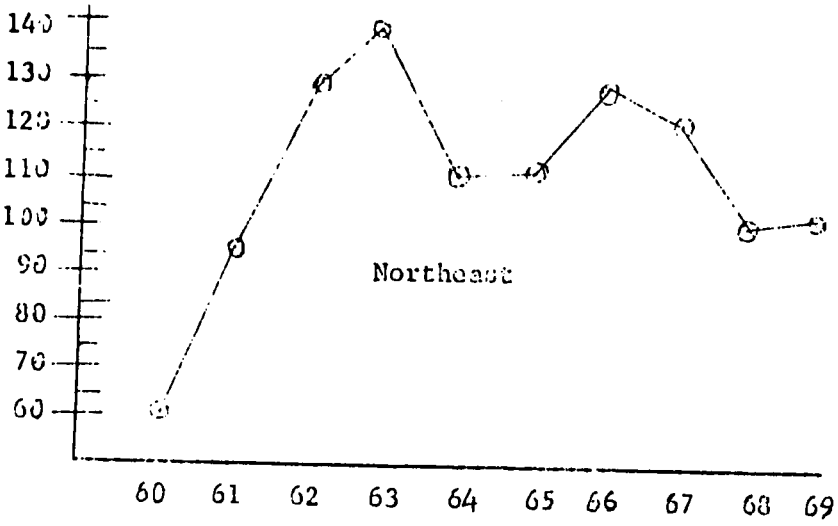
1/ Based on USOM/PEC Analysis. See also Chapter 1.

2/ The Construction is presumed to be offices, barracks, etc. which has a percentage factor of 0.44.

Basis for Targets and Value Added Calculations for Some Manufacturers

SLAUGHTER HOUSES	43

60	61	62	63	64	65	66	67	68	69	Year
62	95	129	137	111	116	129	120	100	100	Northeast Production Value Added M. Baht
770	781	817	841	831	830	900	926	951	975	Whole Kingdom Production Value-Added
8.1	12.2	15.8	16.3	13.4	14.0	14.3	13.0	10.5	10.3	% N.E./WK

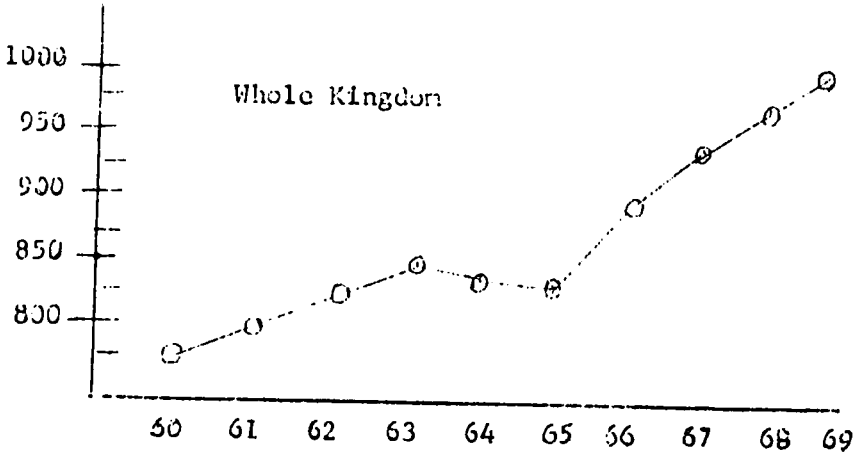


Historic Growth Rate 2.6%

Current Trend 1966-69 -10.0%

Exponential $y = ab^x$

$Y = 96\ (1.026)$



Historic Growth Rate 2.7%

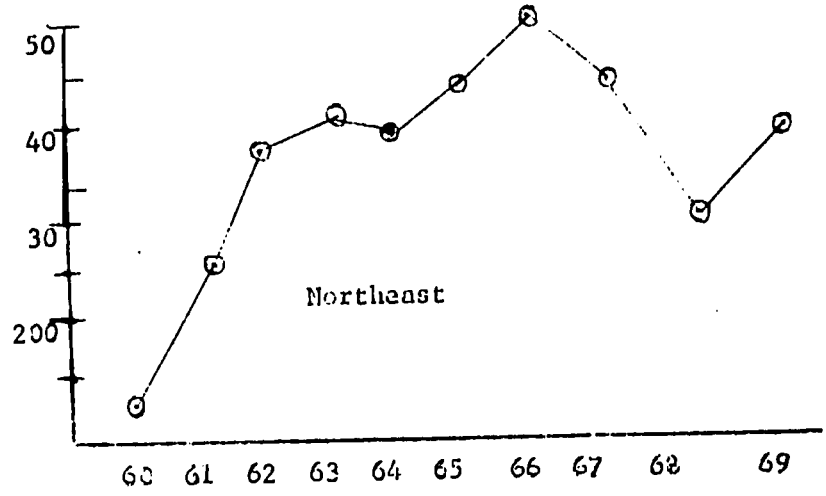
Current Trend 2.7%

Method for Forecasting Future Value Added

The value added projection is determined on the basis of new slaughtering facilities being constructed in the Northeast. The large increments of value added between 1973 and 1974 and 1975 and 1976 are result of private investment in slaughtering facilities, as discussed in Chapter 3.

BEVERAGES	48

60	61	62	63	64	65	66	67	68	69	Year
14	27	40	43	42	44	50	44	31	42	Northeast Production Value Added M. Baht
427	486	721	686	667	705	795	823	857	939	Whole Kingdom Production Value-Added
3.3	5.6	5.5	6.3	6.3	6.2	6.3	5.3	3.6	4.2	% N.E./WK

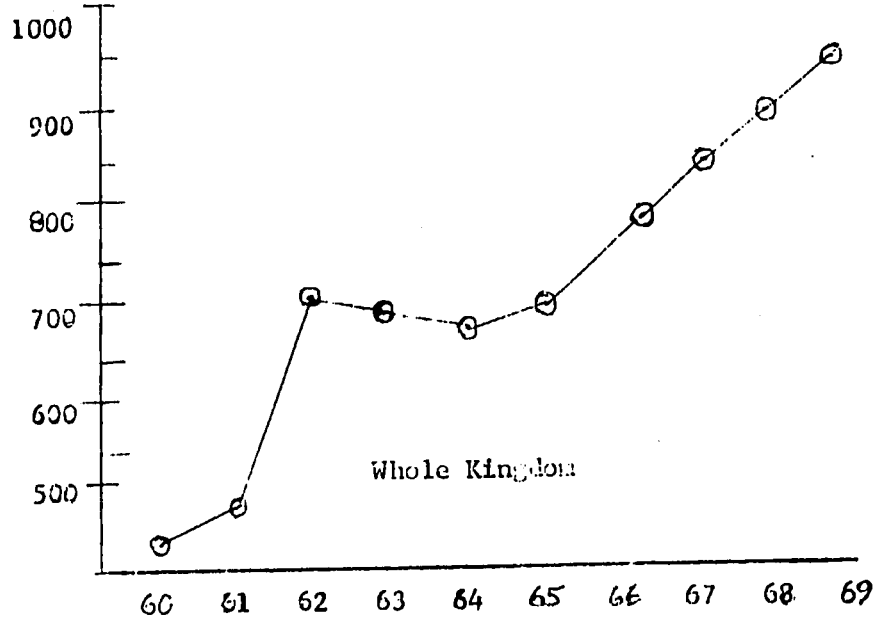


Historic Growth Rate 7.4%

Current Trend 1966-69 -12.0%

Exponential $y = ab^x$

$y = 25.9\ (1.074)$



Historic Growth Rate 7.0%

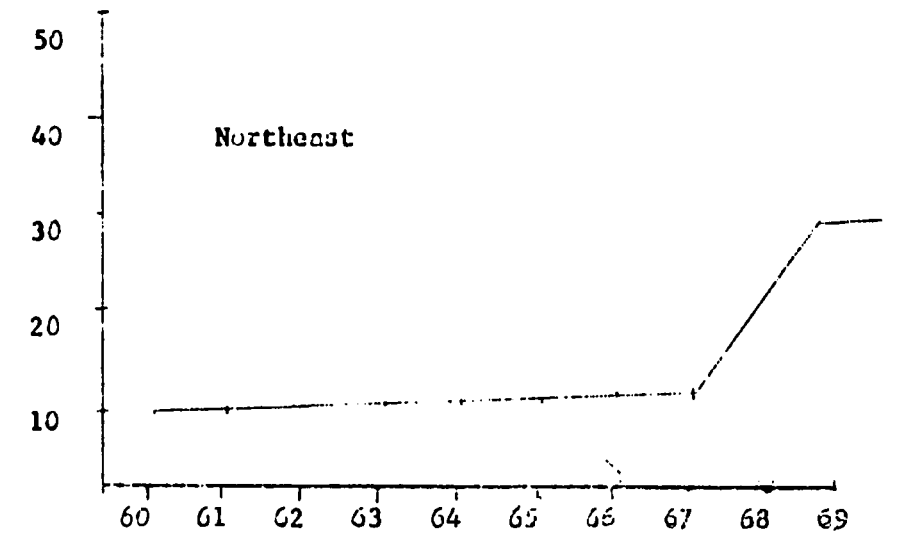
Current Trend 5.3%

Method for Forecasting Future Value Added

The growth rate of the consumption of beverages in Thailand has been close to the growth rate of the Gross Domestic Product. The production in the Northeast has been virtually constant through the decade, indicating imports into the region. The val added projected for the Third Plan period implies the setting up of facilities in the Northeast to meet this demand and reduce imports from other regions, as discussed in Chapter 3.

SOFT DRINKS	49

60	61	62	63	64	65	66	67	68	69	Year
12	13	13	13	14	14	15	15	35	36	Northeast Production Value Added M. Baht
80	83	96	113	110	129	164	211	256	334	Whole Kingdom Production Value-Added
15.0	15.7	13.5	11.5	2.7	10.0	9.1	7.1	13.7	10.0	% N.E./WK

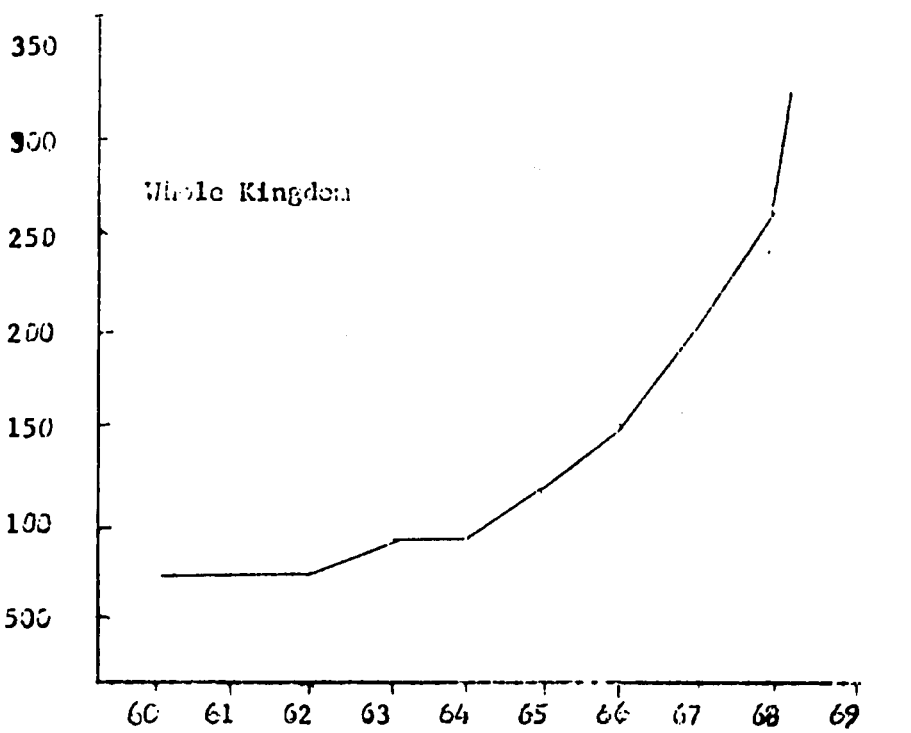


Historic Growth Rate 11.5%

Current Trend 1966-69 35.0%

Exponential $Y-ab^x$

$Y = 10.1\ (1.115)$



Historic Growth Rate 17.5%

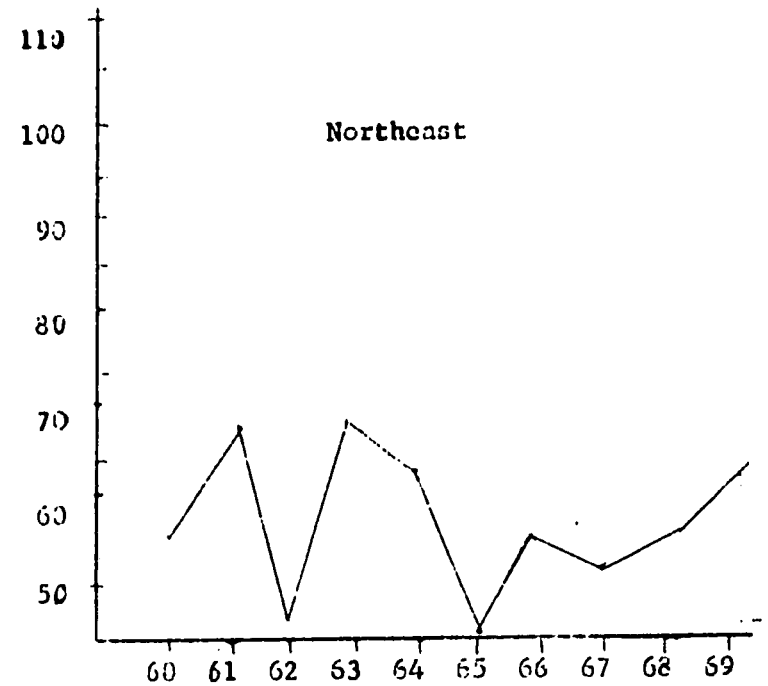
Current Trend 25.4%

Method for Forecasting Future Value Added

The value added for the Third Plan period is dependent on the construction of new factories in the Northeast to reduce dependence on other regions. (See Chapter 3.)

TOBACCO	50

60	61	62	63	64	65	66	67	68	69	Year
56	67	43	67	60	45	56	52	55	61	Northeast Production Value Added M. Baht
741	867	1149	1158	1162	1186	1247	1346	1473	1475	Whole Kingdom Production Value-Added
7.5	7.7	4.2	5.8	5.2	3.8	4.5	3.9	3.8	4.1	% N.E./WK

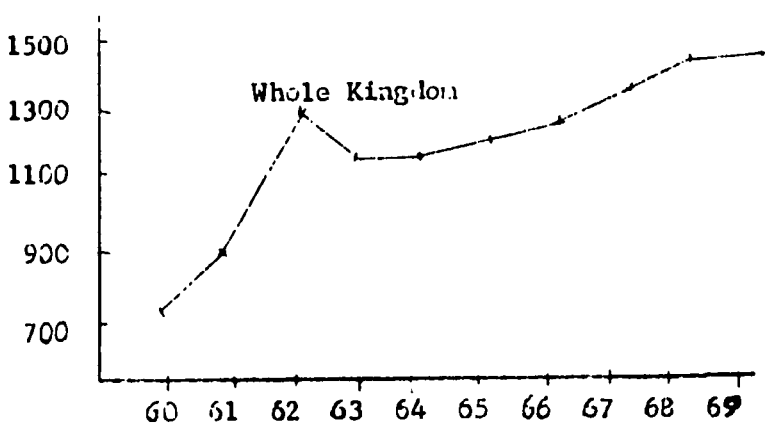


Historic Growth Rate -0.6%

Current Trend 1966-69 4.0%

Exponential $y = ab^x$

$y = 58(0.994)^x$



Historic Growth Rate 6.5%

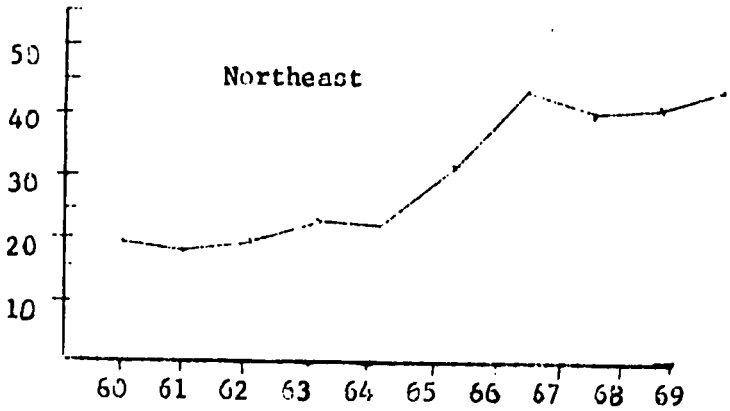
Current Trend 6.6%

Method for Forecasting Future Value Added

The value added forecast for the Third Plan period assumes increased processing facilities for locally grown tobacco, as discussed in Chapter 3.

COTTON PROCESSING	52

60	61	62	63	64	65	66	67	68	69	Year
10	18	19	22	23	32	43	40	42	46	Northeast Production Value Added M. Baht
195	240	291	363	434	578	640	695	795	890	Whole Kingdom Production Value Added
9.6	7.5	6.5	6.1	5.3	5.5	6.7	5.8	5.3	5.2	% N.E./WK

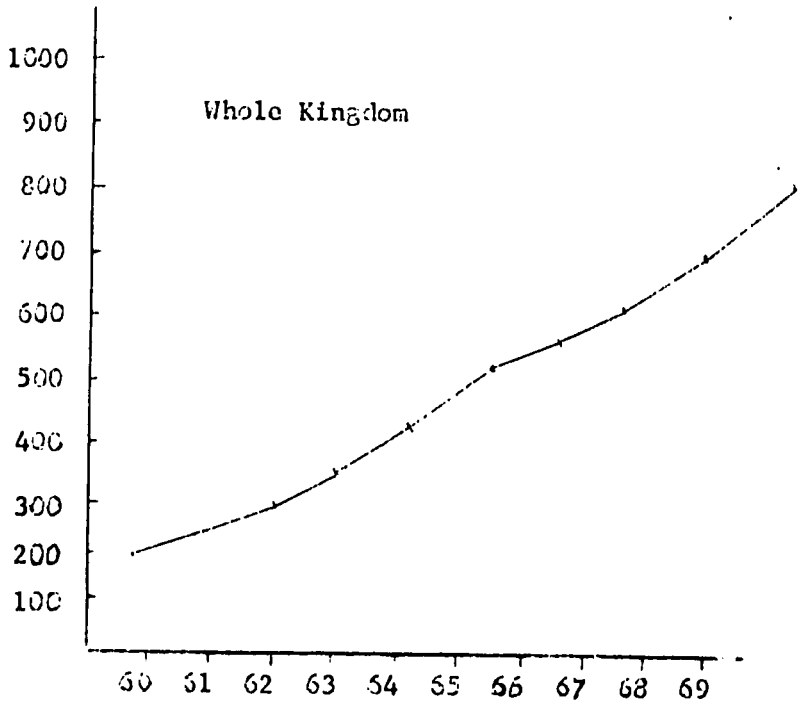


Historic Growth Rate 12.9%

Current Trend 3.0%

Exponential $y = ab^x$

$y = 16.5(1.129)$



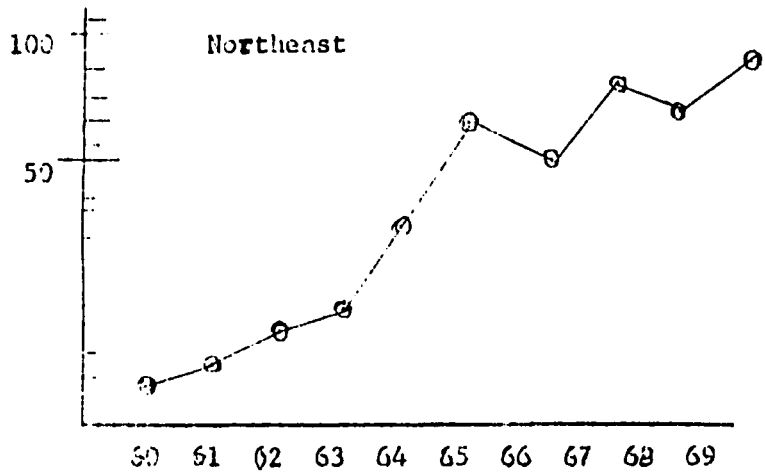
Historic Growth Rate 18.4%

Current Trend 12.3%

Method for Forecasting Future Value Added

The cotton processing industry will continue to expand only at a growth rate of 6.8% in line with the general economy until 1974. The construction of new facilities considered in Chapter 3 will then increase the production by 50 million baht in 1975 and 100 million baht in 1976.

60	61	62	63	64	65	66	67	68	69	Year
9	12	23	29	65	87	78	95	92	106	Northeast Production Value Added M. Baht
38	49	59	127	184	222	257	300	304	246	Whole Kingdom Productic Value-Added
23.7	24.5	39.0	22.8	35.9	39.2	30.4	31.7	30.3	43.1	% N.E./WK

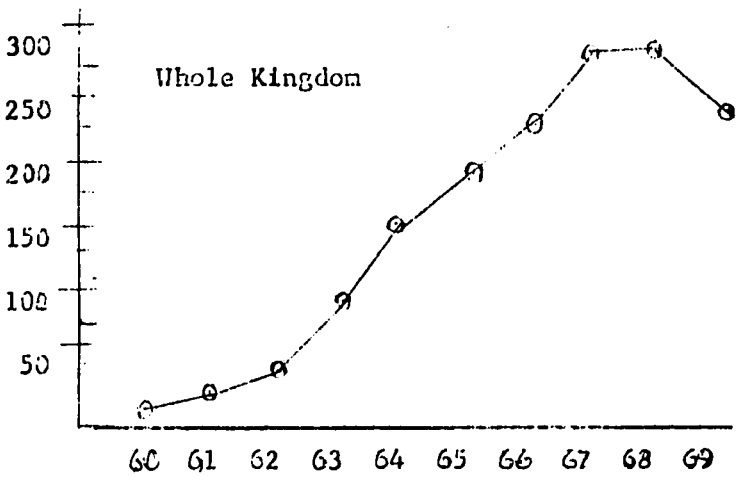


Historic Growth Rate 32.7%

Current Trend 1966-69 7.0%

Exponential $y = ab^x$

$y = 12.4(1.327)^x$



Historic Growth Rate 28.3%

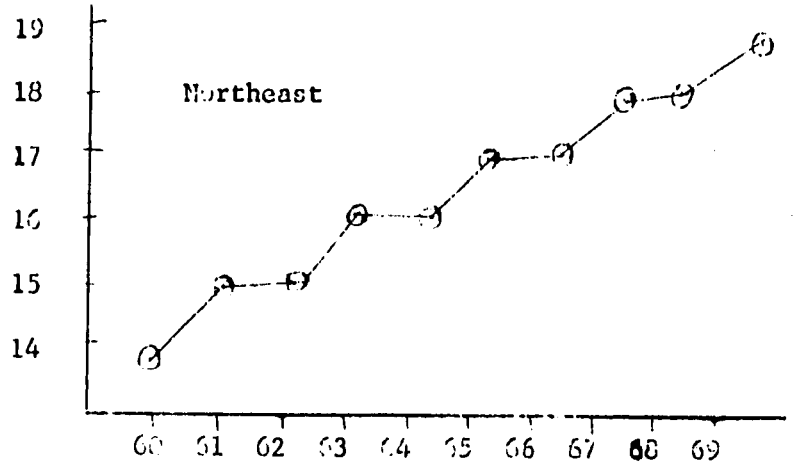
Current Trend 0%

Method for Forecasting Future Value Added

The value added forecast for the Third Plan period is dependent on the extension and improvement of facilities, as discusse in Chapter 3.

SILK	54

60	61	62	63	64	65	66	67	68	69	Year
14	15	15	16	16	17	17	18	18	19	Northeast Production Value Added M. Baht
21	22	21	27	26	33	38	39	65	85	Whole Kingdom Production Value-Added
66.7	68.2	71.4	59.3	61.5	56.7	44.7	46.2	27.7	22.4	% N.E./WK

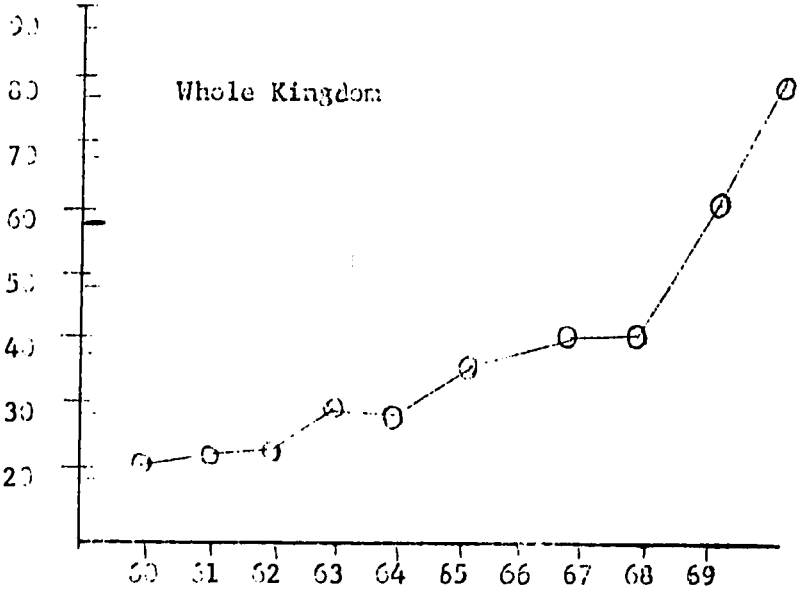


Historic Growth Rate 3.5%

Current Trend 1966-69 3.5%

Exponential $y = ab^x$

$y = 84.5(1.035)^x$



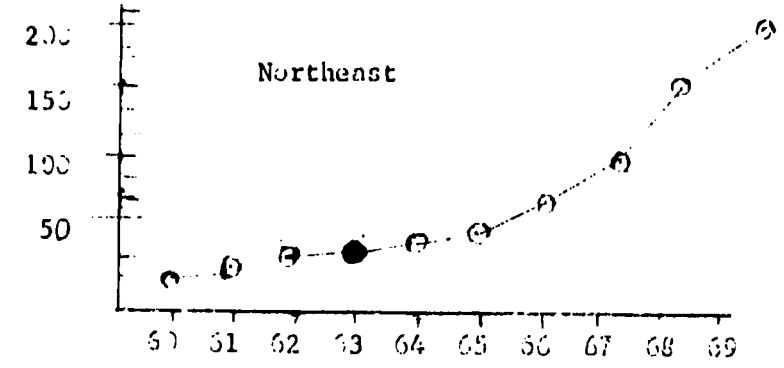
Historic Growth Rate 17.0%

Current Trend 40.0%

Method for Forecasting Future Value Added

The increase in silk production at a rate of 9% per annum is based on a continuing government community program and private investment.

60	61	62	63	64	65	66	67	68	69	Year
13	17	22	24	31	41	62	91	151	210	Northeast Production Value Added M. Baht
241	326	373	386	478	600	809	912	1180	1428	Whole Kingdom Production Value-Added
5.4	5.2	5.3	6.2	6.5	6.7	7.7	9.3	13.5	14.7	% N.E./WK

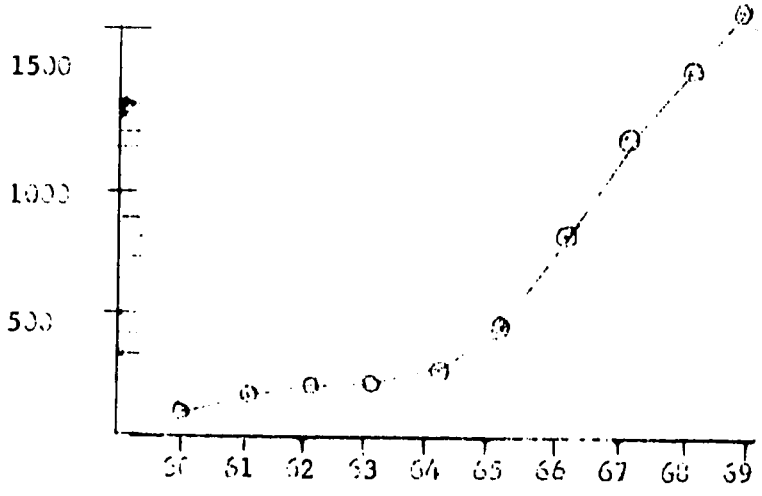


Historic Growth Rate 36.2%

Current Trend 1966-69 55%

Exponential $y = ab^x$

$y = 11.0\ (1.362)$



Historic Growth Rate 21.1%

Current Trend 21%

Method for Forecasting Future Value Added

The growth rate of value added at constant 1962 prices is directly proportional to the growth rates of production of electricity and water. Value added for electricity is determined by consumption multiplied by cost in baht per Kw.h. All data including intermediate costs is collected from Provincial Electricity Authority records at t changwat level and aggregated for the region. On average for the region, the price is about 75 satangs per Kw.h. with intermediate costs running at about 50% of earnings.

For projection purposes, it has been assumed that up to 1971, value added has increased by 10% per annum. From 1972 onwards, expansion of consumption will depend on the percentage increase in installed capacity, which is assumed to increase from the current 80 MW, as follows:

1972	92 M.W.
1973	98 M.W.
1974	104 M.W.
1975	110 M.W.
1976	116 M.W.

Value added at Constant 1962 Prices:	1972	1973	1974	1975	1976
	258	274	291	308	325

The value added for water supplies is dependent on the revenue from Water Companies in the towns, plus an assessed revenue from village water supplies based on capacity of supply and village population. Each family is assessed at 25 satangs per day, and the intermediate costs depend on the capacity, but are of the order of 28% of revenue.

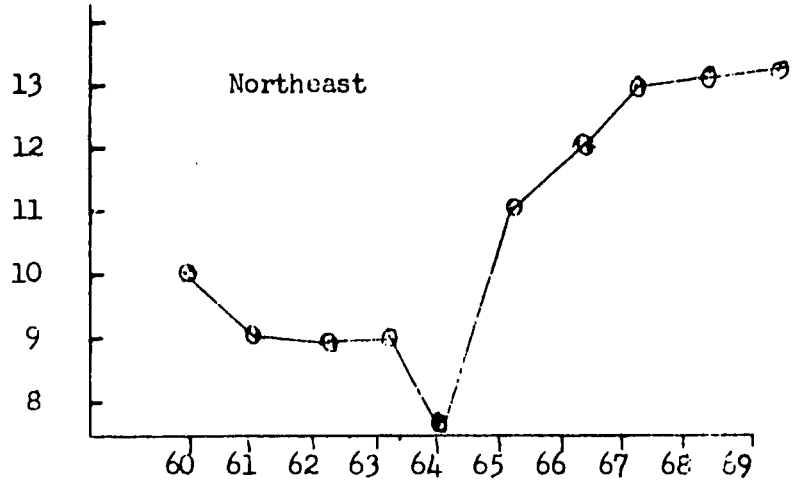
It is assumed that the growth rate of value added will be directly proportional to that of installed capacity. Total past government expenditure (up to 1969) was assessed as 200 million baht, and this was used as a measure of installed capacity. Annual budget expenditure will increase installed capacity and, thus, can be used as a measure of it. The annual budget expenditures are used to calculate an annual growth rate of installed capacity of 29% (which was rounded to 30%).

	Million Baht				
	1972	1973	1974	1975	1976
Value Added at Constant 1962 Prices	54	71	92	120	156
Electricity and Water Total	312	345	383	428	481

Basis for Targets and Value Added Calculations for Some Dependent Items

OTHER (INCL. DAIRY)	26+27

60	61	62	63	64	65	66	67	68	69	Year
10	9	9	9	8	11	12	13	13	13	Northeast Production Value Added M. Baht
20	22	24	25	27	29	31	32	34	36	Whole Kingdom Production Value Added
50.0	40.9	37.5	36.0	29.6	37.9	38.7	40.6	38.2	36.1	% N.E./W.K.

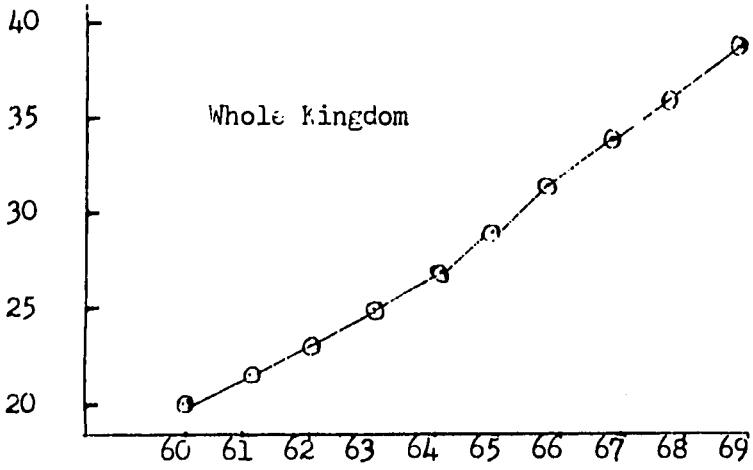


Historic Growth Rate 4.9%

Current Trend 2.0%

Exponential $y = ab^x$

$y = 8.5\ (1.49)^x$



Historic Growth Rate 6.4%

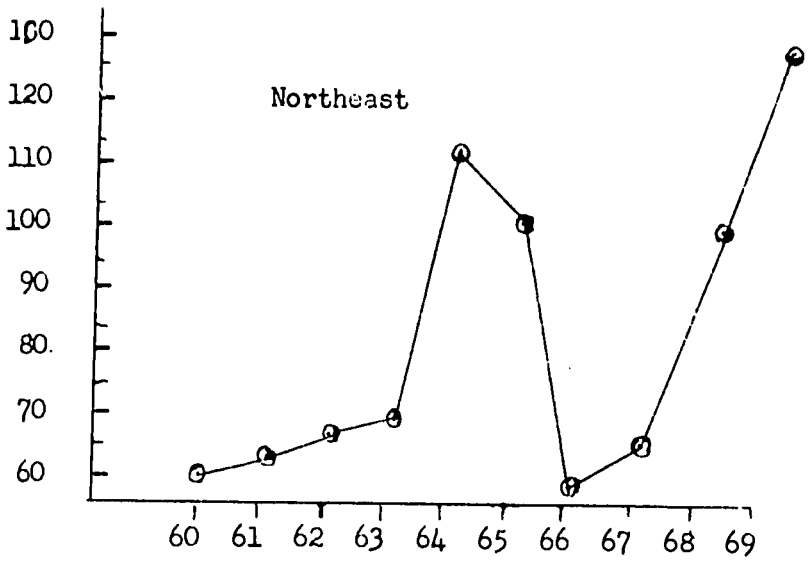
Current Trend 5.4%

Method for Forecasting Future Value Added

These items are unlikely to be of any greater significance through the Third Plan period than they have been previously. Growth rate has been assumed to continue at the historic rate of 4.9%.

OTHER FORESTRY PRODUCTS	36

60	61	62	63	64	65	66	67	68	69	Year
58	63	68	69	112	95	57	66	95	124	Northeast Production Value Added M. Baht
237	273	245	247	319	271	231	244	330	372	Whole Kingdom Production Value Added
24.5	23.1	27.8	27.9	35.1	35.1	24.7	27.0	28.9	33.3	% N.E./W.K.

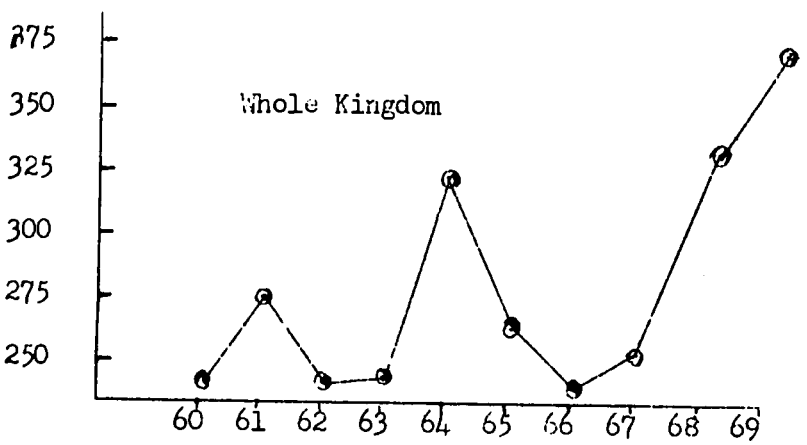


Historic Growth Rate 5.5%

Current Trend 1966-69 33.5%

Exponential $y = ab^x$

$y = 61(1.055)^x$



Historic Growth Rate 3.3%

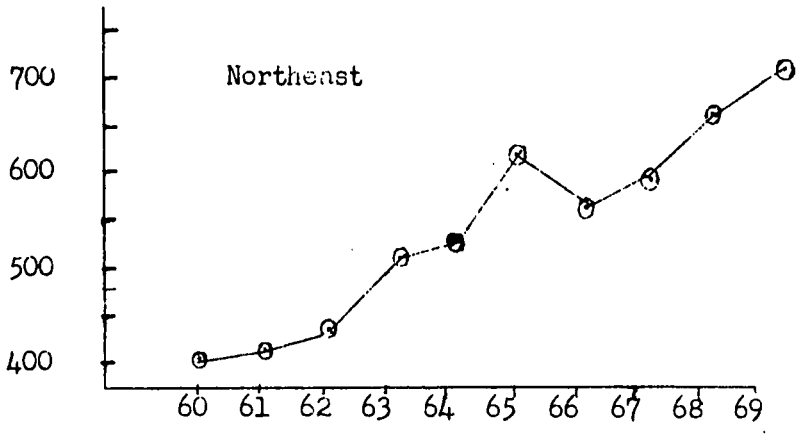
Current Trend 22%

Method for Forecasting Future Value Added

The forecast value added for Other Forestry Products, which are mostly construction materials, is assumed to be dependent directly on the historic growth rate in the Northeast.

CONSTRUCTION (PRIVATE)	40

60	61	62	63	64	65	66	67	68	69	Year
390	399	434	511	544	651	623	648	705	729	Northeast Production Value Added M. Baht
2091	2191	2418	2456	2769	2933	3278	3573	3975	4572	Whole Kingdom Production Value Added
18.7	18.2	17.9	20.8	19.6	22.2	19.0	18.1	17.7	15.9	% N.E./W.K.

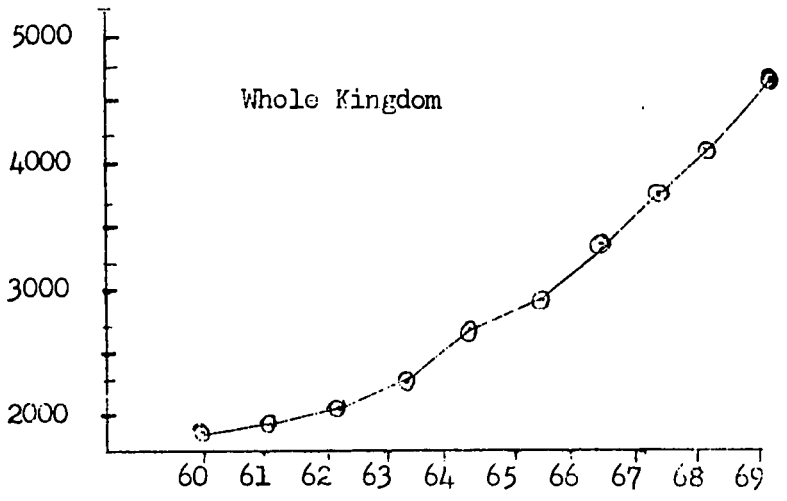


Historic Growth Rate 7.8%

Current Trend 1966-69 6.1%

Exponential $y = ab^x$

$y = 392(1.078)^x$



Historic Growth Rate 8.8%

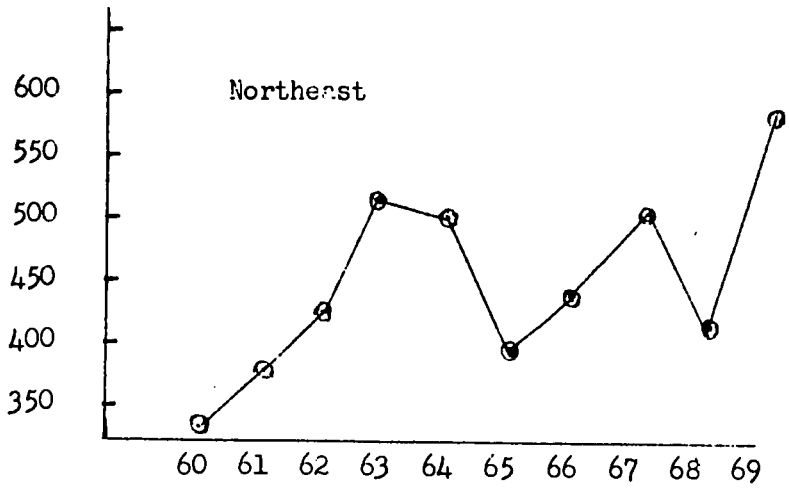
Current Trend 12%

Method for Forecasting Future Value Added

For a short period in the early 1960's, private construction grew more quickly than the gross regional product, but later it grew less quickly. An average construction value added has been 4.1% of G.R.P., with variations between 3.83% and 4.3%, except for one year, 1965. It is clear that private construction value added is closely related to G.R.P., and it is assumed that they will grow at the same rate during the plan period.

RICE MILLS	44

60	61	62	63	64	65	66	67	68	69	Year
345	378	423	519	510	417	441	520	424	582	Northeast Production Value Added M. Baht
1313	1469	1581	1771	1837	1751	1824	1954	1772	1956	Whole Kingdom Production Value Added
26.3	25.7	27.9	29.3	27.8	23.8	24.2	26.6	23.9	29.8	% N.E./W.K.

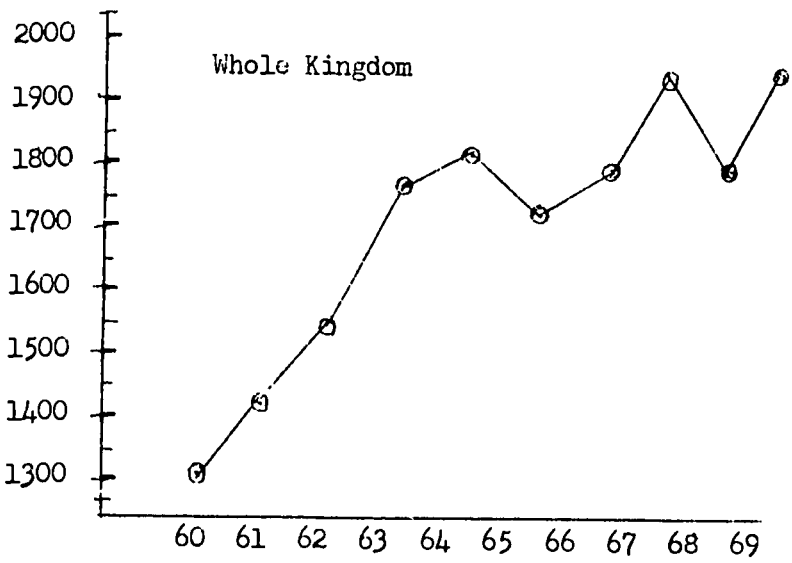


Historic Growth Rate 3.7%

Current Trend 1966-69 2.3%

Exponential $y = ab^x$

$y = 382(1.037)^x$



Historic Growth Rate 3.9%

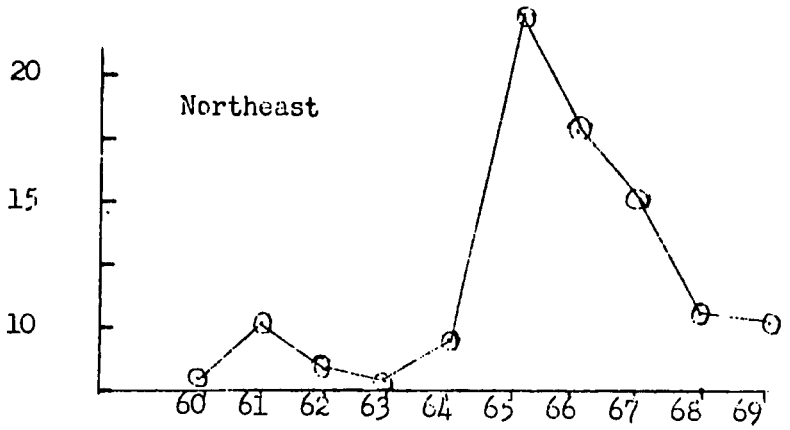
Current Trend 2.1%

Method for Forecasting Future Value Added

Rice mill production (value added) forecast for the Third Plan period, will be 16% of rice production. During the 1960's, the ratio was 15.4%, compared with about 18% for the country as a whole. It is anticipated that through improvement of facilities, the ratio for the Northeast will increase and the value of 16% has been assumed.

SUGAR MILLS	45

60	61	62	63	64	65	66	67	68	69	Year
8	11	10	8	11	22	18	16	13	13	Northeast Production Value Added M. Baht
118	127	128	106	142	270	227	196	160	269	Whole Kingdom Production Value Added
6.7	8.7	7.8	7.5	7.7	8.1	7.9	8.2	8.1	4.8	% N.E./W.K.

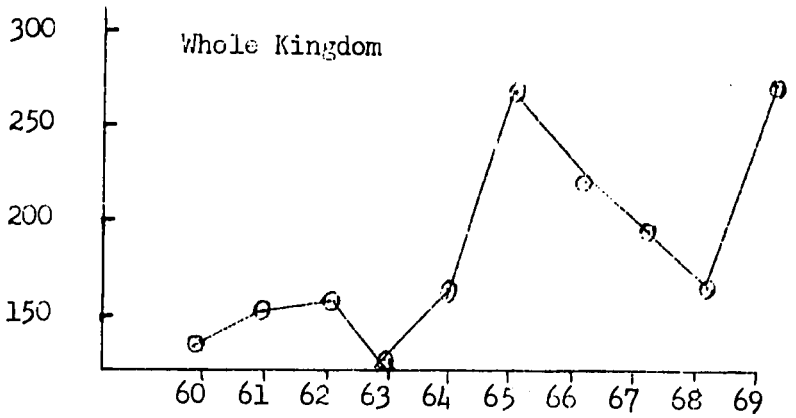


Historic Growth Rate 6.9%

Current Trend 1966-69 -12.0%

Exponential $y = ab^x$

$y = 9.1(1.069)^x$



Historic Growth Rate 7.7%

Current Trend 0%

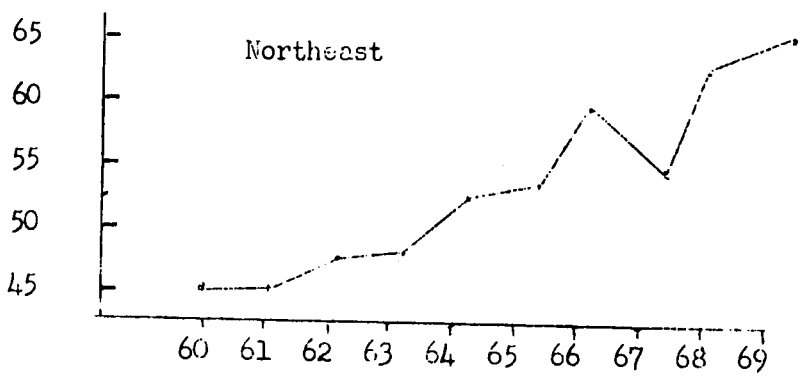
Method for Forecasting Future Value Added

Sugar mill value added is assumed to be dependent on sugar production in the Northeast, but increased local milling of sugar, as proposed for the Third Plan, is expected to increase its value added relative to sugarcane production. The increase suggested is modest and should result in a one percent increase per year, as follows:

	1972	1973	1974	1975	1976
Sugarcane (M. Baht)	62	64	66	68	69
Ratio of Sugar Milling to above	37%	38%	39%	40%	41%
Sugar Milling (M.Baht)	23	24	26	27	28

OTHER FOOD	46

60	61	62	63	64	65	66	67	68	69	Year
44	44	46	47	51	52	58	54	62	64	Northeast Production Value Added M. Baht
878	924	859	969	1028	1087	1178	1256	1309	1418	Whole Kingdom Production Value Added
5.0	4.8	5.4	4.9	5.0	4.8	4.9	4.3	4.7	4.5	% N.E./W.K.

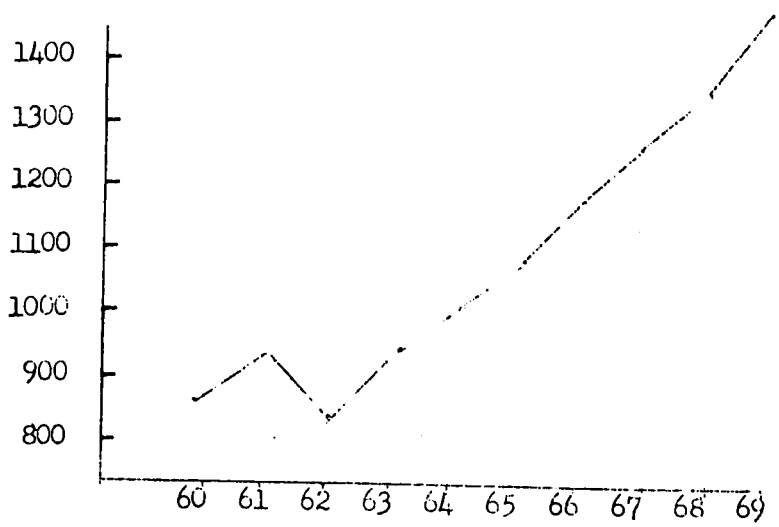


Historic Growth Rate 4.6%

Current Trend 6.0%

Exponential $y = ab^x$

$y = 43(1.046)$



Historic Growth Rate 5.9%

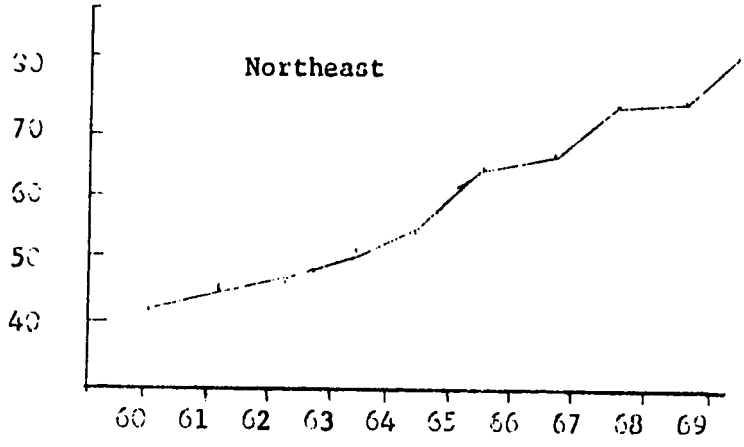
Current Trend 5.8%

Method for Forecasting Future Value Added

Other food manufacturers are considered to be a function of population size and per capita income. It was decided to use an elasticity of 1.5 with the population growth rate of 2.9% giving a growth rate for other food manufactures of 4.4%.

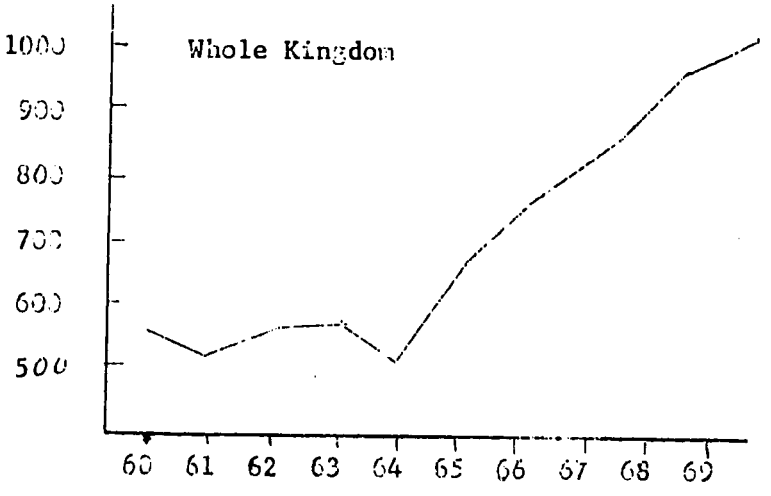
WEARING APPAREL	51

60	61	62	63	64	65	66	67	68	69	Year
43	46	46	49	52	65	68	75	78	84	Northeast Production Value Added M. Baht
551	540	565	568	533	652	787	866	957	1045	Whole Kingdom Production Value Added
7.8	8.5	8.1	8.6	9.8	10.0	8.6	8.7	8.2	8.0	% N.E./WK



Historic Growth Rate 9.0%

Current Trend 1966-69 5.7%
Exponential $y = ab^x$
$y = 39.3(1.090)^x$



Historic Growth Rate 8.2%

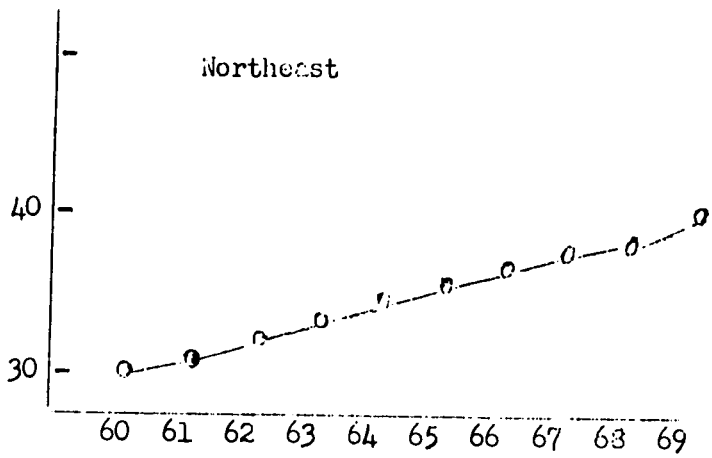
Current Trend 10.1%

Method for Forecasting Future Value Added

Wearing apparel production has been resumed to depend on the gross regional product, and so it grows at 6.8% per annum.

MATS	55

60	61	62	63	64	65	66	67	68	69	Year
30	31	33	34	35	36	37	38	40	41	Northeast Production Value Added M. Baht
75	77	83	85	88	90	93	95	100	103	Whole Kingdom Production Value Added
40	40	40	40	40	40	40	40	40	40	% N.E./W.K.

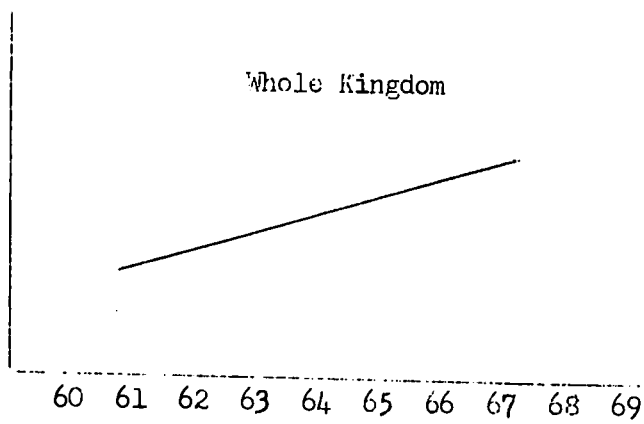


Historic Growth Rate 3.4%

Current Trend 1966-69 3.8%

Exponential $y = ab^x$

$y = 30.3(1.034)^x$



Historic Growth Rate -

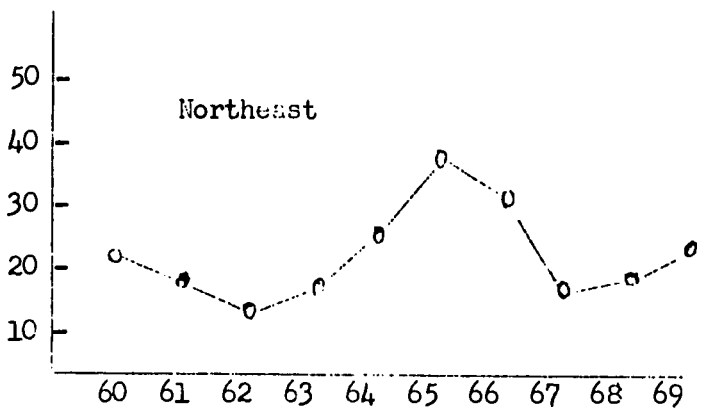
Current Trend -

Method for Forecasting Future Value Added

Mat making is a cottage industry in the Northeast. There is little opportunity to expand it as the market is limited. The growth rate for the plan period is assumed to be the same as the historic.

OTHER TEXTILES	-

60	61	62	63	64	65	66	67	68	69	Year
20	16	11	13	25	39	35	18	19	24	Northeast Production Value Added M. Baht
73	79	66	76	102	147	187	224	232	290	Whole Kingdom Production Value Added
27.4	20.2	16.7	17.1	24.5	26.5	18.7	8.0	8.2	8.3	% N.E./W.K.

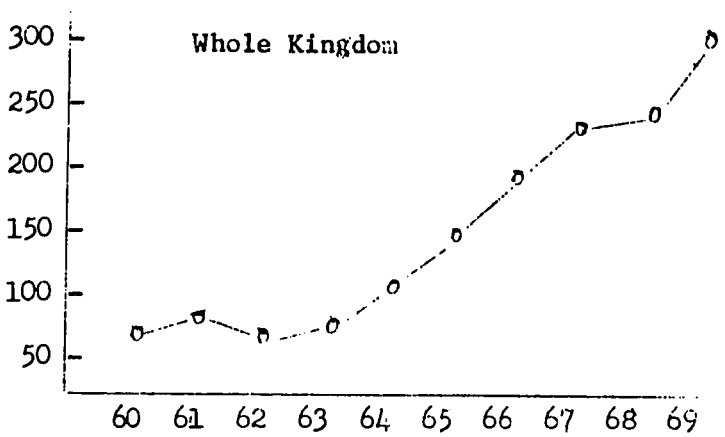


Historic Growth Rate 5.4%

Current Trend -

Exponential $y = ab^x$

$y = 16.1\ (1.054)^x$



Historic Growth Rate 19.2%

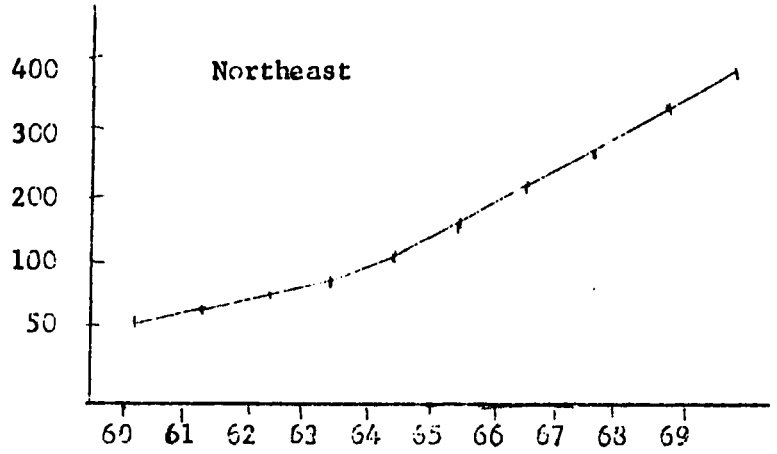
Current Trend 12.7%

Method for Forecasting Future Value Added

Other textiles are assumed to follow the trend of the aggregate of all textile production through the plan period, that is a growth rate of 10%.

WOOD & CORK	57

60	61	62	63	64	65	66	67	68	69	Year
48	60	76	96	120	152	192	243	307	389	Northeast Production Value Added M. Baht
295	284	316	411	460	552	529	604	685	707	Whole Kingdom Production Value Added
16.3	21.1	24.0	23.4	26.1	27.5	36.3	40.2	44.8	55.0	% N.E./WK

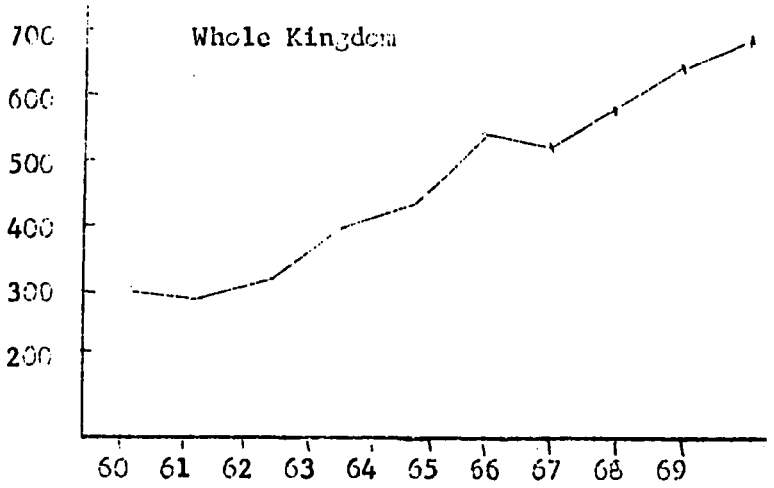


Historic Growth Rate 26.2%

Current Trend 1966-69 26.5%

Exponential $y = ab^x$

$y = 47.7(1.262)^x$



Historic Growth Rate 12.1%

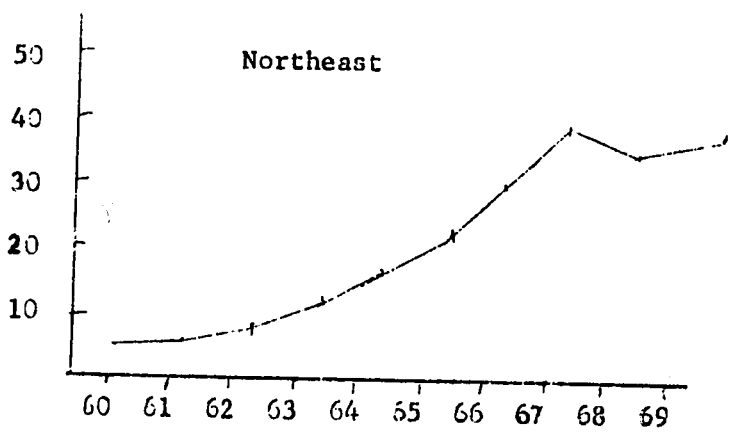
Current Trend 10.8%

Method for Forecasting Future Value Added

Wood manufacturing is related to construction generally. Historically, there was an elasticity of 1.33 between them and this is assumed to continue into the Third Plan period, resulting in an 8% growth rate.

FURNITURE	53

60	61	62	63	64	65	66	67	68	69	Year
6	7	9	12	15	19	25	37	32	34	Northeast Production Value Added M. Baht
87	97	105	118	142	175	202	332	417	516	Whole Kingdom Production Value Added
6.9	7.2	8.6	10.2	10.6	10.9	8.9	11.1	7.7	6.6	% N.E./WK

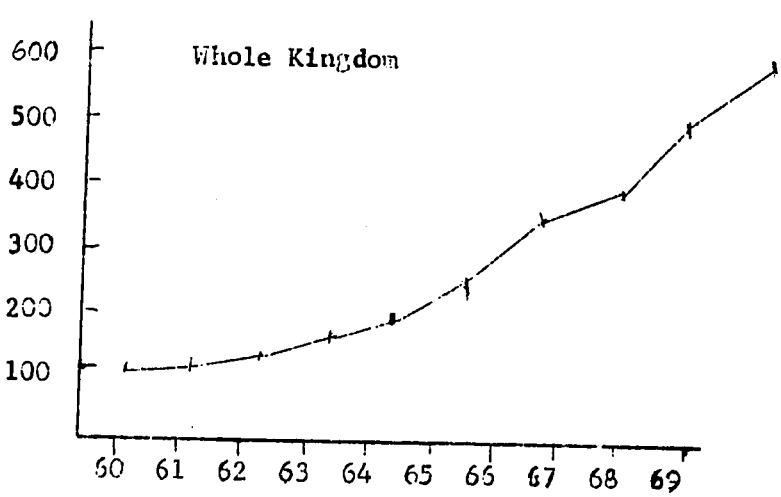


Historic Growth Rate 24.2%

Current Trend 1966-69 3.2%

Exponential $y = ab^x$

$y = 6.1(1.242)$



Historic Growth Rate 23.5%

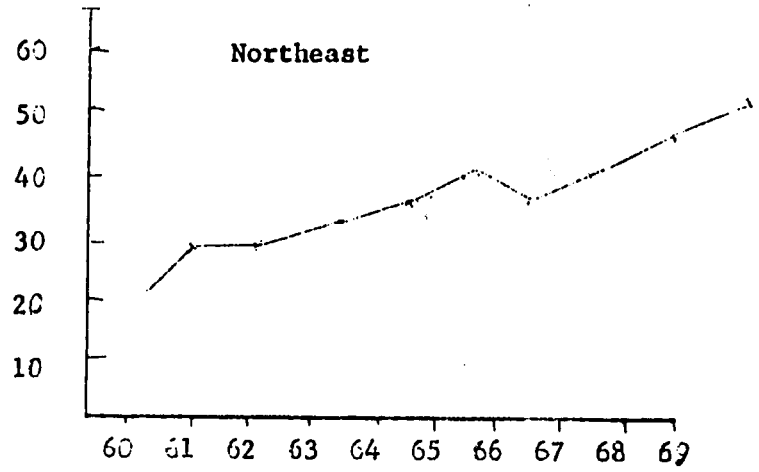
Current Trend 23.3%

Method for Forecasting Future Value Added

Furniture manufacturing is related to private construction. Because it started from such a low base in 1960, it had a very much higher historic growth rate than private construction, 24.2%, compared with 7.8%, an elasticity of 3. Between 1966 and 1969, however, the growth rates dropped to 10.8% and 5.4%, an elasticity of 2. It seems probable that this elasticity will become lower and a value of 1.5 has been used, giving a growth rate for furniture manufacturing of 10%.

OTHERS (MACHINE SHOPS ETC.)	59-63

60	61	62	63	64	66	66	67	68	69	Year
23	29	30	33	36	39	38	42	49	54	Northeast Production Value Added M. Baht
1660	1838	2136	2374	2860	3877	4474	5053	6067	6909	Whole Kingdom Production Value Added
1.4	1.5	1.4	1.4	1.2	1.0	0.8	0.8	0.8	0.8	% N.E./WK

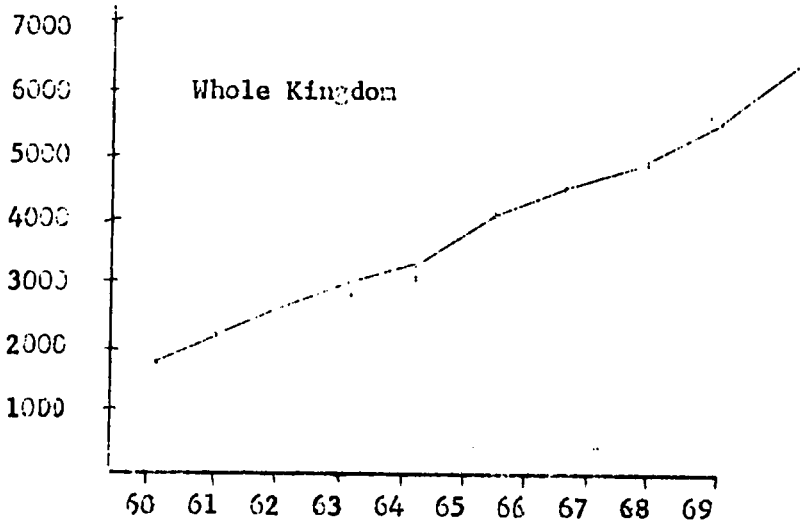


Historic Growth Rate 8.6%

Current Trend 1966-69 13.5%

Exponential $y = ab^x$

$y = 25.1(1.086)$



Historic Growth Rate 17.9%

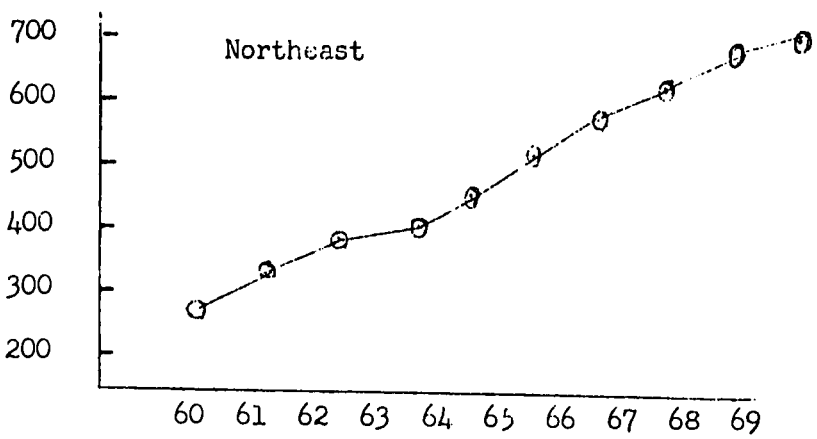
Current Trend 16.7%

Method for Forecasting Future Value Added:

This aggregate of small manufacturing establishments depends for its growth on the general level of activity in the non-agricultural sectors. The historic growth rate of 8.6% was lower than that of the non-agricultural sectors (10.4%), but in the last four years, the growth rate has surpassed it, 13.5%, compared with 9.6%. This trend seems likely to continue and a growth rate of 15% is forecast. That is an elasticity of 1.7 with the non-agricultural sectors as a whole.

TRANSPORT (PRIVATE)	67

60	61	62	63	64	65	66	67	68	69	Year
248	303	347	354	380	459	514	579	646	703	Northeast Production Value Added M. Baht
3552	3549	3891	4004	4537	4698	4918	5259	5519	6270	Value Added Whole Kingdom Production
7.0	8.5	8.9	8.8	8.4	9.8	10.4	11.0	11.7	11.2	% N.E./W.K.

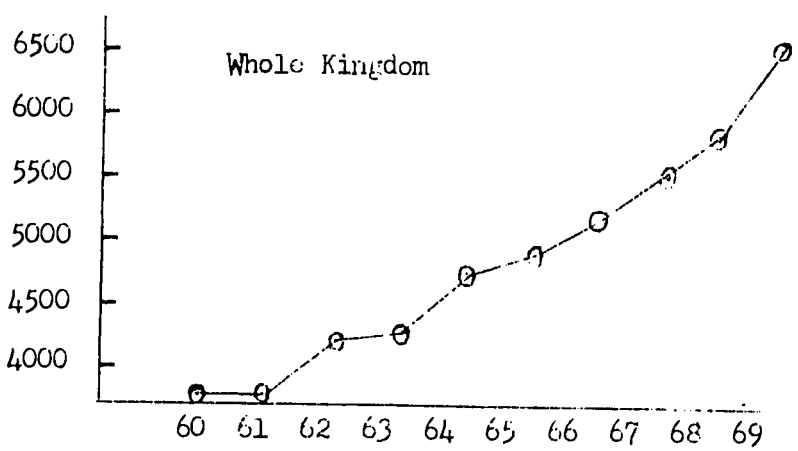


Historic Growth Rate 11.9%

Current Trend 1966-69 11.0%

Exponential $y = ab^x$

$y = 259(1.119)^x$



Historic Growth Rate 6.5%

Current Trend 7.5%

Method for Forecasting Future Value Added

The method of forecasting value added from transportation both private and public, has been reappraised. The new values vary a little from those given in the main table at the start of this appendix. The transport sector has increased its growth rate compared with that of the non-agricultural sectors as a whole:

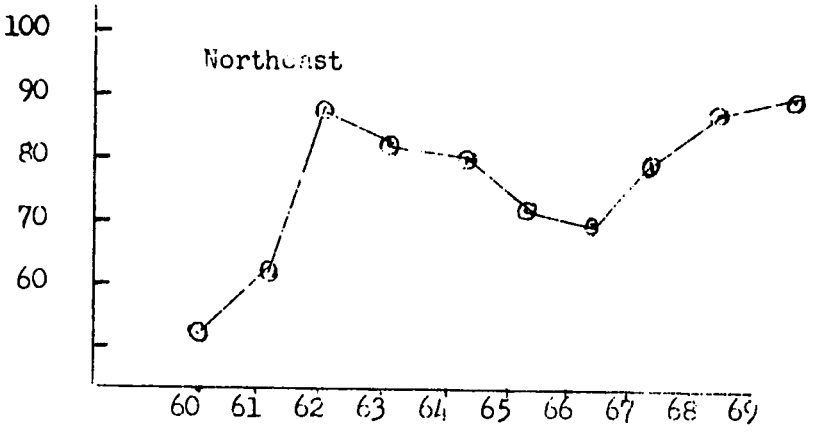
	Historic	
	1960-69	1966-69
All Transport	10.3	10.9
Non-Agricultural Sectors	10.4	9.5

Because the road program will continue to open up new areas it is assumed that the high growth rate continues. Private transport will continue to expand at the expense of public transport, particularly the railway. Private transport has been calculated as all transport minus public transport, giving the following forecast:

	1972	1973	1974	1975	1976
Private Transportation	961	1077	1205	1335	1477
Public Transportation	116	110	105	110	116
All Transport	1077	1187	1310	1445	1593

TRANSPORT (PUBLIC)	68 + 69

60	61	62	63	64	65	66	67	68	69	Year
57	65	88	84	82	73	72	85	94	95	Northeast Production Value Added M. Baht
529	539	564	571	585	641	781	883	915	903	Whole Kingdom Production Value Added
10.8	12.1	15.6	14.7	14.0	11.4	9.2	9.6	10.3	10.5	% N.E./W.K.

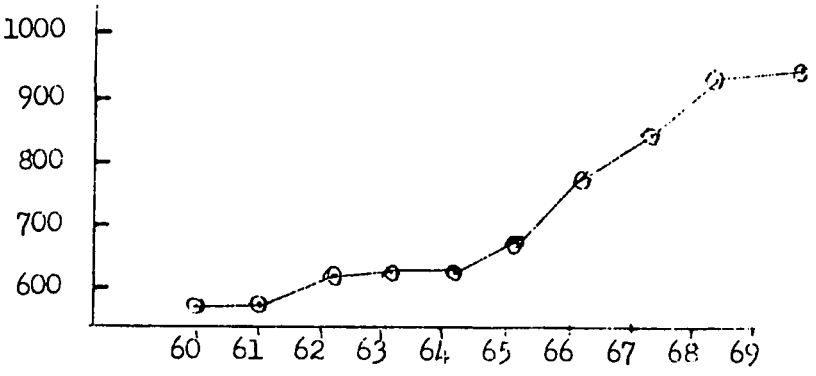


Historic Growth Rate 4.0%

Current Trend 1966-69 9.7%

Exponential $y = ab^x$

$y = 65.9(1.040)^x$



Historic Growth Rate 7.5%

Current Trend

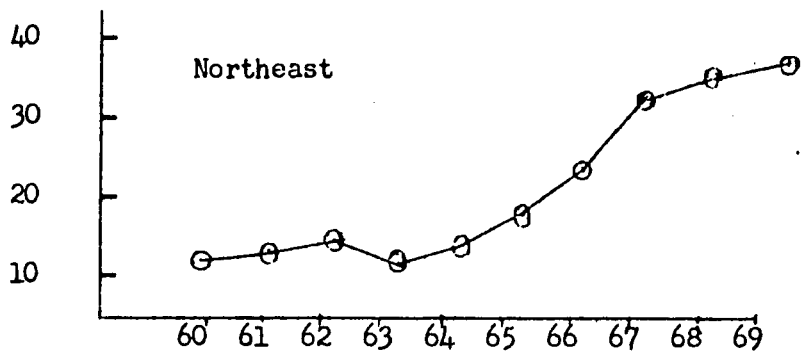
Method for Forecasting Future Value Added

The growth rate of public transport has been very uncertain because private transport, as it has expanded, took trade from the railways. The situation is relatively stable at present, and a growth rate of 5% has been assumed. However, the completion of the road link between Bangkok and Ubol will be complete in 1972 or 1973 and this will compete directly with the railway. In consequence, a negative growth rate has been assumed for two years, while adjustment occurs. After this, a 5% growth rate is again assumed. This results in the following forecast for value added in constant 1962 prices.

	1971	1972	1973	1974	1975	1976
Public Transport	110	116	110	105	110	116

COMMUNICATION	70

60	61	62	63	64	65	66	67	68	69	Year
11	12	13	12	15	22	30	38	39	41	Northeast Production Value Added M. Baht
143	161	178	190	232	270	315	382	430	464	Whole Kingdom Production Value Added
7.7	7.5	7.3	6.3	6.5	8.1	9.5	9.9	9.1	8.8	% N.E./W.K.

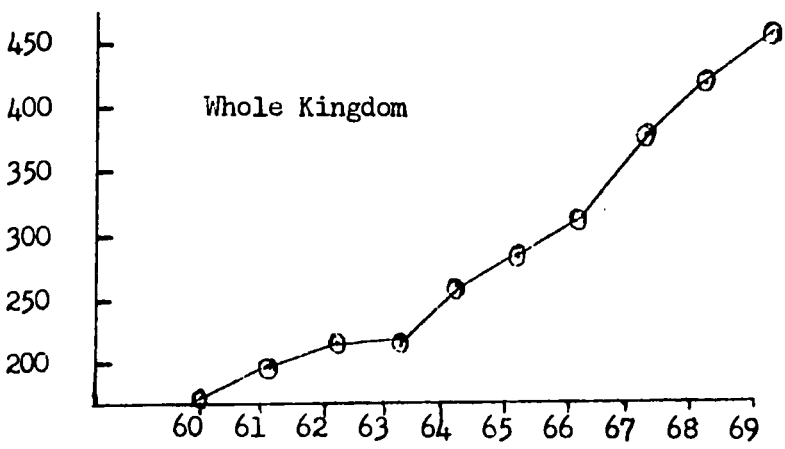


Historic Growth Rate 18.7%

Current Trend 1966-69 8.5%

Exponential $y = ab^x$

$y = 9.4(1.187)^x$



Historic Growth Rate 14.9%

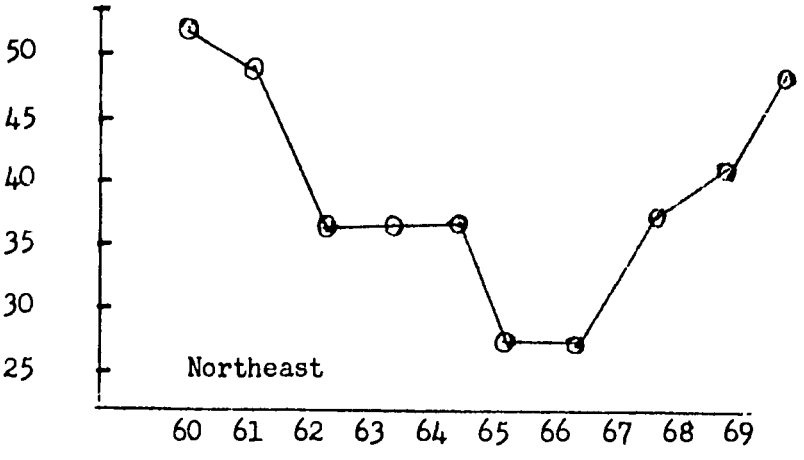
Current Trend 13%

Method for Forecasting Future Value Added

An elasticity of 1.3 was determined between the recent growt of communications and that of the combined trade and service sec tors. This was assumed to continue during the Third Plan period giving a growth rate of 10.4% compared with the trade and servic growth rate of 8%.

TRADE OF IMPORT INTER. GOODS	71

60	61	62	63	64	65	66	67	68	69	Year
49	47	37	37	37	27	27	36	39	44	Northeast Production Value Added M. Baht
-	-	-	-	-	-	-	-	-	-	Whole Kingdom Production Value Added
-	-	-	-	-	-	-	-	-	-	% N.E./W.K.

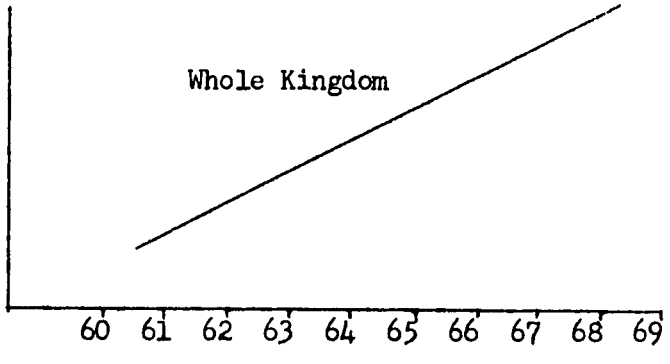


Historic Growth Rate: -2.2%

Current Trend 1966-69: 5.0%

Exponential $y = ab^x$

$y = 41.3(0.978)^x$



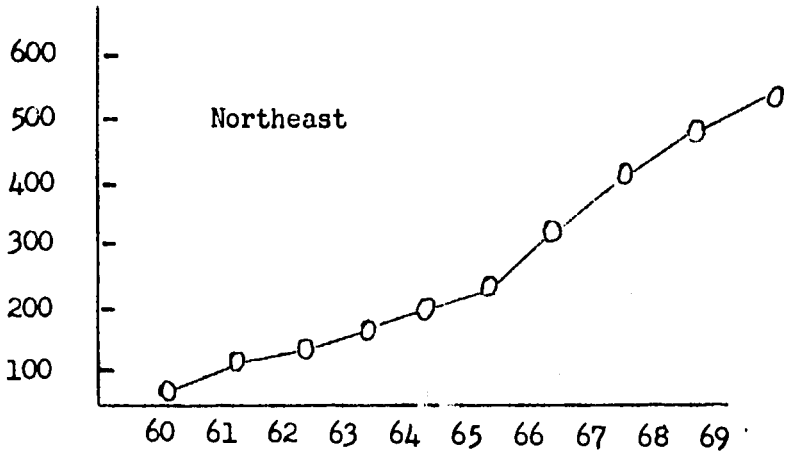
Historic Growth Rate: -

Current Trend: -

Method for Forecasting Future Value Added

With the changed emphasis to increase manufacturing in the Northeast, it is assumed that this category will grow at the same rate as the manufacturing sector, that is 11%.

60	61	62	63	64	65	66	67	68	69	Year
97	119	148	174	209	230	338	428	454	543	Northeast Production Value Added M. Baht
-	-	-	-	-	-	-	-	-	-	Whole Kingdom Production Value-Added
-	-	-	-	-	-	-	-	-	-	% N.E./W.K.

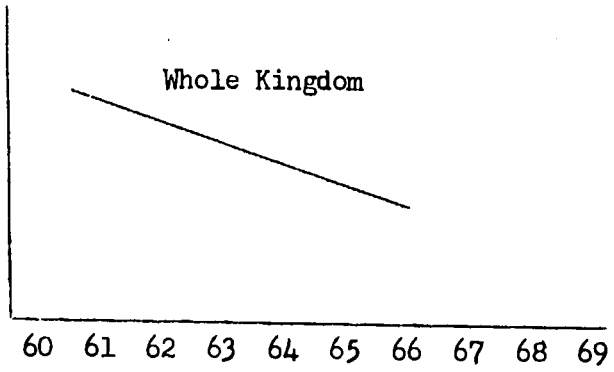


Historic Growth Rate 21.6%

Current Trend 1966-69 14.0%

Exponential $y = ab^x$

$y = 97.4(1.216)^x$



Historic Growth Rate -

Current Trend -

Method for Forecasting Future Value Added:

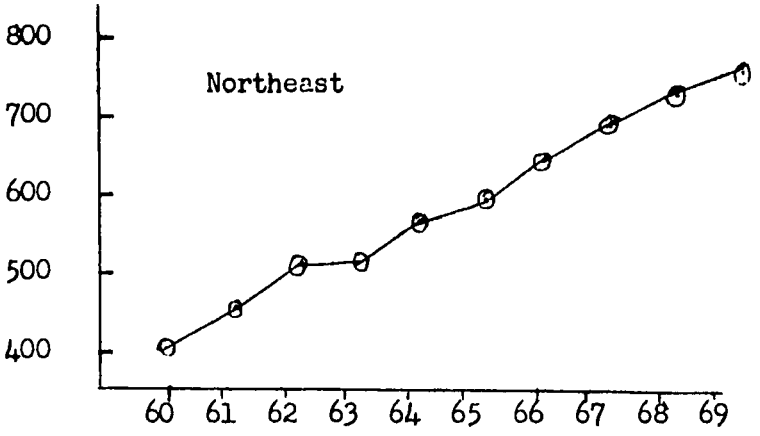
A relationship between the growth of trade in capital import goods and that of construction and manufactures was established as follows:

Growth rate of trade in capital import goods = Growth rate of construction and 1/2 growth rate of manufacturers.

Using this to forecast growth in the Third Plan period would give a growth rate of 11.5%. Because of the current balance of payment problems, this value is probably too high. Therefore, the growth rate was reduced by a factor of 0.8 to give a growth rate of 9%.

TRADE OF IMPORT CONSUMER GOODS	73

60	61	62	63	64	65	66	67	68	69	Year
384	439	484	479	526	548	591	666	703	753	Northeast Production Value Added M. Baht
-	-	-	-	-	-	-	-	-	-	Whole Kingdom Production Value Added
-	-	-	-	-	-	-	-	-	-	% N.E./W.K.



Historic Growth Rate 7.3%

Current Trend 1966-69 7.6%

Exponential $y = ab^x$

$y = 398(1.073)^x$

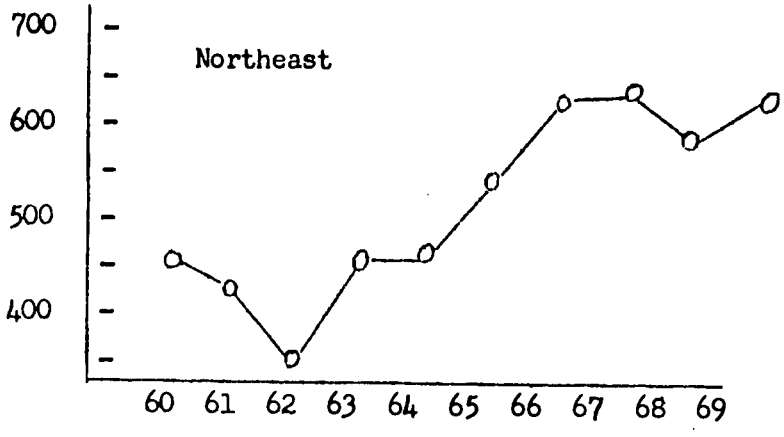
Historic Grwoth Rate -

Current Trend -

Method of Forecasting Future Value Added

Trade of import consumer goods is related to available per capita income. An elasticity of 1.6 is assumed based on previous history. With a per capita income growth of 3.9% per year, this gives a 6.2% increase in trade of import consumer goods.

60	61	62	63	64	65	66	67	68	69	Year
464	445	373	475	484	555	635	644	586	626	Northeast Production Value Added M. Baht
2099	2269	2362	2576	2772	2858	3135	3251	3489	4102	Whole Kingdom Production Value-Added
22.1	19.6	15.8	18.4	17.5	19.4	20.3	19.8	16.8	15.3	% N.E./W.K.

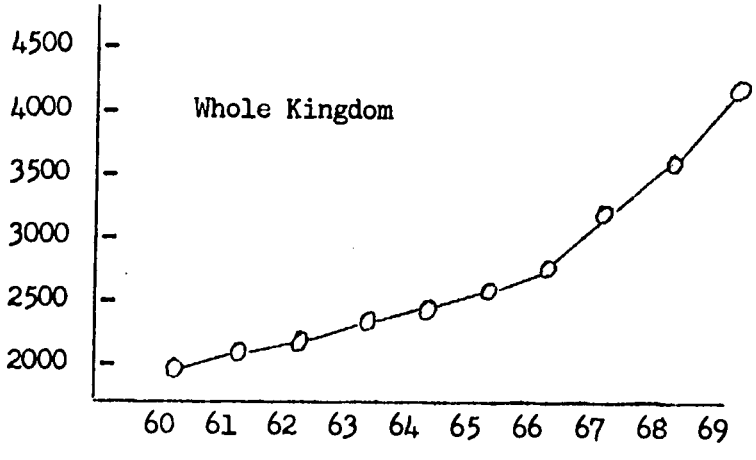


Historic Growth Rate 5.2%

Current Trend 1966-69 -2.7%

Exponential $y = ab^x$

$y = 415(1.052)^x$



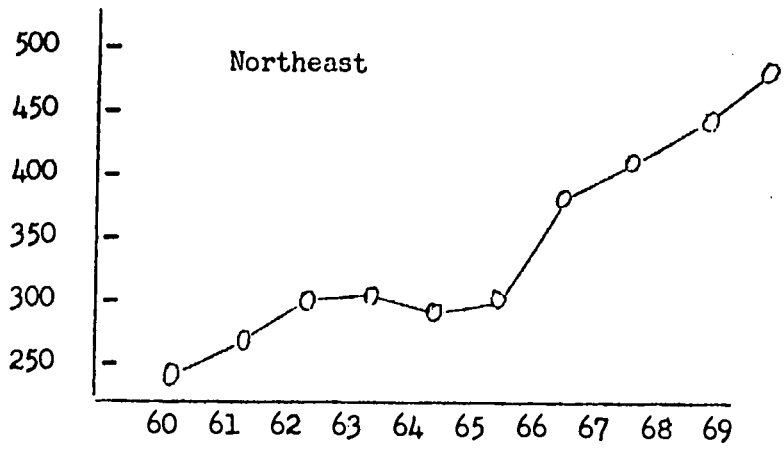
Historic Growth Rate 7.1%

Current Trend -

Method of Forecasting Future Value Added:

Trade of domestic agriculture is directly related to agricultural production, but both have been very varied over the last 10 years. The trade value added increases approximately at twice the rate of production value added and this has been used in forecasting for the Third Plan period. Production is forecast to have a 4.1% growth rate, giving trade of domestic agriculture on 8.2% growth rate.

60	61	62	63	64	65	66	67	68	69	Year
213	241	278	292	279	290	385	427	447	475	Northeast Production Value Added M. Baht
3891	4136	4187	4687	5334	6005	6336	6887	7271	7781	Whole Kingdom Production Value Added
5.5	5.8	6.6	6.2	5.2	4.8	6.1	6.2	6.1	6.1	% N.E./W.K.

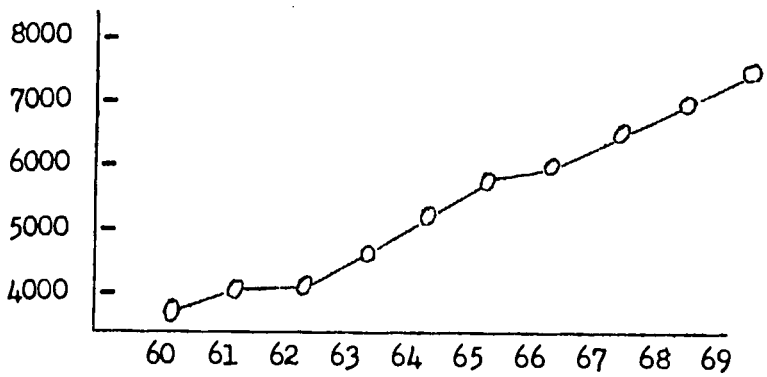


Historic Growth Rate 9.2%

Current Trend 1966-69 6.5%

Exponential $y = ab^x$

$y = 216(1.092)^x$



Historic Growth Rate 8.7%

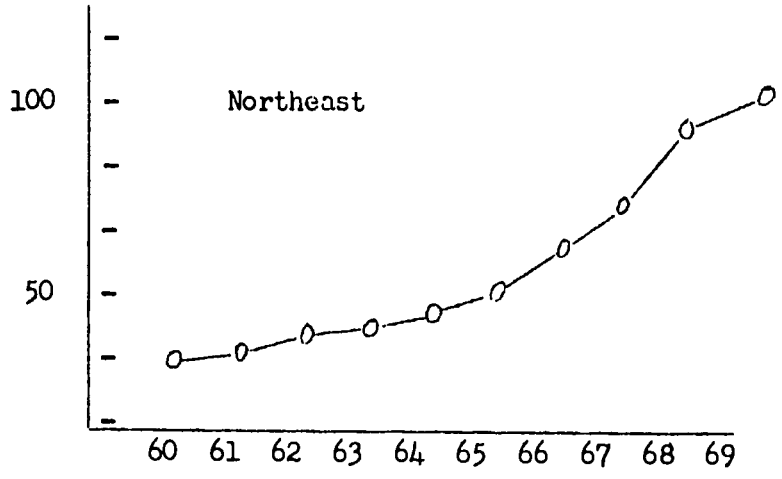
Current Trend 6.7%

Method of Forecasting Future Value Added:

The trade of mining and manufactures has grown at the same rate as the production from mining and manufactures. This is assumed to continue giving a growth rate of 10.5%.

BANKING	77

60	61	62	63	64	65	66	67	68	69	Year
22	27	33	37	42	52	64	80	94	105	Northeast Production Value Added M. Baht
946	1008	1246	1369	1561	1776	2179	2568	2965	3406	Whole Kingdom Production Value Added
2.3	2.7	2.6	2.7	2.7	2.9	2.9	3.1	3.2	3.1	% N.E./W.K.

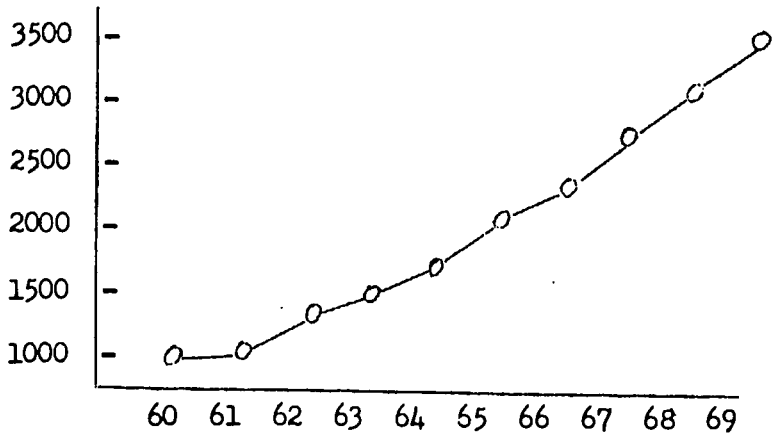


Historic Growth Rate 19.2%

Current Trend 1966-69 16.8%

Exponential $y = ab^x$

$y = 22.2(1.192)^x$



Historic Growth Rate 15.8%

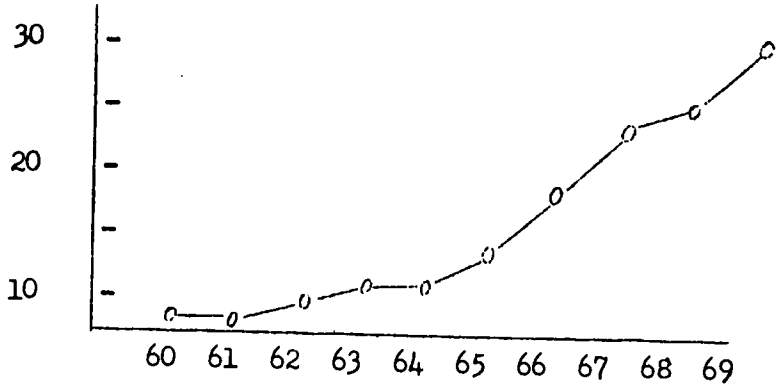
Current Trend 16%

Method of Forecasting Future Value Added:

Starting from very low level in 1960, Banking has increased at a rate of twice the average for trade and services. It seems likely that this rate will slow and become closer to that of the whole kingdom which is 1.5 times the average for trade and services. This elasticity has been assumed giving a growth rate for banking of 12.0% per annum.

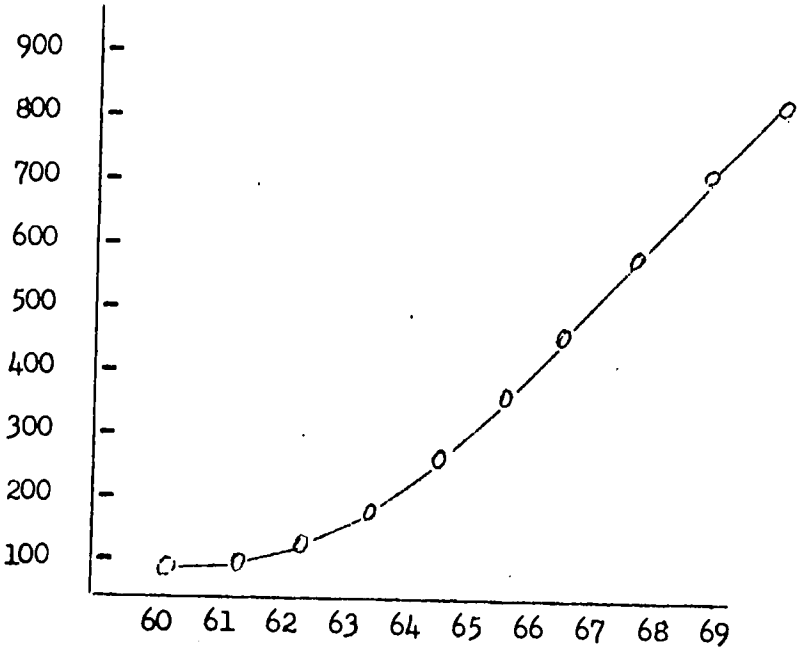
INSURANCE & REAL ESTATE	78

60	61	62	63	64	65	66	67	68	69	Year
9	9	10	11	11	13	19	26	28	34	Northeast Production Value Added M. Baht
142	164	234	247	308	374	476	559	684	839	Whole Kingdom Production Value Added
6.3%	5.5%	4.3%	4.5%	3.6%	3.5%	4.0%	4.7%	4.1%	4.1%	% N.E./W.K.



Historic Growth Rate 17.4%

Current Trend 17.4%



Historic Growth Rate 21.2%

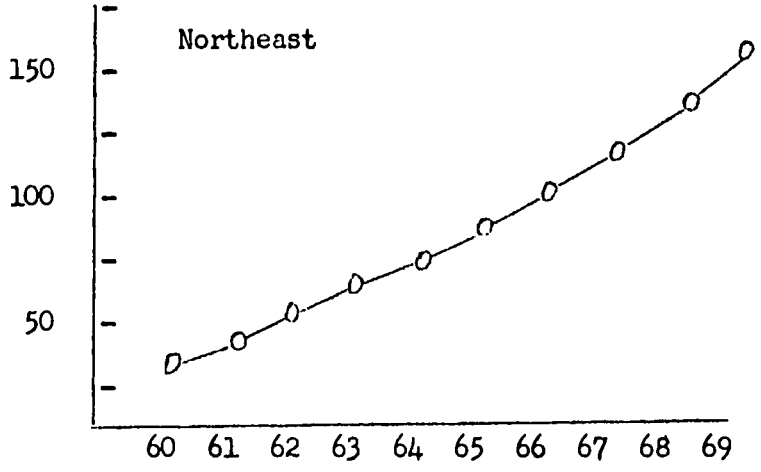
Current Trend 21.2%

Method for Forecasting Future Value Added:

Insurance and real estate is still of only minor importance in the Northeast. It is assumed to be related to the trade and services sectors and because of its low level, it will have a high elasticity. Historically, the growth rate has been twice that of the average between trade and services and this condition is assumed to continue giving a forecast growth rate of 16%.

RECREATION & ENTERTAINMENT	81

60	61	62	63	64	65	66	67	68	69	Year
40	47	57	65	72	80	93	111	133	157	Northeast Production Value Added M. Baht
485	495	494	511	578	716	786	860	945	1028	Whole Kingdom Production Value Added
8.2	9.5	11.5	12.7	12.5	11.1	11.8	12.9	14.1	15.3	% N.E./W.K

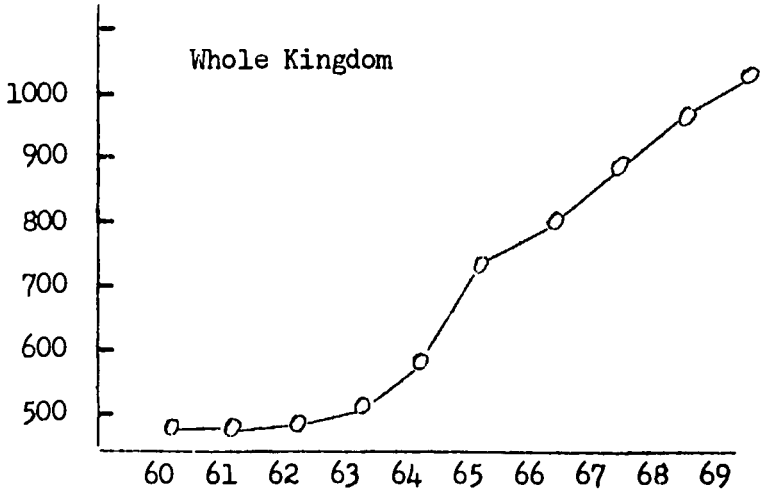


Historic Growth Rate 15.7%

Current Trend 1966-69 19.2%

Exponential $y = ab^x$

$y = 40.6\ (1.157)^x$



Historic Growth Rate 9.8%

Current Trend 9.5%

Method for Forecasting Future Value Added:

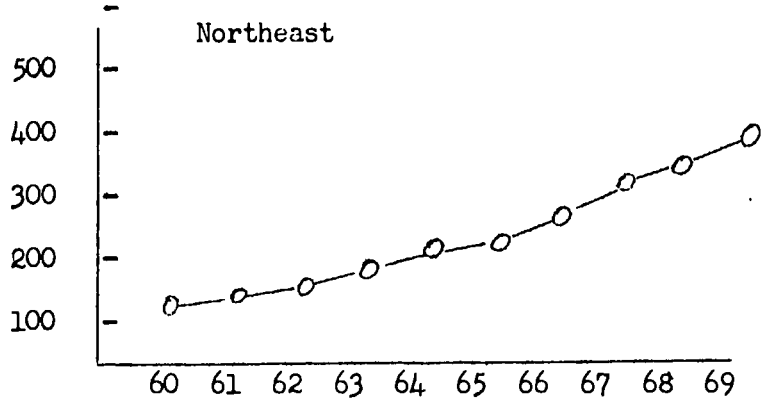
Recreation and Entertainment was considered with Hotels and Restaurants. The growth was divided into two periods, the first up to 1964 and the second, 1964-1969. During the latter period, the U.S. bases had an effect as well as the normal regional economic growth. The effect of the U.S. Bases was derived as follows:

Between 1960 and 1964, Recreation and Hotels had a growth rate of about 10% (1.4 x G.R.P. Growth) and by 1964, had a value added of 274 million baht. Assuming this growth rate continued to 1969, the value added would have been 441 million baht. Because of the introduction of the U.S. Bases, the growth rate increased to about 16% and the value added reached 565 million baht. The residual 124 million baht is assumed to be due to U.S. Base Personnel spending.

There will be a continued U.S. presence, but lacking specific figures, a continuation of spending at the 1969 rate has been assumed. The growth due to normal regional economic growth is assumed to continue to have an elasticity of 1.4 with the G.R.P. growth, resulting in a growth rate of 9.76. Combined with U.S. base personnel spending,this gives a growth rate for the Third Plan period of 8.1%.

HOTELS & RESTAURANTS	83

60	61	62	63	64	65	66	67	68	69	Year
136	147	159	180	201	223	249	289	361	408	Northeast Production Value Added M. Baht
1648	1789	1931	2104	2266	2571	2974	3402	3736	4006	Whole Kingdom Production Value Added
8.3	8.2	8.2	8.6	8.9	8.7	8.4	8.5	9.7	10.1	% N.E./W.K.

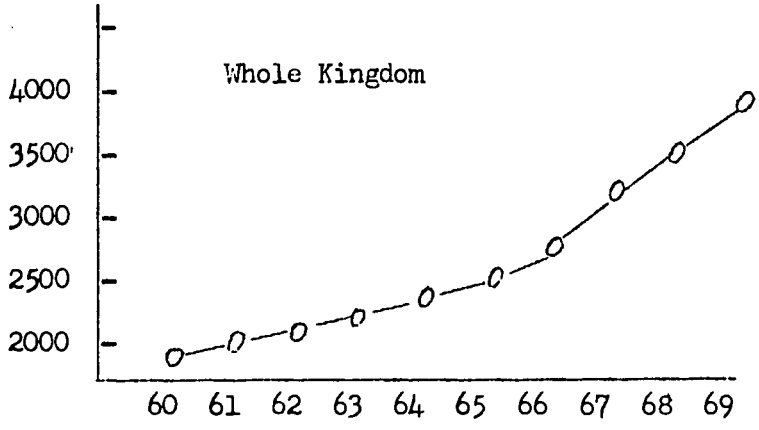


Historic Growth Rate 13.1%

Current Trend 1966-69 17.4%

Exponential $y = ab^x$

$y = 127(1.131)^x$



Historic Growth Rate 11.0%

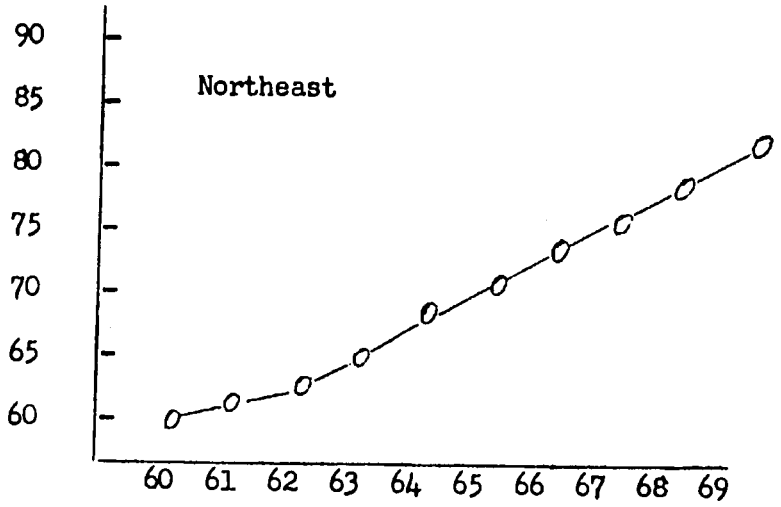
Current Trend 10.1%

Method for Forecasting Future Value Added

See Recreation and Entertainment.

DOMESTICS	82

60	61	62	63	64	65	66	67	68	69	Year
62	63	66	68	71	73	76	78	81	83	Northeast Production Value Added M. Baht
356	380	405	434	469	509	551	595	644	688	Whole Kingdom Production Value Added
17.4	16.6	16.3	15.7	15.1	14.3	13.8	13.1	12.6	12.1	% N.E./W.K.

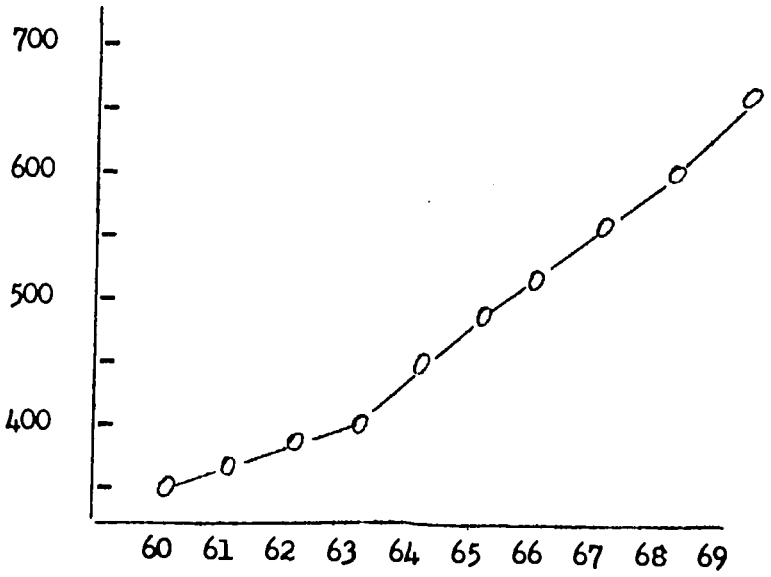


Historic Growth Rate 3.4%

Current Trend 1966-69 3.2%

Exponential $y = ab^x$

$y = 61.6(1.034)^x$



Historic Growth Rate 7.8%

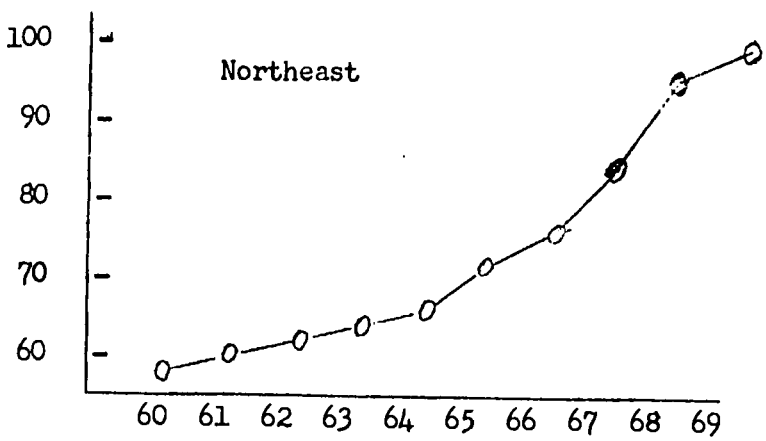
Current Trend 8.0%

Method for Forecasting Future Value Added

The value added in this category is very uncertain. It was assumed that the growth rate is, in fact, higher than statistics suggest, and a value of 6% was assumed which is closer to the national figure.

LAUNDRIES, BARBER SHOPS ETC.	84

60	61	62	63	64	65	66	67	68	69	Year
56	58	60	64	67	71	75	82	96	100	Northeast Production Value Added M. Baht
391	410	442	479	514	558	613	672	725	781	Whole Kingdom Production Value Added
14.3	14.1	13.6	13.4	13.0	12.7	12.2	12.2	13.2	12.8	% N.E./W.K.

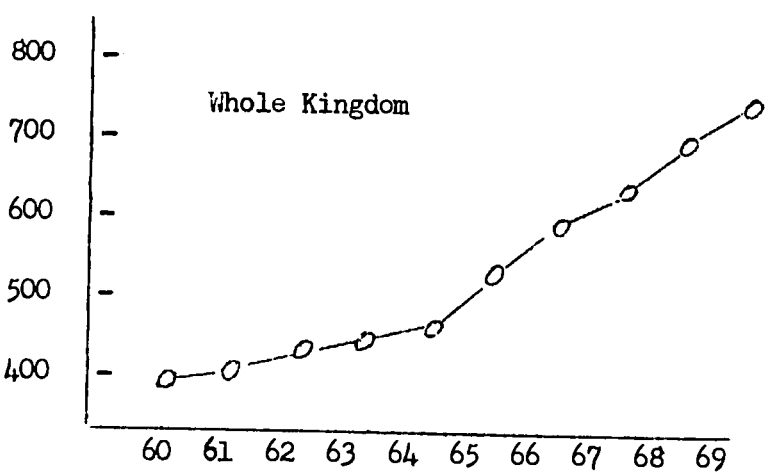


Historic Growth Rate 6.9%

Current Trend 1966-69 12%

Exponential $y = ab^x$

$y = 53.2(1.070)^x$



Historic Growth Rate 8.4%

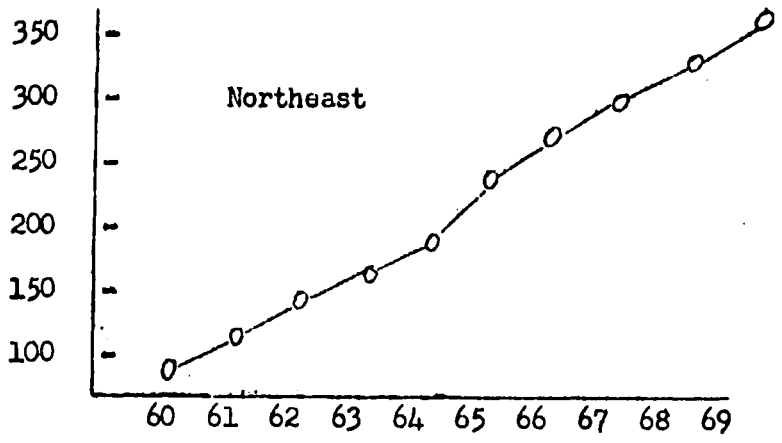
Current Trend -

Method for Forecasting Future Value Added

Although in the latter half of the 1960's these services have grown at a greater rate than the G.R.P., this is assumed to have been temporary and a return to the historical growth rate which is the same as that of the G.R.P. is forecast, that is 6.9%.

RELIGIOUS, ETC.	85

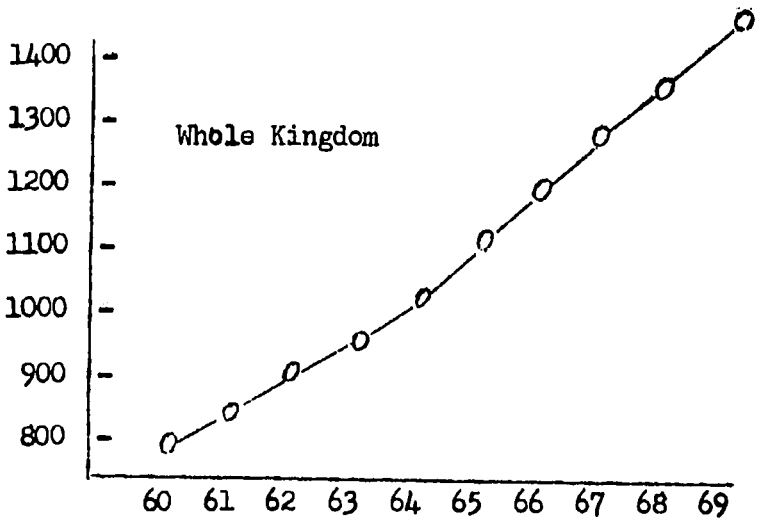
60	61	62	63	64	65	66	67	68	69	Year
111	134	162	190	217	254	282	314	335	361	Northeast Production Value Added M. Baht
785	837	873	933	1005	1090	1167	1263	1368	1447	Whole Kingdom Production Value Added
14.1	16.0	18.6	20.4	21.6	23.3	24.2	24.9	24.5	24.9	% N.E./W.K.



Historic Growth Rate 13.9

Current Trend 1966-69 8.0%

Exponential $y = ab^x$



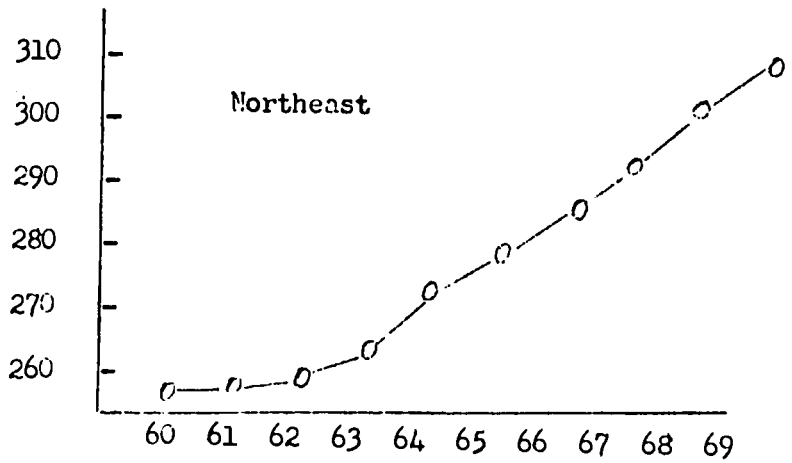
Historic Growth Rate 7.3%

Current Trend 7.5%

Method for Forecasting Future Value Added

The rate of growth of the finances of religious organizations has gradually declined over the last decade and it is assumed that it will be less than the G.R.P. growth rate for the Third Plan Period. A figure of 6.2% is assumed.

60	61	62	63	64	65	66	67	68	69	Year
250	254	257	264	272	279	287	295	304	312	Northeast Production Value Added M. Baht
1611	1655	1703	1750	1803	1859	1931	2009	2091	2187	Whole Kingdom Production Value Added
15.5	15.3	15.1	15.1	15.1	15.0	14.9	14.7	14.5	14.3	% N.E./W.K.

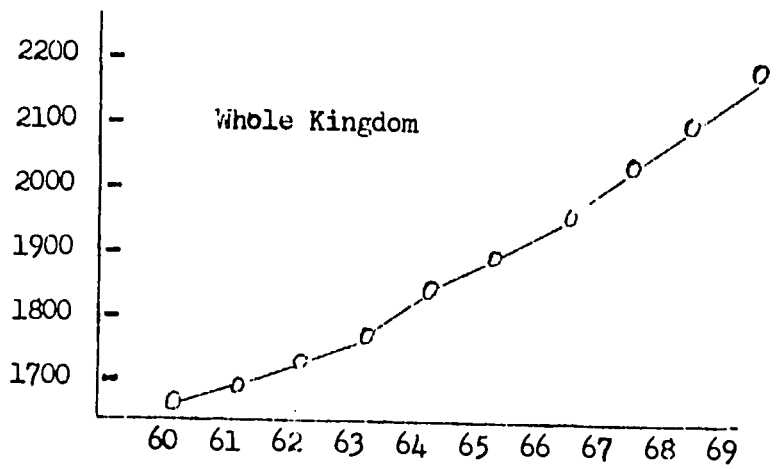


Historic Growth Rate 2.6%

Current Trend 1966-69 2.8%

Exponential $y = ab^x$

$y = 247(1.026)^x$



Historic Growth Rate 3.4%

Current Trend 4.7%

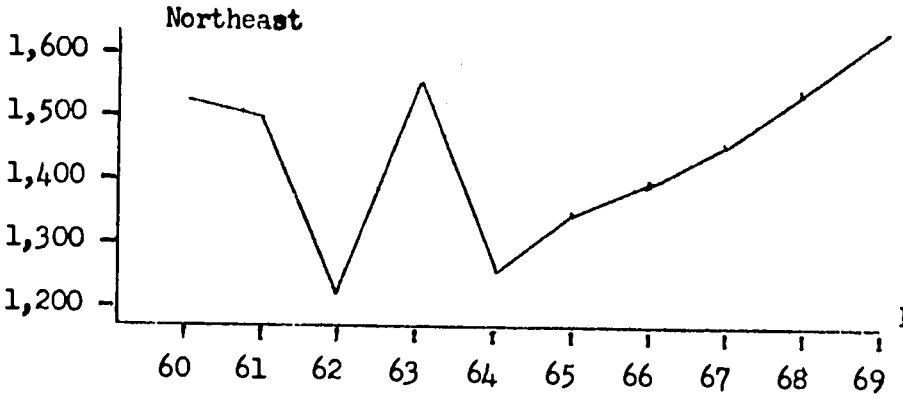
Method for Forecasting Future Value Added

The rate of growth of value added has been gradually increasing at both the regional and national levels. It is currently about 3% per annum in the Northeast, but it is assumed to reach the current growth rate of the Whole Kingdom during the plan period, that is 4.

Value Added for Aggregate Items

CROPS OTHER THAN PADDY & KENAF	19

60	61	62	63	64	65	66	67	68	69	Year
1536	1497	1273	1565	1298	1364	1404	1453	1557	1637	Northeast Production, Value Added Mil. ฿
7411	7386	7801	8518	8647	9047	10216	10150	10788	11644	Whole Kingdom Production Value Added
20.7	20.3	16.3	18.4	15.0	15.1	13.7	14.3	14.4	14.1	% N.E./WK

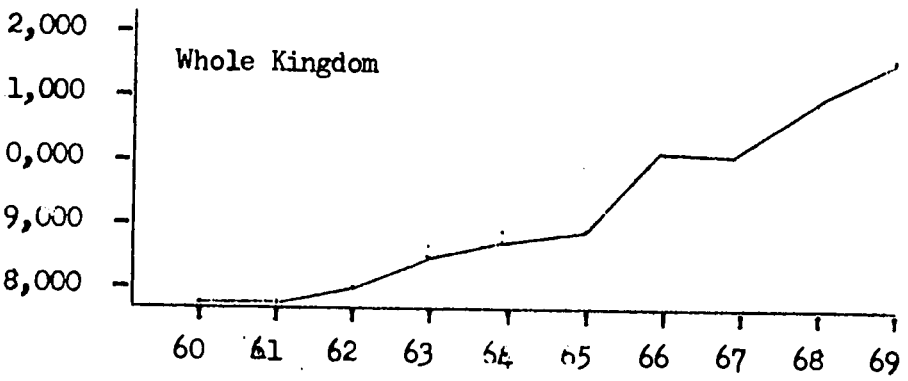


Historic Growth Rate 0.8%

Current Trend 1966–69 5.7%

Exponential $y = ab^x$

$y = 1406\ (1.008)^x$



Historic Growth Rate 5.4%

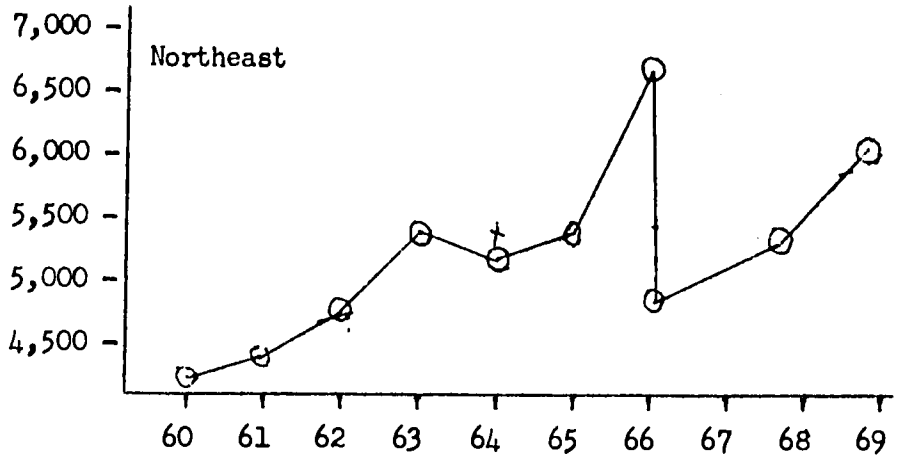
Current Trend 5.0%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for Coconut, Sugarcane, Maize and Sorghum, Groundnuts, Beans (Mung, Caster and Soy) Cassava, Tobacco, Cotton, Kapok, Sesame Seeds, Garlic, Shallot, Onion, Chili, Vegetables and Fruit.

ALL CROPS	20

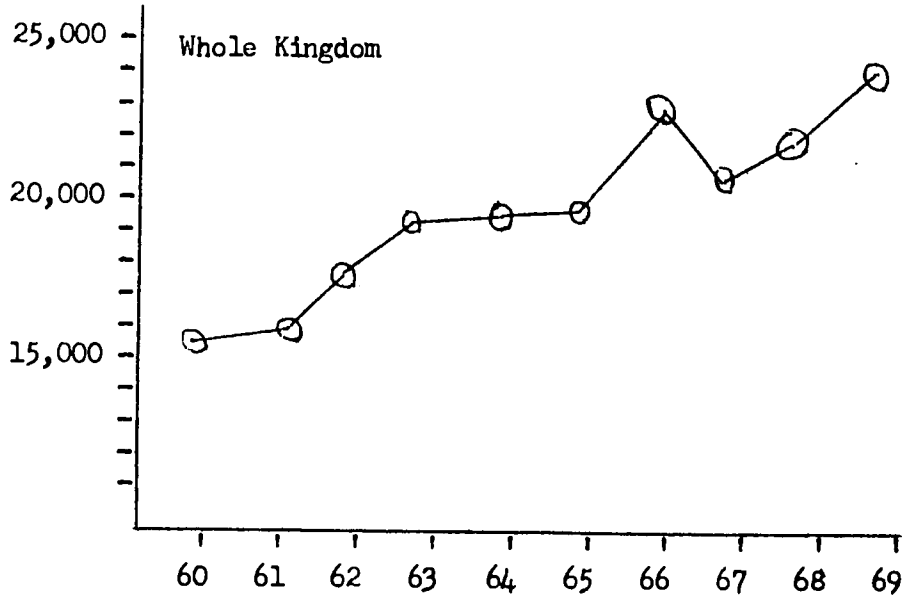
60	61	62	63	64	65	66	67	68	69	Year
4311	4379	4750	5419	5046	5200	6655	4879	5372	6232	Northeast Production Value Added Mil. $
15873	16317	17674	19302	19146	19581	23056	20718	21834	23902	Whole Kingdom Production Value Added
27.2	26.8	26.9	28.1	26.4	26.6	28.9	23.5	24.6	26.1	% N.E./W.K.



Historic Growth Rate 3.4%

Current Trend 0.3%

Exponential $y = ab^x$
$y = 4454\ (1.034)^x$



Historic Growth Rate 4.2%

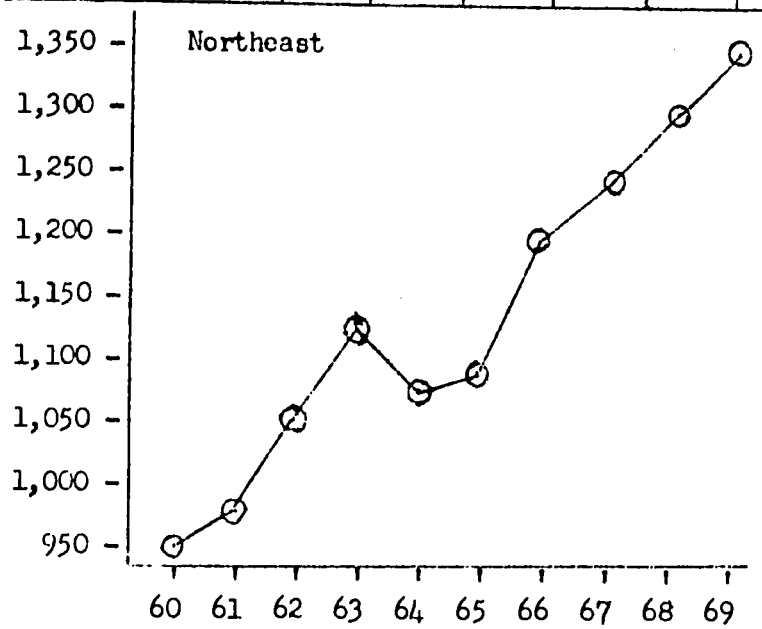
Current Trend 4.2%

Method of Forecasting Future Value Added

This is an aggregate of all crop production, and the forecast target is also an aggregate.

LIVESTOCK	28

60	61	62	63	64	65	66	67	68	69	Year
953	987	1048	1120	1079	1085	1207	1247	1309	1349	Northeast Production Value Added Mil. ¥
2936	3040	3099	3165	3251	3341	3510	3626	3734	3830	Whole Kingdom Production Value Added
32.5	32.5	33.8	35.4	33.2	32.5	34.4	34.4	35.1	35.2	% N.E./W.K.

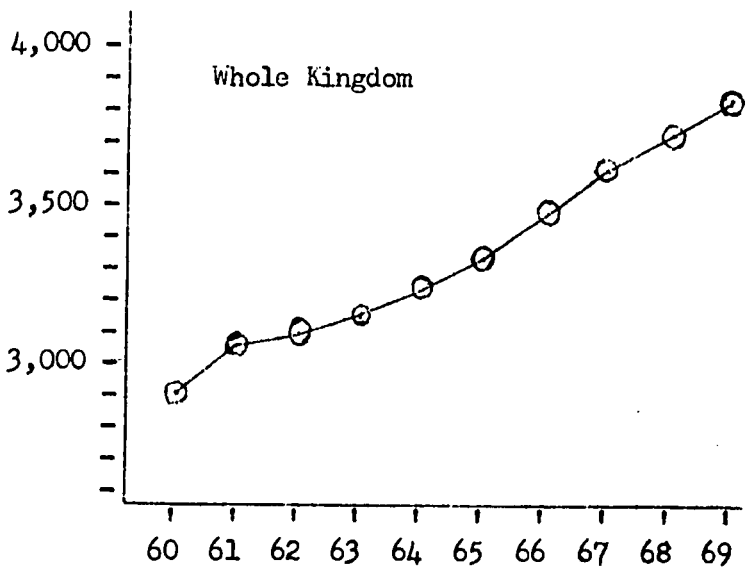


Historic Growth Rate 3.8%

Current Trend 1966-69 4.1%

Exponential $y = ab^x$

$y = 955\ (1.038)^x$



Historic Growth Rate 6.4%

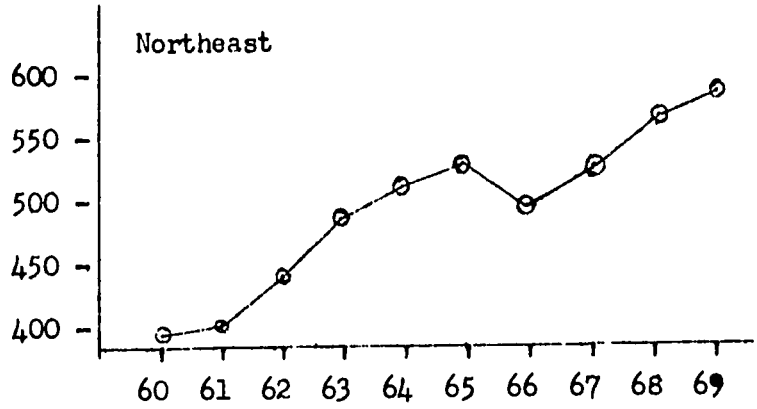
Current Trend 2.9%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for Cattle, Water Buffalo, Swine, Hens, Ducks, Eggs and other livestock products.

FORESTRY	37

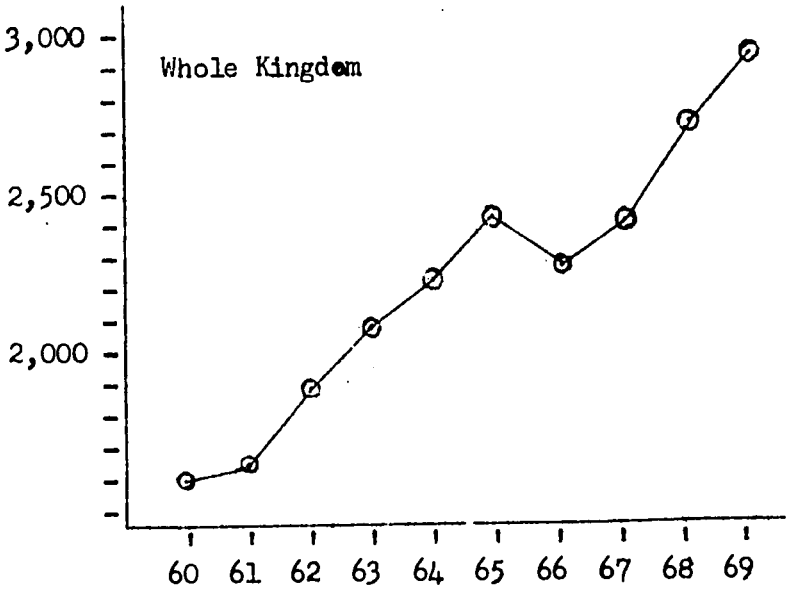
60	61	62	63	64	65	66	67	68	69	Year
358	387	443	482	513	521	499	517	570	580	Northeast Production Value Added Mil. $
1859	1874	1947	2088	2215	2456	2268	2441	2747	2915	Whole Kingdom Production Value Added
19.3	20.7	22.8	23.1	23.2	21.2	22.0	21.2	20.8	20.0	% N.E./W.K.



Historic Growth Rate 4.9%

Current Trend 1966-69 6.5%

Exponential $y = ab^x$
$y = 388\ (1.049)^x$



Historic Growth Rate 5.2%

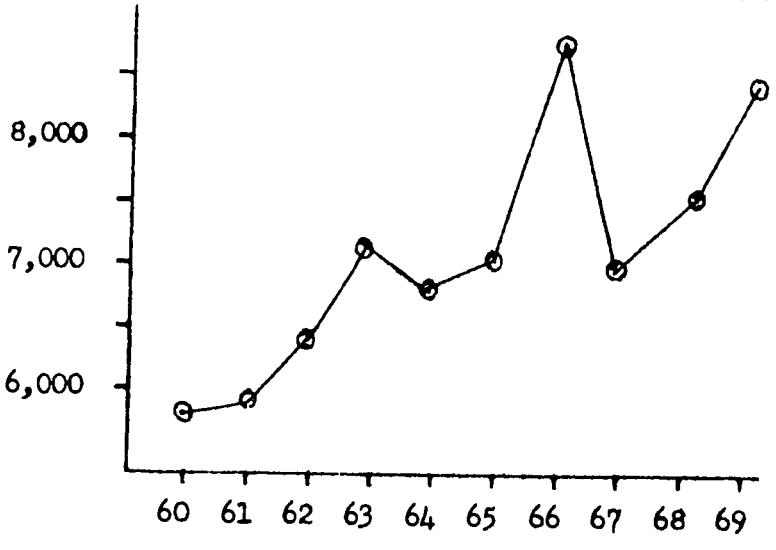
Current Trend 9.6%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for Timber, Charcoal, Firewood and other forest products.

ALL AGRICULTURE	38

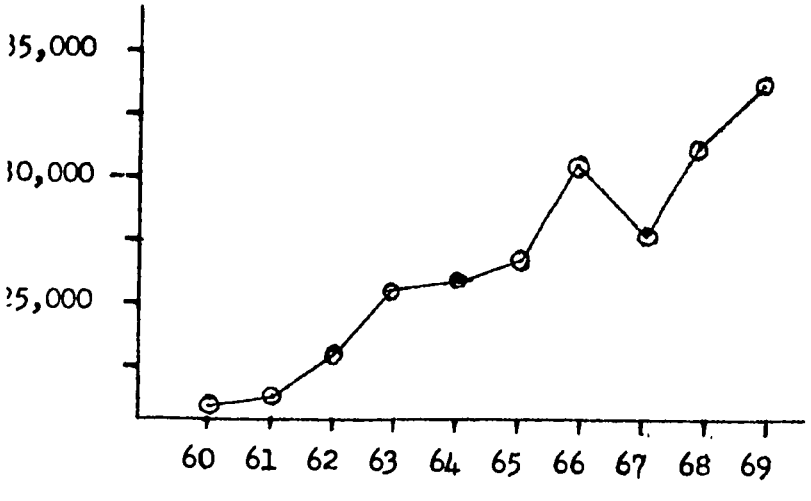
60	61	62	63	64	65	66	67	68	69	Year
5775	5909	6417	7190	6827	7062	8638	6911	7540	8474	Northeast Production, Value Added Mil. ₱
1400	22062	23689	25797	26123	27061	30785	28971	31091	34234	Whole Kingdom Production — Value Added
27.0	26.8	27.1	27.9	26.1	26.1	28.1	23.9	24.3	24.8	% N.E./W.K.



Historic Growth Rate 3.8%

Current Trend 1966-69 1.3%

Exponential $y = ab^x$
$y = 5940\ (1.038)^x$



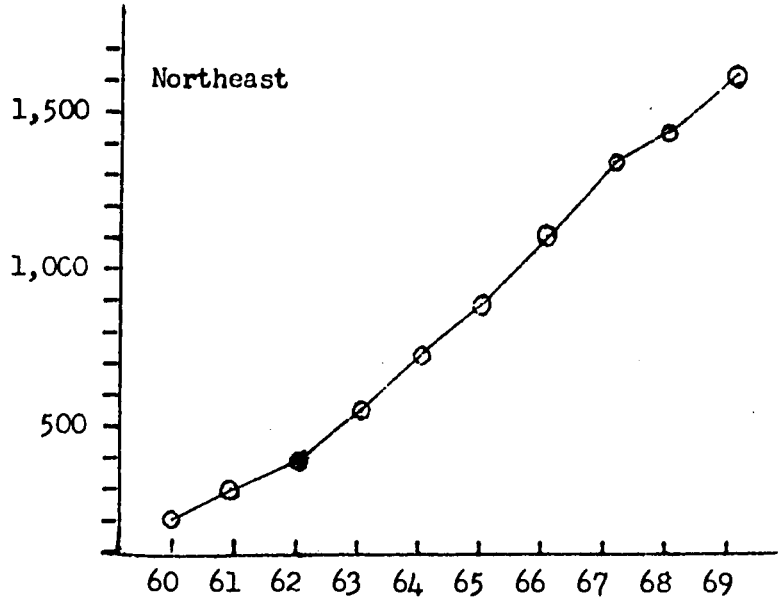
Historic Growth Rate 4.9%

Current Trend 4.5%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for Crops, Livestock, Forestry and Fishing.

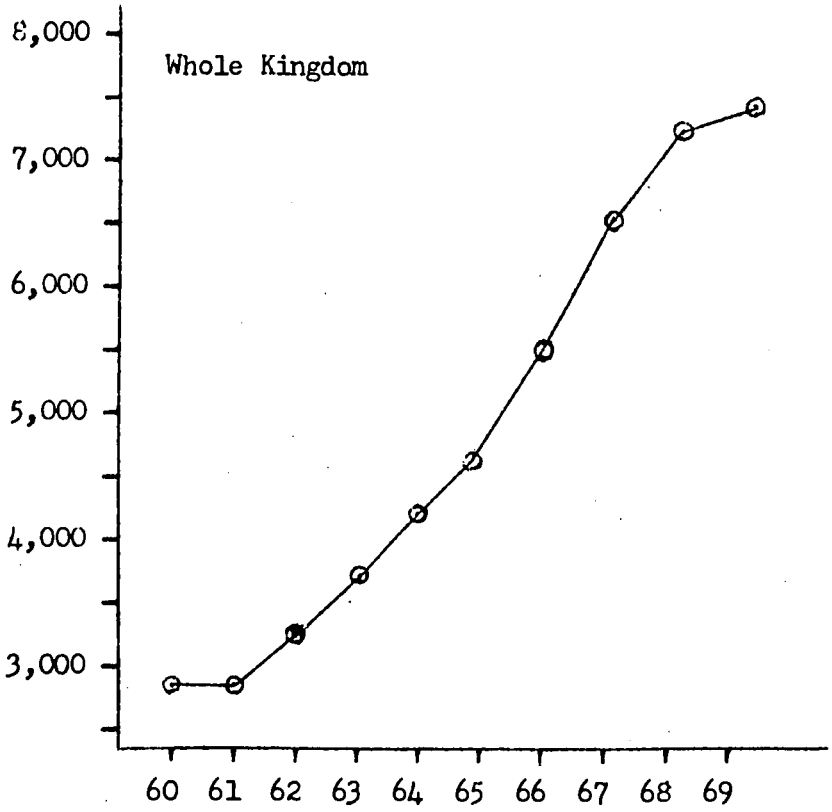
60	61	62	63	64	65	66	67	68	69	Year
412	426	474	571	741	942	1131	1373	1455	1624	Northeast Production, Value Added Mil. $
2725	2863	3270	3614	4152	4612	5604	6669	7266	7599	Whole Kingdom Production Value Added
15.1	14.9	14.5	15.8	17.8	20.4	20.2	20.6	20.0	21.4	% .E. W.K.



Historic Growth Rate 18.9%

Current Trend 1966-69 10.6%

Exponential $y = ab^x$
$y = 372\ (1.189)^x$



Historic Growth Rate 13.5%

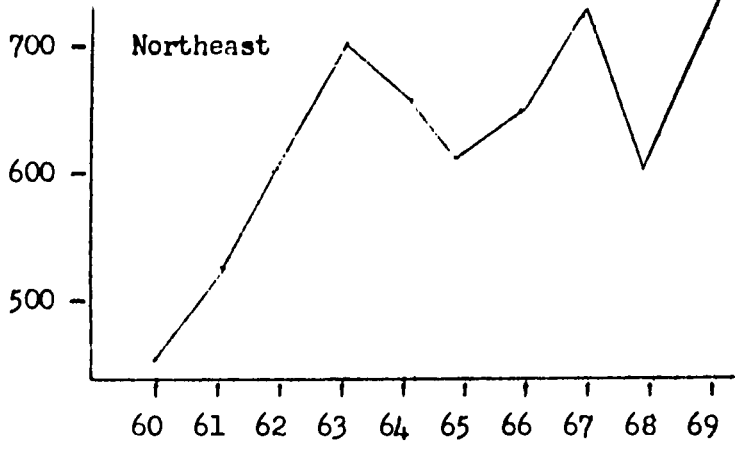
Current Trend 10%

Method of Forecasting Future Value Added

The forecast targets are the sum of the targets for private and public construction.

ALL FOOD MANUFACTURES	47

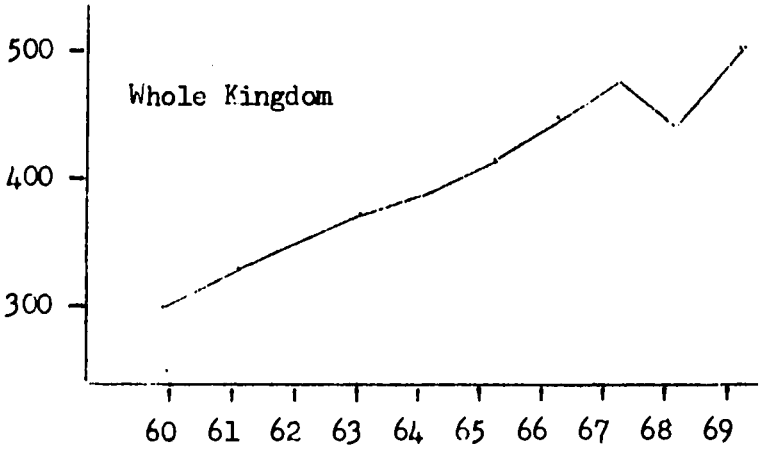
60	61	62	63	64	65	66	67	68	69	Year
459	523	608	711	683	607	646	71	599	759	Northeast Production, Value Added Mil. ₱
3079	3301	3385	3687	3838	3938	4130	4332	4192	4618	Whole Kingdom Production ~~Value Added~~
14.9	15.8	18.0	19.3	17.8	15.4	15.6	16.5	14.3	16.4	% N.E./W.K.



Historic Growth Rate 3.6%

Current Trend 1966-69 0

Exponential $y = ab^x$
$Y = 532\ (1.036)^x$



Historic Growth Rate 4.3%

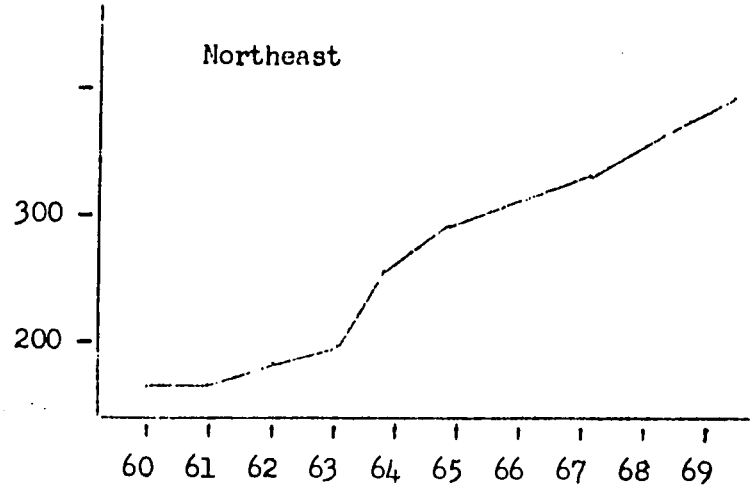
Current Trend 2.0%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for slaughter houses, rice mills, sugar mills and other food manufacturers.

ALL TEXTILES	56

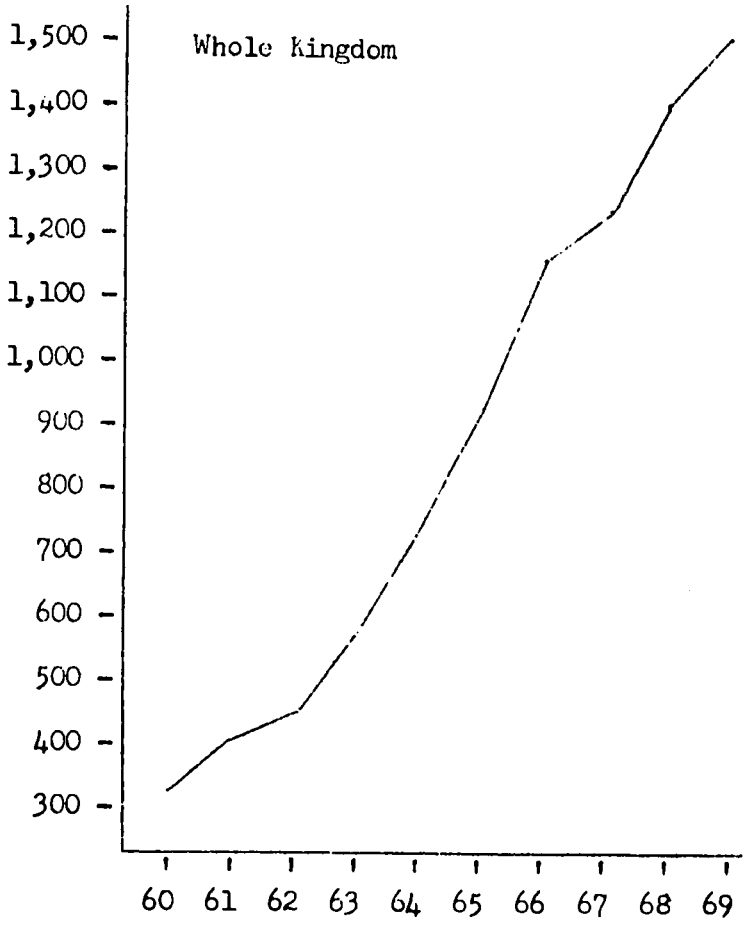
60	61	62	63	64	65	66	67	68	69	Year
163	163	177	192	246	295	297	299	304	332	Northeast Production, Value Added Mil. ₹
337	398	445	601	754	986	1131	1267	1406	1521	Whole Kingdom Production Value Added
48.4	41.0	39.8	31.9	32.6	29.9	26.3	23.6	21.6	21.8	% N.E./W.K.



Historic Growth Rate 9.4%

Current Trend 1966-69 6.2%

Exponential $y = ab^x$
$y = 159\ (1.094)^x$



Historic Growth Rate 19.9%

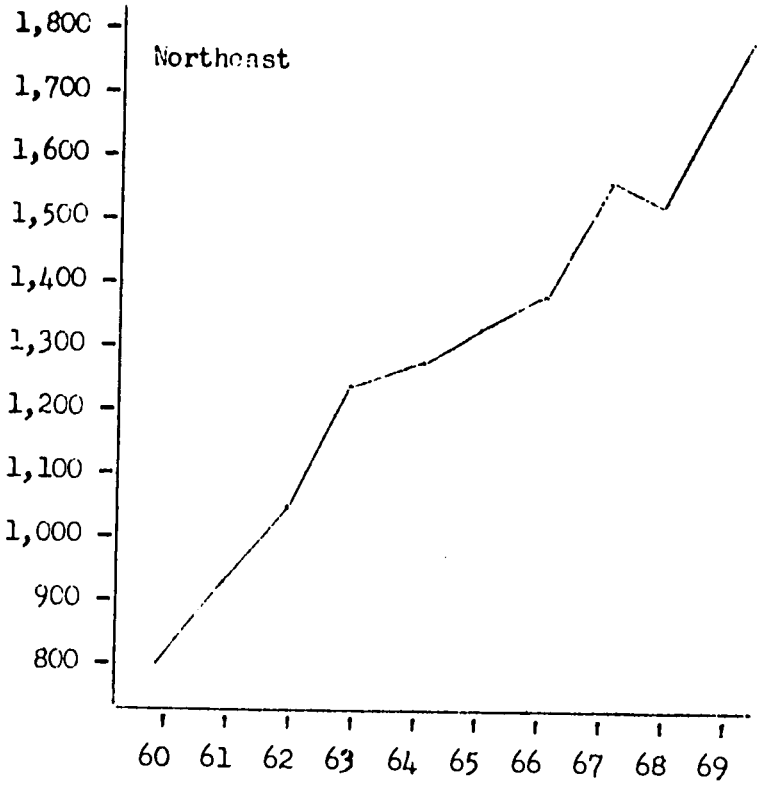
Current Trend 10.5%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for Cotton processing, Gunny Bag manufacture, Silk, Mat Making and other textiles.

ALL MANUFACTURES	64

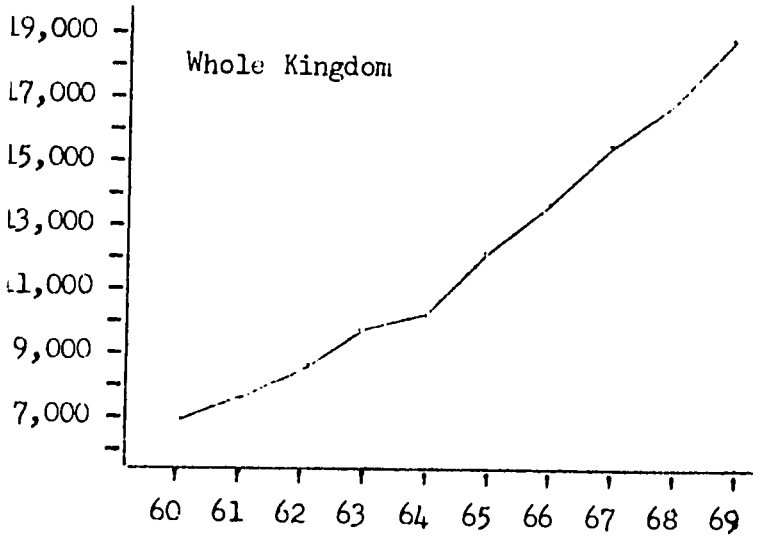
60	61	62	63	64	65	66	67	68	69	Year
824	935	1047	1216	1268	1280	1387	1523	1491	1791	Northeast Production, Value Added Mil. $
7320	8013	8997	9810	10654	12355	13795	15157	16680	18456	Whole Kingdom Production Value Added
11.3	11.7	11.6	12.4	11.9	10.4	10.1	10.0	8.9	9.7	% N.E./W.K.



Historic Growth Rate 7.9%

Current Trend 1966-69 6.2%

Exponential $y = ab^x$
$y = 885\ (1.079)^x$



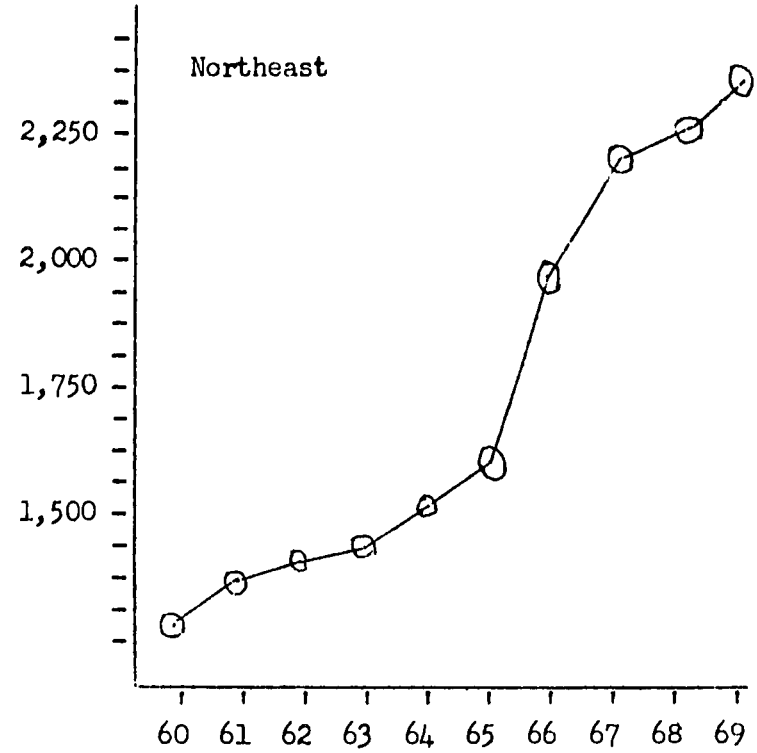
Historic Growth Rate 10.9%

Current Trend 10.2%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for all food manufacture, distilleries, soft drinks, tobacco, wearing apparel, all textiles, wood manufacture, furniture and machine shops, etc.

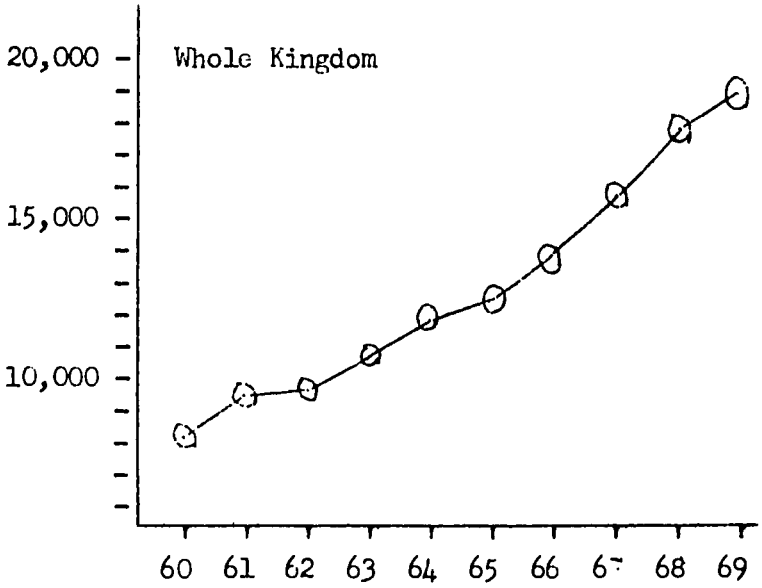
60	61	62	63	64	65	66	67	68	69	Year
1208	1289	1320	1456	1534	1649	1976	2201	2230	2441	Northeast Production, Value Added Mil. ₱
8846	9472	9898	10883	12095	12824	14133	15877	17249	18819	Whole Kingdom Production Value Added
13.7	13.6	13.3	13.4	12.7	12.9	14.0	13.9	12.9	13.0	% N.E./W.K.



Historic Growth Rate 8.7%

Current Trend 1966-69 5.7%

Exponential $y = ab^x$
$y = 1156\ (1.087)^x$



Historic Growth Rate 9.2%

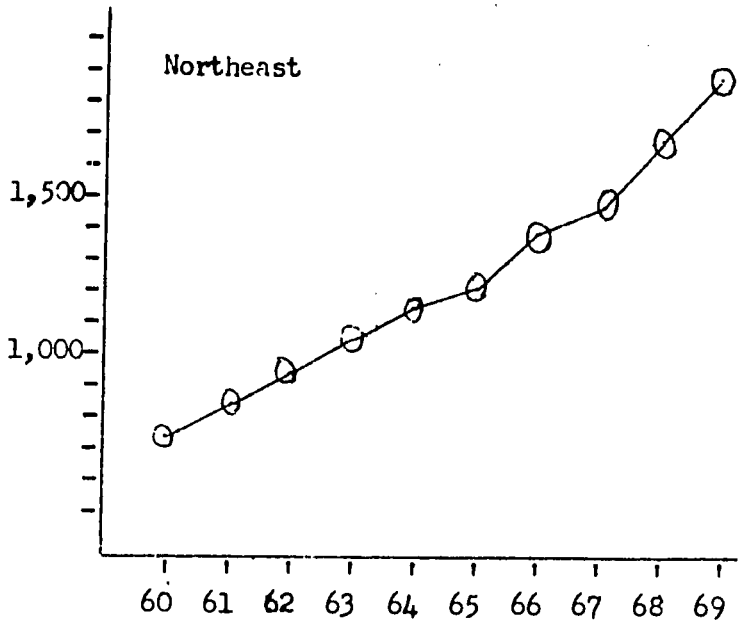
Current Trend 9.5%

Method of Forecasting Future Value Added

The forecast targets are aggregates of the targets for five categories of trade: Import Intermediate Goods, Import Capital Goods, Import Consumer Goods, Domestic Agriculture and Mining and Manufacturing.

ALL SERVICES	86

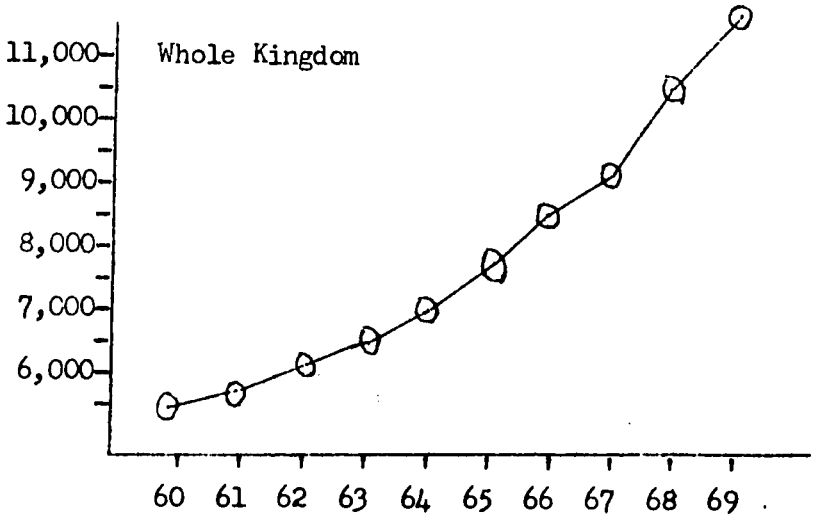
60	61	62	63	64	65	66	67	68	69	Year
776	851	942	1042	1143	1251	1360	1516	1709	1909	Northeast Production, Value Added Mil. ₱
5418	5742	6142	6548	7030	7771	8539	9397	10441	11216	Whole Kingdom Production Value Added
14.3	14.8	15.3	15.9	16.3	16.1	15.9	16.1	16.4	17.0	% N.E./W.K.



Historic Growth Rate 10.3%

Current Trend 1966-69 12%

Exponential $y = ab^x$
$y = 771\ (1.103)^x$



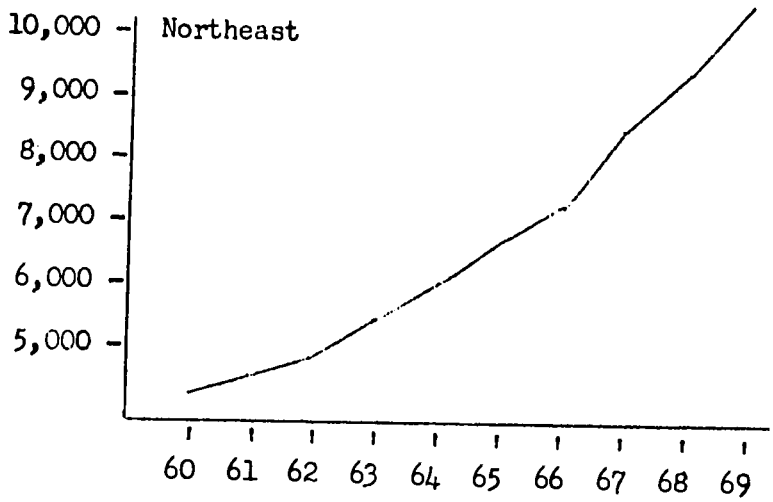
Historic Growth Rate 8.7%

Current Trend

Method of Forecasting Future Value Added:

The forecast targets are aggregates of the targets for Education, Medical and Health, Recreation and Entertainment, Domestics, Hotels and Restaurants, Laundries, Barber Shops, Religious Organizations, etc.

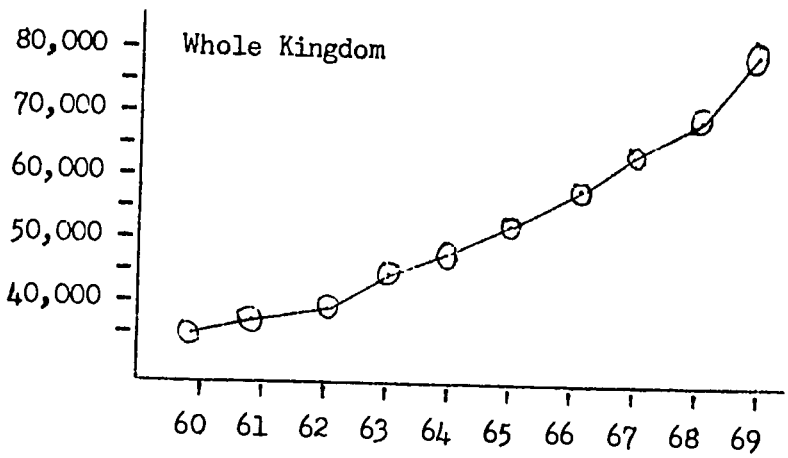
60	61	62	63	64	65	66	67	68	69	Year
4290	4675	5059	5633	6120	6735	7627	8651	9212	10320	Northeast Production, Value Added Mil. ₱
34670	36968	40114	43328	47570	[illegible]	58404	65139	71488	78143	Whole Kingdom Production Value Added
12.4	12.6	12.6	13.0	12.9	12.8	13.1	13.3	12.9	13.2	% N.E./W.K.



Historic Growth Rate 10.4%

Current Trend 1966-69 9.5%

Exponential $y = ab^x$
$y = 4202\ (1.104)^x$



Historic Growth Rate 9.8%

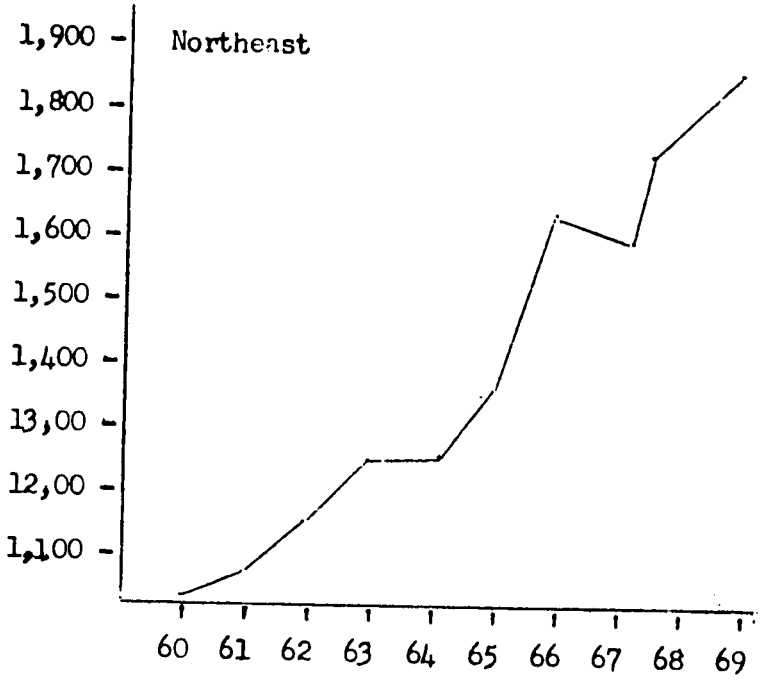
Current Trend

Method of Forecasting Future Value Added

The forecast targets are the difference between the gross regional product targets and all agricultural production target. Consequently, they are the aggregate of targets for Mining, Construction, Manufacturing, Electricity, Water Transport, Communications, Trade, Services, Ownership of Dwellings and Public and Administration and Defense.

NORTHEAST REGIONAL PRODUCT	90

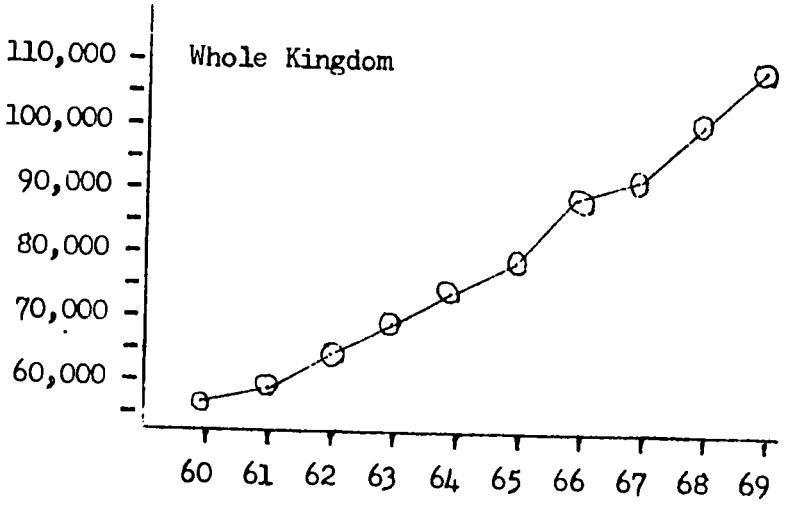
60	61	62	63	64	65	66	67	68	69	Year
10065	10584	11476	12823	12947	13797	16265	15562	16752	18794	Northeast Production Value Added Mil. $
56069	59029	63793	69125	73693	79487	98190	94109	102578	112378	Whold Kingdom Production Value Added
18.0	17.9	18.0	18.6	17.6	17.4	18.2	16.5	16.3	16.7	% N.E./W.K.



Northeast Growth Rate 7.0%

Current Trend 1966-69 5.7%

Exponential $y = ab^x$
$y = 10069\ (1.070)^x$



Historic Growth Rate 8.1%

Current Trend

Method of Forecasting Future Value Added

The forecast targets are the aggregate of the forecast targets for the 65 production items which are individually determined to give the NEED/PAG production forecast for the Northeast for the Third Plan period.

IV. CROP MODEL

Crop Model for Northeast Thailand

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IV. CROP MODEL

1. INTRODUCTION

The unreliability of all data concerned with agricultural production in Northeast Thailand is a deterent to the development of a crop model, but because a model can be such a useful tool, it was decided to accept the limitations where necessary and rely on the best judgment of the team members to give quantitative values where the statistics were doubtful.

2. PURPOSE OF THE CROP MODEL

The purpose of the crop model is to compare the costs, particularly the government costs involved, of various alternative ways of achieving the crop production targets set for the Third Development Plan. The outcome of the analysis is a set of comparative benefit/costs. The benefits are the values of the crop production at constant 1962 prices. The costs are not total costs as they do not include all farm costs, but the government costs necessary to achieve the production. Because farmer's costs are not included, the benefit/costs derived appear high, but within this limitation the output of the model is useful for government planning purposes.

3. PRODUCTION AND PRODUCTIVITY ATTRIBUTABLE TO THE CROP PRODUCTION FACTORS, LAND, IRRIGATION WATER, AND CHANGE AGENTS. (THE BENEFIT SIDE OF THE MODEL)

The crop production factors, fertilizer, un-irrigated land, and irrigated land are considered to be individually responsible for a fraction of the total regional crop production and they can, in fact, be quantified with a reasonable degree of assurance in the Northeast. Though "Change Agents" are difficult to define individually there is a group of government inputs in this category which can be quantified through budget allocations and expenditures. Analysis indicates that a useful model can be built which relates the above four production factors to productivity, production, and value of the production, on a time basis.

The four factors are introduced in the form of the following equation:

(Fertilizer Production) + (Un-irrigated Land Production + Irrigated Land Production) x Change Agent Function. Total Production.

$$F.p_f + (L_1.P_1 + L_i.P_i).\ C. = P.$$

Where:

F is the quantity of fertilizer applied in the region.

P_f is the ratio of the quantity of additional crop grown per unit of fertilizer applied.

L_1 is the area of un-irrigated land planted to the crop in the region.

P_1 is the productivity of un-irrigated land.

L_i is the area of irrigated land planted to the crop in the region.

P_i is the productivity of irrigated land.

C is the Change Agent function, acting to increase productivity (P_1 or P_i) by a constant factor.

P is the total regional production of the crop.

Benefits are determined by the incremental production achieved. To complete the calculation of benefits, the individual crop production increment is multiplied by a value added per ton at constant 1962 prices to give a value for each important crop (13 in all) and these are summed to give the benefit from the crop production program. It is emphasized that the crop production targets were determined through a separate analysis and that in this model alternative ways of achieving these are costed in order to get comparative benefit/costs.

4. GOVERNMENT COSTS FOR IRRIGATION (CANALS AND DISTRIBUTION SYSTEMS), INFRASTRUCTURE, CHANGE AGENTS, ETC. (THE COST SIDE OF THE MODEL)

The expanded crop development program proposed necessitates some government expenditure. The level of expenditure will depend on how the crop expansion is achieved, and it is the purpose of the model to give some insight into the relative costs so that planners can decide between alternatives.

Government expenditure related to the crop program can be divided into three main categories:

(a) Added infrastructure.

(b) Irrigation canals and distribution systems.

(c) Research, extension, credit etc.

4.1 Added Infrastructure

As new land is opened to agricultural production it is necessary to provide facilities in the new areas. These include administration and security, education, health and the appropriate roads to maintain communications and assist trade. The cost of infrastructure for added land has been calculated on a capital and annual basis for use in the cost side of the model. People moving to new land are almost all transfers from other parts of the Northeast region, and because of this the costing has taken savings into account.

4.2 Irrigation Canals and Distribution Systems

Only government expenditure on canals and distribution systems are considered as costs related to the crop program. No new reservoirs are proposed and the existing ones are considered to be a sunk cost.

4.3 Research, Extension, Credit, etc.

An increased Change Agent program is assumed for all crops except rice. The level is the same in all the alternative programs considered.

4.4 Incremental Costs

All costs determined are incremental costs and these are compared with the incremental production arising through the implementation of a particular plan.

5. EMPIRICAL BACKGROUND

The model is essentially empirical, and numerical values used in the calculations are based on relationships evolved from the analysis of various data and statistics from numerous sources. Before going further into the working of the crop model the major empirical relationships will be discussed. In most of these the emphasis is on rice production, because of its importance.

Specifically the following are given numerical values:

(a) Production attributable to fertilizers.
(b) The area of irrigated land which could become available.
(c) The basic productivity of un-irrigated land.
(d) The value added per ton of the major crops.
(e) Infrastructure costs of cropland expansion.

  (1) Education,
  (2) Health,
  (3) Roads,
  (4) Administration and security.

(f) Irrigation canals and distribution system costs.
(g) Expanded Change Agent program costs.

5.1 Fertilizers and Rice Production

The production attributable to the application of fertilizer was first considered in a macro manner, though it is appreciated that the fertilizer is not spread equally across the region. The total quantity of fertilizer reported used for rice production in the Northeast is as follows:

	Fertilizer Thousand Tons.	Total Rice Area Million Rai	Fertilizer 1/ Per Rai Kg./Rai
1965	28.69	15.332	1.82
1966	64.29	19.630	2.98
1967	42.06	14.095	2.98
1968	50.26	17.874	2.81
1969	63.48	20.187	3.41

The incremental production per Kg. of incremental fertilizer increases as the level of application increases as follows:

Kg. of Incremental Fertilizer per Rai	Kg. Incremental Production of Rice Per Kg. of Incremental Fertilizer
27.5	5.5
35.0	7.4
40.0	9.0

At present and during the Third Plan period it is assumed that the rate of application will be at the lower end of this scale, and a constant ratio of 5.5 is used in the model.

The curve of fertilizer application per rai over time has been smoothed and extrapolated to assist in determining the basic productivity of un-irrigated land. The following curve shows the use of fertilizer per rai measured against time.

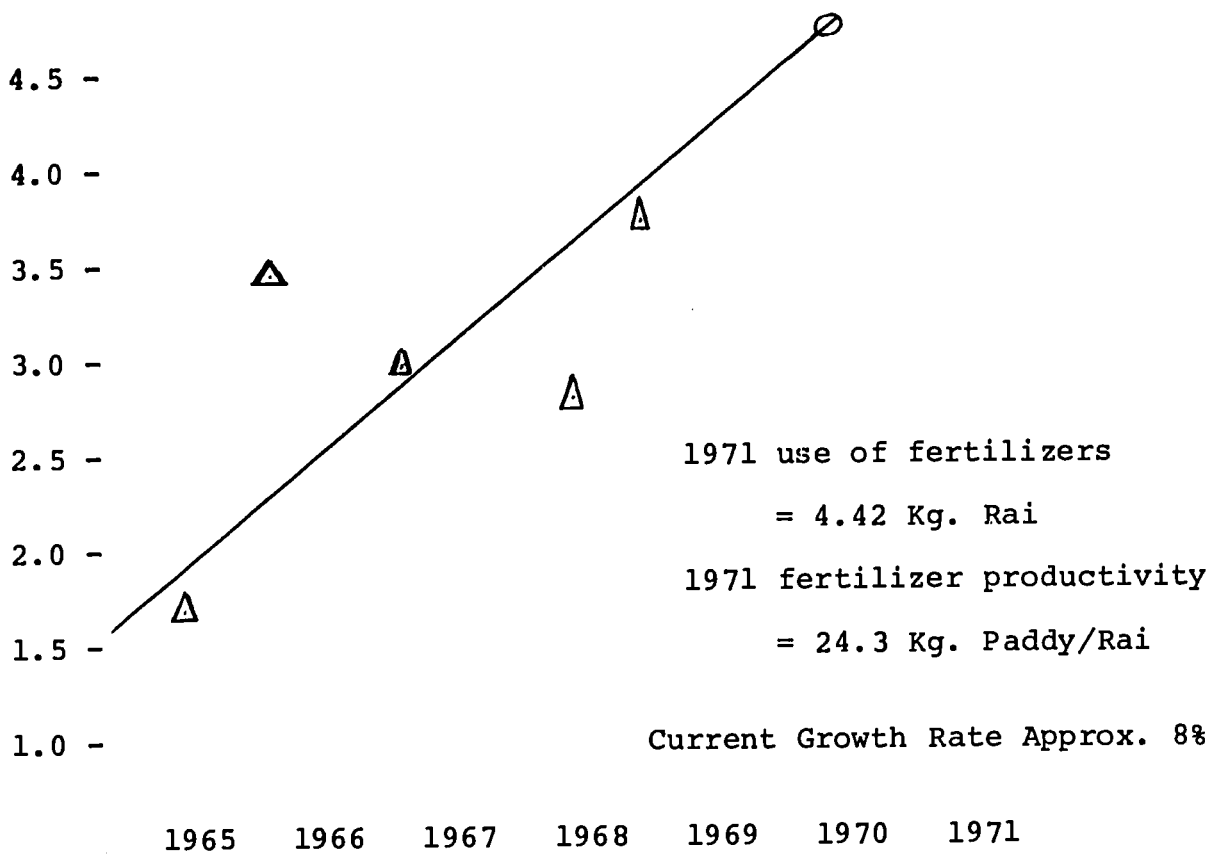
1/ NEED PAG calculation based on (a) Dept. of Customs Import data. (b) NEDB, National Accounts Division, Rice Balance Sheet.

2/ NEED PAG calculations based on analysis by ADB Nongwai Study team.

NORTHEAST THAILAND

ANNUAL FERTILIZER USE PER RAI

FOR RICE PRODUCTION



The incremental production attributable to the application of 1 kilogram of fertilizer varies between crops, and the following lists the values based on experiments which were assumed in the model.1/

Crop	Kg. Incremental Production Per Kg. Fertilizer
Rice	5.5
Fruit	3.0
Garlic, Onion, Shallot, Chili	3.0
Sugarcane	No fertilizer use assumed
Beans	2.0
Groundnuts	2.0
Tobacco	3.0
Cassava	No fertilizer use assumed
Cotton	1.8
Kenaf	1.25
Vegetables	3.0
Sorghum	4.0
Maize	4.0

The average cost of fertilizer in the Northeast is particularly high, 2 baht a kilo, and in some plan programs it is assumed that there is some form of government price control or subsidy which reduces this to 1.50 baht a kilo, which is the Bangkok price.

1/ See Agricultural Appendix for details.

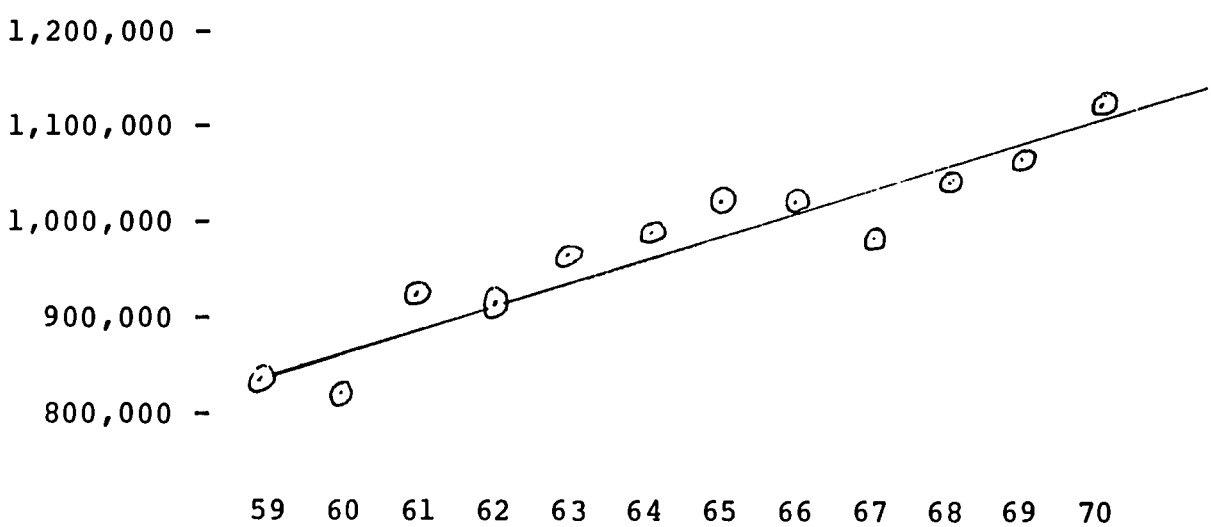
5.2 Area of Irrigated Land

The potentially irrigated areas associated with Royal Irrigation Department projects completed over the last decade are shown in the following diagram. The annual growth rate is about 2 1/2%. All potentially irrigated land is not actually under irrigation, and the National Statistical Office crop cutting survey figure of 5.1% of rice land being irrigated and 94.7% un-irrigated was used to estimate a figure of 950,000 rai under irrigation in 1968. The 2 1/2% growth rate derived above was used to project the amount of irrigable land available in 1971, the base year for the model which was thus assumed to be 1,020,000 rai.

FIGURE

POTENTIALLY IRRIGATED AREA OF R.I.D. PROJECTS

IN NORTHEAST THAILAND 1960-1970



Source: Royal Irrigation Department, April 1, 1970

5.3 Productivity of Un-irrigated Land

The data available for productivity of land in the Northeast is an overall figure made up from the productivity of;

(a) Fertilizer

(b) Irrigated land

(c) Un-irrigated land

The NEED PAG best estimate of this for the base year for the Third Plan, 1971 was 232.9Kg./rai. This is a mean value based on a minimum and maximum growth rate of 1.0% and 2.2% and a minimum and maximum productivity in 1969 of 215.9 and 235.7 Kg./rai.

The overall Paddy production target for the base year, 1971 is 4.318 million tons and this is used in conjunction with the overall productivity of 232.9 Kg./rai to determine an overall requirement for 18.54 million rai of land. The production from un-irrigated land can be obtained by subtracting the production from irrigated land and that attributable to fertilizers. The latter depends on a fertilizer productivity of 24.3 Kg./rai determined from the curve of fertilizer used, which combined with an area of 18.54 million rai, gives a production of 451,000 tons of Paddy.

In the absence of data on productivity of irrigated land an assumption was made that, on the average, productivity is 150% of that of un-irrigated land. This value is probably high, and it must be made clear that it is simply the ratio between un-irrigated productivity and irrigated productivity, and does not take into account inputs which are practical to use with irrigation but not practical without it. These additional inputs are accounted for elsewhere in the model. If p_1 is the productivity of un-irrigated land then the following equation which uses the empirical values given above determines a numerical value for p_1.

$$18.54 \times 0.0243 + (18.54-1.02)p_1 + 1.02 \times \frac{3}{2} p_1 = 4.318$$

This gives a value of 203 Kg./rai, which is used in the model as the productivity of un-irrigated land in the base year 1971.

The productivity of un-irrigated land, without fertilizers, for other crops was assumed to be the following in the base year 1971:

Crop	Kg./rai
Fruit	1,000
Garlic, Onion, Shallot, Chili	300
Sugarcane	4,000
Beans	135
Groundnuts	210
Tobacco	155
Cassava	1,960
Cotton	120
Kenaf	207
Vegetables	700
Sorghum	250
Maize	211

5.4 The Value Added Per Ton of the Major Crops

The values added per ton at constant 1962 prices are as follows. They are discussed more fully in the methodology Appendix A.

VALUE ADDED PER TON AT CONSTANT 1962 PRICES

Crop	Baht per Ton
Fruit	1,600
Garlic, Onion, Shallot, Chili	5,000
Sugarcane	80
Beans	2,000
Groundnuts	2,170
Tobacco	7,500
Cassava	230
Cotton	2,880
Kenaf	1,880
Vegetables	500
Sorghum	700
Maize	700
Rice	826

5.5 Infrastructure Costs of Cropland Expansion

5.5.1 Education

The value of crop production is determined basically in terms of baht per rai, and government costs are consequently calculated on a "per rai" basis. It is assumed that in the new areas:

1 Farm = 20 rai. (1 rai = 1,600 sq. meters.)
1 Farm has 5.5 people
1 Farm has 0.86 children of school age.1/

1/ These are regional averages.

Education will be provided for the newly developed areas at approximately the level of the average for the region. New classrooms will be provided as a capital cost and teachers will be employed to give an annual cost. These are based on the following estimates:

Current education capital costs (classrooms) are 3,200 baht/pupil.

Current annual teacher costs are 80 baht/per capita.

The people moving to new land are transfers from areas having education facilities and consequently the above costs must be modified to take into account savings. It is assumed that:

Education capital costs for new land development are 1,600 baht/pupil.

Education annual costs for new land development are 40 baht/per capita.

This gives the following costs per rai:

Capital cost = 69 baht per rai,

Annual cost = 22 baht per rai.

5.5.2 Medical and Health

Health services will include 3rd Class Health Centers appropriate to the population of the new developed lands and the average population to health center ratio for the rural areas of the region. Similarly to education facilities the new land costs take account of savings due to transfers:

The following are the cost estimates per rai:

Capital cost = 24 baht/rai

Annual cost = 4 baht/rai

5.5.3 Roads

It is assumed that the new areas will have a road network grid of approximately 5 kilometers spacing, that is 1 sq. km. (625 rai) requires 0.4 km. road. This is a maximum which because of existing roads and savings elsewhere is not likely to be necessary, and it has been reduced to 80% that is 1 sq. km. (625 rai) requires 0.32 km. of road.

Pioneer road construction costs are 250,000 baht/km.

Pioneer road upkeep costs are 8,000 baht/km. per annum.

On the basis of the above:

Pioneer road capital cost = 128 baht per rai.

Pioneer road annual cost = 4 baht per rai.

5.5.4 Administration and Security

This item is difficult to quantify, there will be a requirement for additional personnel, (officials and police), additional office space, and additional vehicles but there is insufficient data to make an estimate of costs. It was decided to use the same figures as those used for education.

Administration and security capital cost = 69 baht/rai.

Administration and security annual cost = 22 baht/rai.

	Capital Costs Baht/rai	Annual Costs Baht/rai
Education	69	22
Medical and health	24	4
Pioneer Roads	128	4
Administration and security	69	22
Total	290	52

If capital costs are assumed to be amortized over ten years then:

Infrastructure costs of new cropland are 81 baht per rai.

5.6 Irrigation Canals and Distribution System Costs

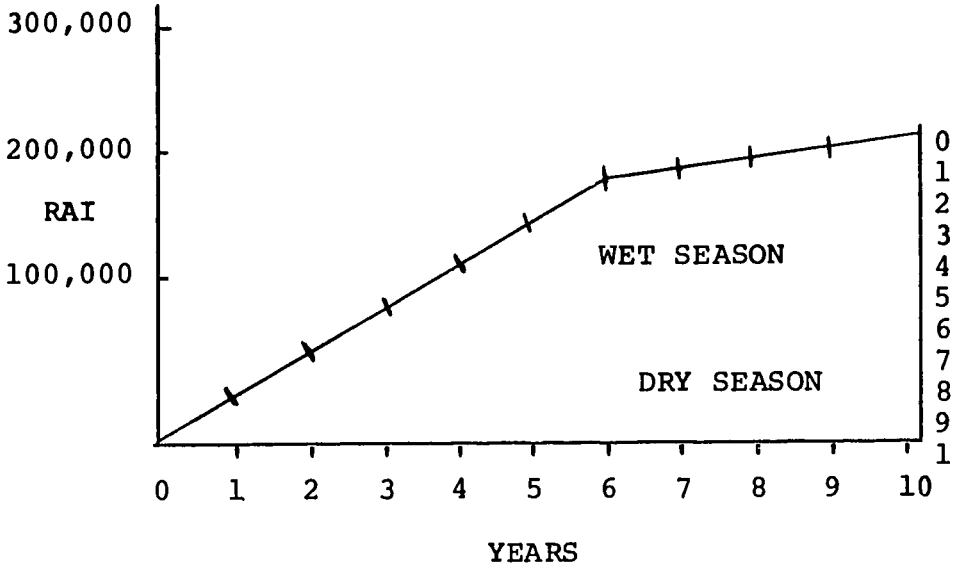
The following estimates are based on data from the Lam Nam Oon Study by BUREC.1/ Total costs of the project can be subdivided as follows:

Preparation, Dam, Spillways (plus % overhead)	166 M. Baht
Canals and Laterals (plus % overhead)	281 M. Baht
Farm distribution and drainage (plus % overhead)	59 M. Baht
Total	506 M. Baht

1/ "Final Draft, Lam Nam Oon Project Planning Report." 1968. U.S. Bureau of Reclamation.

The area of irrigated land which will become available is as follows:

LAM NAM OON
PLAN A. PHASING
FROM YEAR ZERO



	Wet Season Rai	Dry Season Rai
0	0	0
1	34,000	8,000
2	68,000	16,000
3	102,000	24,000
4	136,000	32,000
5	170,000	40,000
6	204,000	48,000
7	204,000	56,000
8	204,000	64,000
9	204,000	72,000
10	204,000	80,000

The full potential irrigation will not be achieved for ten years after the project starts to come into operation. It was considered unlikely that the maximum 283,000 rai of irrigation would be achieved and a figure of 220,000 was used in calculating the cost per rai. This assumption was considered still to give favorable costs of production on irrigated land.

The BUREC study assumed a 50 year amortization of costs in determining a benefit/cost ratio, but this was considered to be too long a period and to establish an annual cost the following amortization periods were assumed.

Preparation, Dam, Spillways	30 years
Canals and Laterals	20 years
Farm Distribution and Drainage	10 years

The operation and maintenance costs are assumed to be 25.0 baht/rai for the whole system and are therefore relevant to any program that is developed.

Preparation, Dam, Spillways Amortized over 30 years.	5.5 M. Baht per year
Canals and Laterals Amortized over 20 years.	14.05 M. Baht per year
Farm Distribution Systems Amortized over 10 years	5.9 M. Baht per year
Total	25.45 M. Baht per year

Most programs considered for the Third Plan excluded further new construction of dams, then:

Canals and laterals cost	14.05 M. Baht per year
Farm distribution systems cost	5.9 M. Baht per year
Assuming 220,000 rai irrigated the cost is	90.68 Baht/rai per year
Operation and maintenance	25.00 Baht/rai per year
Total	115.68
For farm distribution systems only the cost is	5.9 M. Baht per year
That is	27.0 Baht/rai per year
	25.0 Baht/rai per year
Total	52.0 Baht/rai per year

5.7 Expanded Change Agent Program Costs

Expenditure on change agent programs are considered to show their benefits in increased productivity. On the basis of a 300% return for government expenditure on research and extension, program levels determined for the Third Plan period are such as to increase productivity by about 1 1/2% per year above the current trend. The return for research and extension expenditure used here may be low 1/ compared with that experienced in more developed countries where new ideas gain more rapid acceptance. The current productivity trend for some crops, notably maize and sorghum, is downwards because of land depletion, and the productivity increases considered here do not equal the decrease.

The actual additional Change Agent budget is largely nominal and intended to demonstrate the emphasis on a wide variety of crops. The total additional value, 29.25 M. Baht for the five year plan, was the same for all programs considered in the model.

1/ Lester R. Brown "Seeds of Change", 1970.

Additional Change Agent Budget
M. Baht

	5 Years	Annual
Rice	0	0
Fruit	3.75	0.75
Garlic, Onion, Shallot, Chili	1.50	0.30
Sugarcane	1.50	0.30
Beans	3.75	0.75
Groundnuts	1.50	0.30
Tobacco	1.50	0.30
Cassava	1.50	0.30
Cotton	3.75	0.75
Kenaf	3.75	0.75
Vegetables	1.50	0.30
Sorghum	1.50	0.30
Maize	3.75	0.75
Total	29.25	5.85

6. CROP MODEL CALCULATION

6.1 Procedure

There is not a large variation between the alternative ways of achieving the target production of crops other than rice. A basic set of calculations were performed for the other crops, except fruit and vegetables, in which the following were assumed:

(a) No irrigated land used.
(b) Standard fertilizer program.
(c) Standard Change Agent program.
(d) Amount of un-irrigated land used (assuming no land use control).

This basic set of calculations is given in the tables accompanying each plan. Small variations on this are introduced by changing only fruit and vegetables rather than making individual changes to each of the 12 other crops used in the model. For example the variation involving 100,000 rai of double cropping introduced over the 5 year period is all applied to fruit and vegetables and none to the others. Large variations occur in the various ways of achieving the rice production target and these are combined with the minor other crop variations to give the five representative plans detailed in the sections which follow.

6.2 Plans A, B, C, D, E

The assumptions, the calculations, and the outcome of the five plans are detailed in the following sections.

The crop model was developed for the use of NEED agricultural advisors. In using it to develop their proposals they made two modifications; first they used 'Farm Gate' prices rather than value added, and second they used only overall benefit/cost calculations. This results in some minor differences between this Appendix and the final report recommendations. They are, however, of no substantial significance.

6.2.1 Plan A. Maximum Irrigation Plan

If all the existing reservoirs and tanks were to be fully utilized for irrigation it would probably be possible to increase the amount of irrigated land by 1,000,000 rai and this is taken as the target in this plan. It is assumed that half this amount would only require the addition of farm distribution systems, and other half would require canal, laterals and farm distribution systems.

Fertilizer use is assumed to grow at the current rate of 8%.

The production of other crops is assumed to be basic, except for double cropping of 50,000 rai in fruit production and 50,000 rai in vegetable production. The basic figures covering all other crops for Plans A,B,D, and E are broken down by crop following Plan A.

6.2.2 Plan B. Maximum Fertilizer Plan

Sufficient fertilizer is assumed to be used so that there is no need for extra land, irrigated or un-irrigated to achieve the production targets. The other crop production, including fruit and vegetables, is assumed to be the same as in the basic set of calculations.

In all the plans where there is a government input to encourage the use of fertilizers it is assumed that a subsidy amounting to 50 satangs is given on each kilogram of fertilizer. That is a price in the Northeast of 1.50 baht per kilogram, which is the Bangkok wholesale price, instead of the current 2.00 baht.

6.2.3 Plan C. All New Land

This set of calculations is intended to be the most pessimistic view of the way crop production might develop. It is assumed that all increased crop production is obtained by expanding into new un-irrigated land. Fertilizer use for rice does not increase beyond the current level and none is applied to other crops. The amount of irrigated land is assumed also to remain constant. Because no change agent programs are introduced productivity is assumed to remain constant or deteriorate. This is a possible situation, which is hoped will not occur.

6.2.4 Plan D. No Change

The no change calculation is intended to be a moderately optimistic view of the crop production situation as it might be if no particular government effort is made to influence it.

Fertilizer use for rice production grows at the current 8%. Irrigated land increases by 25,000 rai per year, with un-irrigated land expanding to meet the production targets.

Other crop production, including fruit and vegetables, is assumed to be the same as in the basic set of calculations.

6.2.5 Plan E. Recommended Plan

The main assumptions in this plan are that the rate of increase of irrigated land shall be doubled from 25,000 rai to 50,000 rai per year. The use of fertilizer is encouraged for rice production to enable the production target to be achieved without using any new un-irrigated land.

Other crop production generally is the same as in the basic set of calculations, but for fruit and vegetables it is assumed that double cropping of 50,000 rai for each is used by the end of the plan period.

CROP MODEL - PLAN A.

Maximum Irrigation Plan

All Crops

	1971	1972	1973	1974	1975	1976	Total
FERTILIZER							
Tons 1,000	82	99.7	117	135	154	172	
Crops Ton 1,000	-	-	-	-	-	-	
UN-IRRIGATED LAND							
Area Rai 1,000	22084	22179	22190	22232	22305	22405	
Productivity Kg./rai	-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-	
IRRIGATED LAND							
Area Rai 1,000	1020	1220	1420	1620	1820	2020 1/	
Productivity Kg./rai	-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-	
PRODUCTION TOTAL							
Area Rai 1,000	23104	23399	23610	23852	24125	24425	
Crops Tons 1,000	-	-	-	-	-	-	
INCREMENTAL BENEFIT							
Value Added/Ton. Baht	-	-	-	-	-	-	
Increment V. A. M. Baht	0	227.0	443.0	667.2	899.2	1142	3378
COSTS							
Irrigation Canals M. Baht	0	11.6	23.2	34.8	46.4	58.0	174.0
Farm District M. Baht	0	5.2	10.4	15.6	20.8	26.0	78.0
Fertilizer M. Baht	0	36.6	72.7	109.3	147.7	186.0	552.3
Infrastructure M. Baht	0	23.9	40.9	60.8	82.7	106.7	314.9
Change Agent M. Baht	0	5.85	5.85	5.85	5.85	5.85	29.25
Total M. Baht	0	83.15	153.1	226.4	303.5	382.6	1148
Government Total M. Baht	0	51.8	90.6	132.4	176.1	222.0	672.8
BENEFIT/COST							
Overall	-	-	-	-	-	-	2.94
Government	-	-	-	-	-	-	5.02
SUMMARY							
V.A. Total M. Baht	-	6128	6345	6567	6804	7045	32889
ADDITIONAL INPUTS							
Un-irrigated Rai 1,000	-	-	-	-	-	-	321
Irrigated Rai 1,000	-	-	-	-	-	-	1000
Fertilizer Tons 1000	-	-	-	-	-	-	268

1/ Plus 100,000 rai double cropping by 1976

CROP MODEL - PLAN A.

Maximum Irrigation

	Rice							Fruit						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons - 1,000	82	90	98	106	115	124		0	1.0	2.0	3.0	4.0	5.0	
Crops, Tons - 1,000	451	494	540	586	633	681		0	3.0	6.0	9.0	12.0	15.0	
UN-IRRIGATED LAND														
Area Rai - 1,000	17522	17410	17304	17206	17123	17047		463	463	461	459	456	453	
Productivity Kg/Rai	203	205	207	209	211	213		1000	1015	1030	1046	1061	1077	
Production Tons 1,000	3557	3569	3582	3596	3613	3631		463	470	474	479	482	484	
IRRIGATED LAND														
Area, Rai 1,000	1020	1220	1420	1620	1820	2020		0	10	20	30	40	50 1/	
Productivity Kg/Rai	304.5	307.5	310.5	313.5	316.5	319.5		1000	1015	1030	1046	1061	1077	
Production Tons 1,000	311	375	441	508	576	645		0	10	21	31	42	54	
PRODUCTION TOTAL														
Area, Rai 1,000	18542	18630	18724	18826	18943	19067		463	473	481	489	496	503	
Crops Tons 1,000	4318	4438	4563	4690	4822	4957		463	483	501	519	536	553	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	826	826	826	826	826	826		1600	1600	1600	1600	1600	1600	
Increment V. A. M. Baht	0	99.12	202.4	307.3	416.3	527.8	1552.9	0	32.0	60.8	89.6	116.8	144.0	443.2
COSTS														
Irrigat. Canals M. Baht	0	11.6	23.2	34.8	46.4	58.0	174.0	-	-	-	-	-	-	- 2/
Farm Distric M. Baht	0	5.2	10.4	15.6	20.8	26.0	78.0	-	-	-	-	-	-	- 2/
Fertilizer M. Baht	0	16.0	32.0	48.0	66.0	84.0	246.0	0	2.0	4.0	6.0	8.0	10.0	30.0
Infrastructure M. Baht	0	7.13	14.74	23.0	32.48	42.53	119.9	0	0	-0.24	-0.40	-0.73	-1.13	-2.50
Change Agent M. Baht	-	-	-	-	-	-	0	0	0.75	0.75	0.75	0.75	0.75	3.75
Total M. Baht	0	39.93	80.34	121.4	165.7	210.5	617.9	0	2.75	4.51	6.35	8.02	9.62	31.25
Government Total M. Baht	0	23.93	48.34	73.40	99.68	126.5	371.9	0	1.25	1.51	1.85	2.02	2.12	8.75
BENEFIT/COST														
Overall	-	-	-	-	-	-	2.51	-	-	-	-	-	-	14.2
Government	-	-	-	-	-	-	4.18	-	-	-	-	-	-	50.6
SUMMARY														
V.A. Total M. Baht	-	3666	3769	3874	3983	4094	19386	-	773	802	830	858	885	4148
ADDITIONAL INPUTS														
Un-Irrigated Rai 1,000	-	-	-	-	-	-	-475	-	-	-	-	-	-	-14
Irrigated Rai 1,000	-	-	-	-	-	-	1000	-	-	-	-	-	-	50 1/
Fertilizer Tons 1,000	-	-	-	-	-	-	123	-	-	-	-	-	-	15

1/ Double cropping

2/ There should be a portion of the cost of the irrigation but no attempt has been made to allocate it.

CROP MODEL - PLAN A.
Maximum Irrigation

	Vegetables							Other Crops Aggregate 3/						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	0	1.0	2.0	3.0	4.0	5.0		0	7.7	15.3	23.0	30.6	38.3	
Crops, Tons 1,000	0	3	6	9	12	15		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area Rai 1,000	474	489	510	531	557	585		3625	3817	3915	4036	4169	4320	
Productivity Kg/Rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production Tons 1,000	332	348	368	389	414	441		-	-	-	-	-	-	
IRRIGATED LAND														
Area Rai 1,000	0	10	20	30	40	50 1/		-	-	-	-	-	-	
Productivity Kg./Rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production Tons 1,000	0	7	14	22	30	38		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area,Rai 1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Crops Tons 1,000	332	358	388	420	456	494		-	-	-	-	-	-	
INCREMENTAL BENEFIT														
Value Added/Ton. Baht	500	500	500	500	500	500		-	-	-	-	-	-	
Increment V.A. M. Baht	0	13.0	28.0	44.0	62.0	81.0	228.0	0	82.9	151.8	226.3	304.1	389.3	1154.4
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	- 2/	-	-	-	-	-	-	0
Farm District M. Baht	-	-	-	-	-	-	- 2/	-	-	-	-	-	-	0
Fertilizer M. Baht	0	2.0	4.0	6.0	8.0	10.0	30.0	0	16.6	32.7	49.3	65.7	82.0	246.3
Infrastructure M. Baht	0	1.22	2.92	4.62	6.80	8.99	24.55	0	15.5	23.5	33.6	44.1	56.3	173.0
Change Agent M. Baht	0	0.3	0.3	0.3	0.3	0.3	1.5	0	4.8	4.8	4.8	4.8	4.8	24.0
Total M. Baht	0	3.52	7.22	10.92	15.10	19.29	56.05	0	36.9	61.0	87.7	114.6	143.1	443.3
Government Total M. Baht	0	2.02	4.22	6.42	9.10	11.79	33.55	0	24.6	36.5	50.7	65.3	81.6	258.6
BENEFIT/COST														
Overall	-	-	-	-	-	-	4.07	-	-	-	-	-	-	2.60
Government	-	-	-	-	-	-	6.80	-	-	-	-	-	-	4.46
SUMMARY														
V.A. Total M. Baht	-	179	194	210	228	247	1058	-	1510	1580	1653	1735	1819	8297
ADDITIONAL INPUTS														
Un-Irrigated, Rai 1,000	-	-	-	-	-	-	-	111	-	-	-	-	-	695
Irrigated, Rai 1,000	-	-	-	-	-	-	-	50 1/	-	-	-	-	-	0
Fertilizer Tons, 1,000	-	-	-	-	-	-	-	15	-	-	-	-	-	114.9

1/ Double Cropping

2/ There should be a portion of the cost of the irrigation, but no attempt has been made to allocate it.

3/ For individual calculation see relevant tables.

CROP MODEL - OTHER PRODUCTION
PLANS A, B, D & E

	Garlic, Onion, Shallot, Chili.							Sugarcane							Beans						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER																					
Tons - 1,000	0	0.3	0.6	0.9	1.2	1.5		0	0	0	0	0	0		0	0.5	0.9	1.4	1.8	2.3	
Crops Tons-1,000	0	0.9	1.8	2.7	3.6	4.5		0	0	0	0	0	0		0	1.0	1.8	2.8	3.6	4.6	
UN-IRRIGATED LAND																					
Area, Rai-1,000	140	140	139	139	139	139		188	190	193	196	199	202		30	28	32	38	48	63	
Productivity Kg/Rai	300	304	309	313	318	323		4000	4060	4121	4183	4245	4309		135	137	139	141	143	145	
Production Tons-1,000	42.0	42.5	43.0	43.7	44.2	44.9		750	773	796	820	844	869		4.5	3.8	4.4	5.3	6.9	9.1	
IRRIGATED LAND																					
Area, Rai - 1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL																					
Area, Rai-1,000	140	140	139	139	139	139		188	190	193	196	199	202		33	28	32	38	48	63	
Crops, Tons-1,000	42.0	43.4	44.8	46.4	47.8	49.4		750	773	796	820	844	869		4.5	4.8	6.2	8.1	10.5	13.7	
INCREMENTAL BENEFIT																					
Value added/ton Baht	5000	5000	5000	5000	5000	5000		80	80	80	80	80	80		2000	2000	2000	2000	2000	2000	
Increment V.A. M. Baht	0	7.0	14.0	22.0	28.0	36.0	107.0	0	1.84	3.68	5.60	7.52	9.52	28.16	0	0.60	3.40	7.20	12.00	18.40	41.60
COSTS																					
Irrig. Canals, M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizers M. Baht	0	0.7	1.3	2.0	2.7	3.3	10.0	-	-	-	-	-	-	0	0	1.0	1.8	2.8	3.6	4.6	13.8
Infrastructure M. Baht	0	0	-.08	-.08	-.08	-.08	-0.32	0	0.16	0.40	0.65	0.89	1.13	3.23	0	-.40	-.08	0.40	1.22	2.44	3.58
Change Agent M. Baht	0	0.30	0.30	0.30	0.30	0.30	1.50	0	0.30	0.30	0.30	0.30	0.30	1.50	0	0.75	0.75	0.75	0.75	0.75	3.75
Total M. Baht	0	1.00	1.52	2.22	2.92	3.52	11.18	0	0.46	0.70	0.95	1.19	1.43	4.73	0	1.35	2.47	3.95	5.57	7.79	21.49
Government Total M. Baht	0	0.50	0.52	0.72	0.92	1.02	3.68	0	0.46	0.70	0.95	1.19	1.43	4.73	0	0.60	1.12	1.85	2.87	4.34	10.78
BENEFIT/COST																					
Overall	-	-	-	-	-	-	9.57	-	-	-	-	-	-	7.55	-	-	-	-	-	-	1.97
Government	-	-	-	-	-	-	29.07	-	-	-	-	-	-	7.55	-	-	-	-	-	-	3.86
SUMMARY																					
V.A. Total. M. Baht	-	217	224	232	239	247	1159	-	62	64	66	68	70	330	-	10	12	16	21	27	86
ADDITIONAL INPUTS																					
Un-Irrigated Rai-1,000	-	-	-	-	-	-	-1	-	-	-	-	-	-	14	-	-	-	-	-	-	30
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	4.5	-	-	-	-	-	-	0	-	-	-	-	-	-	6.9

CROP MODEL - OTHER CROPS PRODUCTION
PLANS A, B, D & E

	Groundnuts							Tobacco							Cassava						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER																					
Tons - 1,000	0	0.3	0.6	0.9	1.2	1.5		0	0.3	0.6	0.9	1.2	1.5		0	0	0	0	0	0	
Crops Tons-1,000	0	0.9	1.8	2.7	3.6	4.5		0	0.9	1.8	2.7	3.6	4.5		0	0	0	0	0	0	
UN-IRRIGATED LAND																					
Area, Rai-1,000	166	166	166	166	166	166		130	130	130	130	131	132		120	120	123	125	127	132	
Productivity Kg/Rai	210	213	216	220	223	226		155	156	158	159	160	161		1960	1989	2012	2050	2080	2111	
Production Tons-1,000	34.9	35.4	35.9	36.4	36.9	37.5		20.1	20.3	20.5	20.7	20.9	21.2		235	239	248	257	265	278	
IRRIGATED LAND																					
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL																					
Area, Rai-1,000	166	166	166	166	166	166		130	130	130	130	131	132		120	120	123	125	127	132	
Crops, Tons-1,000	34.9	36.0	37.1	38.2	39.3	40.5		20.1	21.2	22.3	23.2	24.5	25.7		235	239	248	257	265	278	
INCREMENTAL BENEFIT																					
Value added/ton Baht	2170	2170	2170	2170	2170	2170		7500	7500	7500	7500	7500	7500		230	230	230	230	230	230	
Increment V.A. M. Baht	0	2.40	4.80	7.19	9.59	12.21	36.19	0	8.25	16.50	24.00	33.00	42.00	123.7	0	0.92	2.99	5.06	6.90	9.89	25.76
COSTS																					
Irrigation Canals, M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr., M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizers M. Baht	0	0.7	1.3	2.0	2.7	3.3	10.0	0	0.7	1.3	2.0	2.7	3.3	10.0	-	-	-	-	-	-	0
Infrastructure M. Baht	0	0	0	0	0	0	0	0	0	0	0	0.08	0.16	0.24	0	0	0.24	0.41	0.57	0.97	2.19
Change Agent M. Baht	0	0.30	0.30	0.30	0.30	0.30	1.50	0	0.30	0.30	0.30	0.30	0.30	1.50	0	0.30	0.30	0.30	0.30	0.30	1.50
Total M. Baht	0	1.00	1.60	2.30	3.00	3.60	11.50	0	1.00	1.60	2.30	3.08	3.76	11.74	0	0.30	0.54	0.71	0.87	1.27	3.69
Government Total M. Baht	0	0.50	0.60	0.80	1.00	1.10	4.00	0	0.50	0.60	0.80	1.08	1.26	4.24	0	0.30	0.54	0.71	0.87	1.27	3.69
BENEFIT/COST																					
Overall	-	-	-	-	-	-	3.14	-	-	-	-	-	-	10.54	-	-	-	-	-	-	6.98
Government	-	-	-	-	-	-	9.04	-	-	-	-	-	-	29.19	-	-	-	-	-	-	6.98
SUMMARY																					
V.A. Total M. Baht	-	78	81	83	86	88	416	-	159	167	174	184	93	877	-	55	57	59	61	64	296
ADDITIONAL INPUTS																					
Un-Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	2	-	-	-	-	-	-	12
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	4.5	-	-	-	-	-	-	4.5	-	-	-	-	-	-	0

CROP MODEL - OTHER CROPS PRODUCTION
PLANS A, B, D & E

	Cotton							Kenaf							Sorghum						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER																					
Tons - 1,000	0	1	2	3	4	5		0	3	6	9	12	15		0	0.3	0.6	0.9	1.2	1.5	
Crops Tons-1,000	0	1.8	3.6	5.4	7.2	9.1		0	3.75	7.50	11.3	15.0	18.7		0	1.2	2.4	3.6	4.8	6.0	
UN-IRRIGATED LAND																					
Area, Rai-1,000	275	287	302	318	335	350		1609	1622	1635	1657	1674	1683		82	96	99	104	113	118	
Productivity Kg/Rai	120	122	124	125	127	129		207	209	211	213	215	218		250	249	247	246	245	243	
Production Ton-1,000	33.0	35.0	37.4	39.7	42.5	45.1		333	339	345	353	360	367		20.6	23.8	24.4	25.5	27.6	28.7	
IRRIGATED LAND																					
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
Production Ton-1,000	-	-	-	-	-	-		-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL																					
Area, Rai-1,000	275	287	302	318	335	350		1609	1622	1635	1657	1674	1683		82	96	99	104	113	118	
Crops, Tons-1,000	33.0	36.8	41.0	45.1	49.7	54.2		333	343	353	364	375	386		20.6	25.0	26.8	29.1	32.4	34.7	
INCREMENTAL BENEFIT																					
Value added/ton Baht	2880	2880	2880	2880	2880	2880		1888	1888	1888	1888	1888	1888		700	700	700	700	700	700	
Increment V.A. M. Baht	0	11.9	23.0	34.8	48.1	61.1	178.9	0	18.9	37.8	58.5	79.3	100	294.5	0	3.08	4.34	5.95	8.26	9.87	31.50
COSTS																					
Irrigation Canals, M. ฿	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr., M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizers M. Baht	0	2.9	5.8	8.7	11.6	14.6	43.4 1/	0	6.0	12.0	18.0	24.0	30.0	90.0	0	0.6	1.2	1.8	2.4	3.0	9.0
Infrastructure M. Baht	0	0.97	2.19	3.48	4.86	6.08	17.58	0	1.05	2.10	3.89	5.27	5.99	18.3	0	1.13	1.38	1.78	2.51	2.92	9.72
Change Agent M. Baht	0	0.75	0.75	0.75	0.75	0.75	3.75	0	0.75	0.75	0.75	0.75	0.75	3.75	0	0.30	0.30	0.30	0.30	0.30	1.50
Total M. Baht	0	4.62	8.74	12.9	17.2	21.4	64.73	0	7.80	14.9	22.6	30.0	36.8	112.1	0	2.03	2.88	3.88	5.21	6.22	20.22
Government Total M. Baht	0	2.44	4.39	6.36	8.51	10.5	32.18	0	3.30	5.95	10.1	12.0	14.2	45.65	0	1.58	1.98	2.53	3.41	3.97	13.47
BENEFIT/COST																					
Overall	-	-	-	-	-	-	2.77	-	-	-	-	-	-	2.63	-	-	-	-	-	-	1.56
Government	-	-	-	-	-	-	5.56	-	-	-	-	-	-	6.45	-	-	-	-	-	-	2.34
SUMMARY																					
V.A. Total M. Baht	-	106	118	130	143	156	653	-	647	666	687	708	729	3437	-	18	19	20	23	24	104
ADDITIONAL INPUTS																					
Un-Irrigated Rai-1,000	-	-	-	-	-	-	75	-	-	-	-	-	-	74	-	-	-	-	-	-	3.6
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	15	-	-	-	-	-	-	4.5	-	-	-	-	-	-	4.5

1/ Agrochemicals added to fertilizer in ratio of 20 fertilizer to 1 agrochemical.

CROP MODEL - OTHER CROPS PRODUCTION
PLANS A, B, D & E

	Maize							Crops/Excluding Paddy, Fruit & Vegetable						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons - 1,000	0	2.0	4.0	6.0	8.0	10.0		0	7.7	15.3	23.0	30.6	38.3	
Crops Tons-1,000	0	8.0	16.0	24.0	32.0	40.0		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	882	1038	1096	1163	1237	1335		3625	3817	3915	4036	4169	4320	
Productivity Kg/Rai	211	210	209	208	207	206		-	-	-	-	-	-	
Production Ton-1,000	186	218	229	242	256	275		-	-	-	-	-	-	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Ton-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	882	1038	1096	1163	1237	1335		3625	3817	3915	4036	4169	4320	
Crops, Tons-1,000	186	226	245	266	288	315		-	-	-	-	-	-	
INCREMENTAL BENEFIT														
Value added/ton Baht	700	700	700	700	700	700		-	-	-	-	-	-	
Increment V.A. M. Baht	0	28.0	41.3	56.0	71.4	90.3	287.0	0	82.9	151.8	226.3	304.1	389.3	1154.4
COSTS														
Irrigation Canals, M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr., M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizers M. Baht	0	4.0	8.0	12.0	16.0	20.0	60.0	0	16.6	32.7	49.3	65.7	82.0	246.3
Infrastructure M. Baht	0	12.6	17.3	23.1	28.8	36.7	118.5	0	15.5	23.5	33.6	44.1	56.3	173.0
Change Agent M. Baht	0	0.75	0.75	0.75	0.75	0.75	3.75	0	4.8	4.8	4.8	4.8	4.8	24.0
Total M. Baht	0	17.4	26.1	35.8	45.5	57.4	182.3	0	36.9	61.0	87.7	114.6	143.1	443.3
Government Total M. Baht	0	14.4	20.1	26.8	33.5	42.4	137.3	0	24.6	36.5	50.7	65.3	81.6	258.6
BENEFIT/COST														
Overall	-	-	-	-	-	-	1.57	-	-	-	-	-	-	2.60
Government	-	-	-	-	-	-	2.09	-	-	-	-	-	-	4.46
SUMMARY														
V.A. Total M. Baht	-	158	172	186	202	221	939	-	1510	1580	1653	1735	1819	8297
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	453	-	-	-	-	-	-	695
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	30	-	-	-	-	-	-	114.9

CROP MODEL - PLAN B

Maximum Fertilizer Plan

	A L L C R O P S						
	1971	1972	1973	1974	1975	1976	Total
FERTILIZER							
Tons 1,000	82	106.7	132.3	158.0	185.6	211.3	
Crops Ton 1,000	-	-	-	-	-	-	
UN-IRRIGATED LAND							
Area Rai 1,000	22082	22309	22446	22605	22781	22975	
Productivity Kg/rai	-	-	-	-	-	-	
Production Tons 1000	-	-	-	-	-	-	
IRRIGATED LAND							
Area Rai 1,000	1020	1020	1020	1020	1020	1020	
Productivity Kg/rai	-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-	
PRODUCTION TOTAL							
Area Rai 1,000	23102	23329	23466	23625	23801	23995	
Crops Tons 1000	-	-	-	-	-	-	
INCREMENTAL BENEFIT							
Value Added/Ton Bht	-	-	-	-	-	-	
Increment V.A. Million Baht	0	227.0	443.0	667.2	899.2	1142.	3378
COSTS							
Irrigation Canals Million Baht	-	-	-	-	-	-	0
Farm District. Million Baht	-	-	-	-	-	-	0
Fertilizer M. Baht	0	50.6	101.7	155.3	211.7	264.0	783.3
Infrastructure Million Baht	0	18.34	29.5	42.68	56.65	72.34	219.5
Change Agent Million Baht	0	5.85	5.85	5.85	5.85	5.85	29.25
Total Million Baht	0	74.79	137.1	203.8	274.2	342.2	1032
Govt. Total M. Baht	0	37.0	60.8	87.3	115.4	144.2	444.7
BENEFIT/COST							
Overall							3.27
Government							7.60
SUMMARY							
V.A. Total M. Baht		6128	6345	6567	6804	7045	32889
ADDITION INPUTS							
Unirrigated Rai 1,000	-	-	-	-	-	-	893
Irrigated Rai 1,000	-	-	-	-	-	-	0
Fertilizer Tons 1000	-	-	-	-	-	-	383.9

CROP MODEL - PLAN B

Maximum Fertilizer Plan

	RICE							FRUIT						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	82	97	113	129	147	163		0	1.0	2.0	3.0	4.0	5.0	
Crops Tons 1,000	451	532	619	709	802	899		0	3	6	9	12	15	
UN-IRRIGATED LAND														
Area, Rai 1,000	17520	17520	17520	17520	17520	17520		463	473	481	488	494	500	
Productivity Kg/Rai	203	205	207	209	211	213		1000	1015	1030	1046	1061	1077	
Production Tons 1,000	3557	3592	3627	3662	3697	3732		463	480	495	510	524	538	
IRRIGATED LAND														
Area, Rai 1,000	1020	1020	1020	1020	1020	1020		-	-	-	-	-	-	
Productivity Kg/Rai	304.5	307.5	310.5	313.5	316.5	319.5		-	-	-	-	-	-	
Production Tons 1,000	311	314	317	320	323	326		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai 1,000	18540	18540	18540	18540	18540	18540		463	473	481	488	494	500	
Crops, Tons 1,000	4318	4438	4503	4690	4822	4957		463	483	501	519	536	553	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	826	826	826	826	826	826		1600	1600	1600	1600	1600	1600	
Increment V.A M. Baht	0	99.12	202.4	307.3	416.3	527.8	1552.9	0	32.0	60.8	89.6	116.8	144.0	443.2
COSTS														
Irrigation Canals M. Bht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm District. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Million Baht	-	30.0	61.0	94.0	130.0	162.0	477.0	0	2.0	4.0	6.0	8.0	10.0	30.0
Infrastructure Million Bht	-	-	-	-	-	-	0	0	0.81	1.46	2.03	2.51	3.00	9.81
Change Agent Million Bht	-	-	-	-	-	-	0	0	0.75	0.75	0.75	0.75	0.75	3.75
Total Million Baht	-	30.0	61.0	94.0	130.0	162.0	477.0	0	3.56	6.21	8.78	11.26	13.75	43.56
Govt. Total Million Baht	-	7.5	15.25	23.5	32.5	40.5	119.2	0	2.06	3.21	4.28	5.26	6.25	21.06
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.26	-	-	-	-	-	-	10.17
Government	-	-	-	-	-	-	13.0	-	-	-	-	-	-	21.0
SUMMARY														
V.A. Total Million Baht	-	3666	3769	3874	3983	4094	19386	-	773	802	830	858	885	4148
ADDITIONAL INPUTS														
Un-irrigated Rai 1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	37
Irrigated Rai 1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons 1,000	-	-	-	-	-	-	239	-	-	-	-	-	-	15

CROP MODEL - PLAN B
Maximum Fertilizer Plan

	Vegetables							Other Crops Aggregate 1/						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	0	1.0	2.0	3.0	4.0	5.0		0	7.7	15.3	23.0	30.6	38.3	
Crops Tons 1,000	0	3	6	9	12	15		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai 1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Productivity Kg/Rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production Tons 1,000	332	355	382	411	444	479		-	-	-	-	-	-	
IRRIGATED LAND														
Area, Rai 1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai 1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Crops, Tons 1,000	332	358	388	420	456	494		-	-	-	-	-	-	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	500	500	500	500	500	500		-	-	-	-	-	-	
Increment V.A. M. Baht	0	13.0	28.0	44.0	62.0	81.0	228.0	0	82.9	151.8	226.3	304.1	389.3	1154.4
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm District M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	0	2.0	4.0	6.0	8.0	10.0	30.0	0	16.6	32.7	49.3	65.7	82.0	246.3
Infrastructure M. Baht	0	2.03	4.54	7.05	10.04	13.04	36.7	0	15.5	23.5	33.6	44.1	56.3	173.0
Change Agent M. Baht	0	0.3	0.3	0.3	0.3	0.3	1.5	0	4.8	4.8	4.8	4.8	4.8	24.0
Total Million Baht	0	4.33	8.84	13.35	18.34	23.34	68.2	0	36.9	61.0	87.7	114.6	143.1	443.3
Govt. Total M. Baht	0	2.83	5.84	8.85	12.34	15.84	45.7	0	24.6	36.5	50.7	65.3	81.6	258.6
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.34	-	-	-	-	-	-	2.60
Government	-	-	-	-	-	-	4.99	-	-	-	-	-	-	4.46
SUMMARY														
V.A. Total Million Baht	-	179	194	210	228	247	1058	-	1510	1580	1653	1735	1819	8297
ADDITIONAL INPUTS														
Un-irrigated Rai 1,000	-	-	-	-	-	-	161	-	-	-	-	-	-	695
Irrigated Rai 1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons 1,000	-	-	-	-	-	-	15	-	-	-	-	-	-	114.9

1/ For individual calculation see relevant tables.

CROP MODEL - PLAN C.
All New Land

	All Crops							Rice						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	82	82	82	82	82	82		82	82	82	82	82	82	
Crops, Tons-1,000	-	-	-	-	-	-		451	451	451	451	451	451	
UN-IRRIGATED LAND														
Area, Rai-1,000	22082	22882	23614	24377	25182	26033		17520	17917	18333	18751	19185	19624	
Productivity Kg/Rai	-	-	-	-	-	-		203	205	207	209	211	213	
Production Tons-1,000	-	-	-	-	-	-		3556	3673	3795	3919	4048	4180	
IRRIGATED LAND														
Area, Rai-1,000	1020	1020	1020	1020	1020	1020		1020	1020	1020	1020	1020	1020	
Productivity Kg/Rai	-	-	-	-	-	-		304.5	307.5	310.5	313.5	316.5	319.5	
Production Tons-1,000	-	-	-	-	-	-		311	314	317	320	323	326	
PRODUCTION TOTAL														
Area, Rai-1,000	23102	23902	24634	25397	26202	27053		18540	18937	19353	19771	20205	20644	
Crops Tons-1,000	-	-	-	-	-	-		4318	4438	4563	4690	4822	4957	
INCREMENTAL BENEFIT														
Value Added/ton Baht	-	-	-	-	-	-		826	826	826	826	826	826	
Increment V.A. M. Baht	0	227.0	443.0	667.2	899.2	114.2	3378	0	99.12	202.4	307.3	416.3	527.8	1552.9
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	64.33	124.1	185.9	251.2	320.6	946.1	-	32.16	65.85	99.71	134.9	170.4	503.0
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	64.33	124.1	185.9	251.2	320.6	946.1	-	32.16	65.85	99.71	134.9	170.4	503.0
Government Total M. Baht	-	64.33	124.1	185.9	251.2	320.6	946.1	-	32.16	65.85	99.71	134.9	170.4	503.0
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.57	-	-	-	-	-	-	3.09
Government	-	-	-	-	-	-	3.57	-	-	-	-	-	-	3.09
SUMMARY														
V.A. Total M. Baht	-	6128	6345	6567	6804	7045	32889	-	3665	3769	3874	3983	4094	19385
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	3951	-	-	-	-	-	-	2104
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Fruit							Garlic, Onion, Shallot, Chilli						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	463	483	501	519	536	553		140	145	149	155	159	165	
Productivity Kg/hai	1000	1000	1000	1000	1000	1000		300	300	300	300	300	300	
Production Tons-1,000	463	483	501	519	536	553		42.0	43.4	44.8	46.4	47.8	49.4	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/hai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	463	483	501	519	536	553		140	145	149	155	159	165	
Crops Tons-1,000	463	483	501	519	536	553		42.0	43.4	44.8	46.4	47.8	49.4	
INCREMENTAL BENEFIT														
Value Added/ton Baht	1600	1600	1600	1600	1600	1600		5000	5000	5000	5000	5000	5000	
Increment V.A. M. Baht	0	32.0	60.8	89.6	116.8	144.0	443.2	0	7.0	14.0	22.0	28.0	36.0	107.0
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-		-	-	-	-	0
Infrastructure M. Baht	-	1.62	3.08	4.54	5.91	7.29	22.44	-	0.41	0.73	1.22	1.54	2.03	5.93
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	1.62	3.08	4.54	5.91	7.29	22.44	-	0.41	0.73	1.22	1.54	2.03	5.93
Government Total M. Baht	-	1.62	3.08	4.54	5.91	7.29	22.44	-	0.41	0.73	1.22	1.54	2.03	5.93
BENEFIT/COST														
Overall	-	-	-	-	-	-	19.75	-	-	-	-	-	-	18.0
Government	-	-	-	-	-	-	19.75	-	-	-	-	-	-	18.0
SUMMARY														
V.A. Total M. Baht	-	773	802	830	858	885	4148	-	217	224	232	239	247	1159
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	90	-	-	-	-	-	-	25
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Sugarcane							Beans						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	188	193	199	205	211	217		33	36	46	60	78	101	
Productivity Kg/Rai	4000	4000	4000	4000	4000	4000		135	135	135	135	135	135	
Production Tons-1,000	750	773	796	820	844	869		4.5	4.8	6.2	8.1	10.5	13.7	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	188	193	199	205	211	217		33	36	46	60	78	101	
Crops Tons-1,000	750	773	796	820	844	869		4.5	4.8	6.2	8.1	10.5	13.7	
INCREMENTAL BENEFIT														
Value Added/ton Baht	80	80	80	80	80	80		2000	2000	2000	2000	2000	2000	
Increment V.A. M. Baht	0	1.84	3.68	5.60	7.52	9.52	28.16	0	0.60	3.40	7.20	12.00	18.40	41.60
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	0.41	0.89	1.38	1.86	2.35	6.89	-	0.24	1.05	2.19	3.65	5.51	12.64
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	0.41	0.89	1.38	1.86	2.35	6.89	-	0.24	1.05	2.19	3.65	5.51	12.64
Government Total M. Baht	-	0.41	0.89	1.38	1.86	2.35	6.89	-	0.24	1.05	2.19	3.65	5.51	12.64
BENEFIT/COST														
Overall	-	-	-	-	-	-	4.19	-	-	-	-	-	-	3.29
Government	-	-	-	-	-	-	4.19	-	-	-	-	-	-	3.29
SUMMARY														
V.A. Total M. Baht	-	62	64	66	68	70	330	-	10	12	16	21	27	86
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	29	-	-	-	-	-	-	68
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Groundnuts							Tobacco						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	166	171	177	182	187	193		130	138	146	153	162	171	
Productivity Kg/Rai	210	210	210	210	210	210		155	154	153	152	151	150	
Production Tons-1,000	34.9	36.0	37.1	38.2	39.3	40.5		20.1	21.2	22.3	23.2	24.5	25.7	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	166	171	177	182	187	193		130	138	146	153	162	171	
Crops Tons-1,000	34.9	36.0	37.1	38.2	39.3	40.5		20.1	21.2	22.3	23.2	24.5	25.7	
INCREMENTAL BENEFIT														
Value Added/ton Baht	2170	2170	2170	2170	2170	2170		7500	7500	7500	7500	7500	7500	
Increment V.A. M. Baht	0	2.40	4.80	7.19	9.59	12.21	36.19	0	8.25	16.50	24.00	33.00	42.00	123.7
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	0.41	0.89	1.30	1.70	2.19	6.49	-	0.16	1.30	1.86	2.59	3.32	9.23
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	0.41	0.89	1.30	1.70	2.19	6.49	-	0.16	1.30	1.86	2.59	3.32	9.23
Government Total M. Baht	-	0.41	0.89	1.30	1.70	2.19	6.49	-	0.16	1.30	1.86	2.59	3.32	9.23
BENEFIT/COST														
Overall	-	-	-	-	-	-	5.57	-	-	-	-	-	-	13.4
Government	-	-	-	-	-	-	5.57	-	-	-	-	-	-	13.4
SUMMARY														
V.A. Total M. Baht	-	78	81	83	86	88	416	-	159	167	174	184	193	872
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	27	-	-	-	-	-	-	41
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Cassava							Cotton						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	120	122	126	131	135	142		275	307	342	376	414	452	
Productivity Kg/Rai	1960	1960	1960	1960	1960	1960		120	120	120	120	120	120	
Production Tons-1,000	235	239	248	257	265	278		33.0	36.8	41.0	45.1	49.7	54.2	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	120	122	126	131	135	142		275	307	342	376	414	452	
Crops Tons-1,000	235	239	248	257	265	278		33.0	36.8	41.0	45.1	49.7	54.2	
INCREMENTAL BENEFIT														
Value Added/ton Baht	230	230	230	230	230	230		2880	2880	2880	2880	2880	2880	
Increment V.A. M. Baht	0	0.92	2.99	5.06	6.90	9.89	25.76	0	11.9	23.0	34.8	48.1	61.1	178.9
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	0.16	0.49	0.89	1.22	1.78	4.54	-	2.59	5.43	8.18	11.26	14.34	41.80
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	0.16	0.49	0.89	1.22	1.78	4.54	-	2.59	5.43	8.18	11.26	14.34	41.80
Government Total M. Baht	-	0.16	0.49	0.89	1.22	1.78	4.54	-	2.59	5.43	8.18	11.26	14.34	41.80
BENEFIT/COST														
Overall	-	-	-	-	-	-	5.67	-	-	-	-	-	-	4.28
Government	-	-	-	-	-	-	5.67	-	-	-	-	-	-	4.28
SUMMARY														
V.A. Total M. Baht	-	55	57	59	61	64	296	-	106	118	130	143	156	653
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	22	-	-	-	-	-	-	177
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Kenaf							Vegetables						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	1609	1665	1722	1784	1847	1911		474	511	554	600	651	706	
Productivity Kg/Rai	207	206	205	204	203	202		700	700	700	700	700	700	
Production Tons-1,000	333	343	353	364	375	386		332	358	388	420	456	494	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	1609	1665	1722	1784	1847	1911		474	511	554	600	651	706	
Crops Tons-1,000	333	343	353	364	375	386		332	358	388	420	456	494	
INCREMENTAL BENEFIT														
Value Added/ton Baht	1888	1888	1888	1888	1888	1888		500	500	500	500	500	500	
Increment V.A. M. Baht	-	18.9	37.8	58.5	79.3	100	294.5	-	13.0	28.0	44.0	62.0	81.0	228.0
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	4.54	9.15	14.18	19.28	24.46	71.61	-	3.00	6.48	10.21	14.34	18.79	52.82
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	4.54	9.15	14.18	19.28	24.46	71.61	-	3.00	6.48	10.21	14.34	18.79	52.82
Government Total M. Baht	-	4.54	9.15	14.18	19.28	24.46	71.61	-	3.00	6.48	10.21	14.34	18.79	52.82
BENEFIT/COST														
Overall	-	-	-	-	-	-	4.11	-	-	-	-	-	-	4.31
Government	-	-	-	-	-	-	4.11	-	-	-	-	-	-	4.31
SUMMARY														
V.A. Total M. Baht	-	647	666	687	708	729	3437	-	179	194	210	228	247	1058
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	302	-	-	-	-	-	-	232
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN C.
All New Land

	Sorghum							Maize						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Crops, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	82	102	112	124	140	154		882	1092	1207	1337	1477	1644	
Productivity Kg/Rai	250	245	240	235	231	226		211	207	203	199	195	191	
Production, Tons-1,000	20.6	25.0	26.8	29.1	32.4	34.7		186	226	245	266	288	315	
IRRIGATED LAND														
Area, Rai-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/Rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production, Tons-1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	82	102	112	124	140	154		882	1092	1207	1337	1477	1644	
Crops Tons-1,000	20.6	25.0	26.8	29.1	32.4	34.7		186	226	245	266	288	315	
INCREMENTAL BENEFIT														
Value Added/ton Baht	700	700	700	700	700	700		700	700	700	700	700	700	
Increment V.A. M. Baht	0	3.08	4.34	5.95	8.26	9.87	31.50	0	28.0	41.3	56.0	71.4	90.3	287.0
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Infrastructure M. Baht	-	1.62	2.43	3.40	4.70	5.83	17.98	-	17.01	26.33	36.86	48.20	61.72	190.1
Change Agent M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Total M. Baht	-	1.62	2.43	3.40	4.70	5.83	17.98	-	17.01	26.33	36.86	48.20	61.72	190.1
Government Total M. Baht	-	1.62	2.43	3.40	4.70	5.83	17.98	-	17.01	26.33	36.86	48.20	61.72	190.1
BENEFIT/COST														
Overall	-	-	-	-	-	-	1.76	-	-	-	-	-	-	1.51
Government	-	-	-	-	-	-	1.76	-	-	-	-	-	-	1.51
SUMMARY														
V.A. Total M. Baht	-	18	19	20	23	24	104	-	158	172	186	202	221	9.39
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	72	-	-	-	-	-	-	762
Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0

CROP MODEL - PLAN D

No Change

	ALL CROPS						
	1971	1972	1973	1974	1975	1976	Total
FERTILIZER							
Tons 1,000	82	99.7	117.3	135.0	153.6	172.3	
Crops tons 1,000	-	-	-	-	-	-	
UN-IRRIGATED LAND							
Area Rai 1,000	22082	22459	22756	23085	23441	23815	
Productivity Kg/rai	-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-	
IRRIGATED LAND							
Area Rai 1,000	1020	1045	1070	1095	1120	1145	
Productivity Kg/rai	-	-	-	-	-	-	
Production Tons	-	-	-	-	-	-	
PRODUCTION TOTAL							
Area Rai 1,000	23102	23504	23826	24180	24561	24960	
Crops Tons 1,000	-	-	-	-	-	-	
INCREMENTAL BENEFIT							
Value Added/Ton Baht	-	-	-	-	-	-	
Increment V.A.M. Baht	0	227.0	443.0	667.2	899.2	1142	3378
COSTS							
Irrigation Canals Mil.Baht	0	1.45	2.90	4.35	5.80	7.25	21.75
Farm District Mil. Baht	0	0.65	1.30	1.95	2.60	3.25	9.75
Fertilizers Mil. Baht	0	36.6	72.7	109.3	147.7	186.0	552.3
Infrastructure Mil. Baht	0	32.52	58.66	87.64	118.2	150.5	447.5
Change Agent Mil. Baht	0	5.85	5.35	5.85	5.85	5.85	29.25
Total Mil. Baht	0	77.07	141.4	209.1	280.2	352.9	1061
Govt. Total Mil. Baht	0	45.77	78.91	115.1	152.9	192.4	585.0
B EMEFIT/COST							
Overall							3.18
Government							5.77
SUMMARY							
V.A. Total Mil. Baht	0	6128	6245	6567	6804	7045	32889
ADDITIONAL INPUTS							
Unirrigated Rai 1,000	-	-	-	-	-	-	1733
Irrigated Rai 1,000	-	-	-	-	-	-	125
Fertilizes Tons 1,000	-	-	-	-	-	-	267.9

CROP MODEL - PLAN D
No Change Plan

	RICE							FRUIT						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	82	90	98	106	115	124		0	1.0	2.0	3.0	4.0	5.0	
Crops Tons 1,000	451	494	540	586	633	681		0	3	6	9	12	15	
UNIRRIGATED LAND														
Area Rai 1,000	17520	17670	17830	18000	18180	18360		463	473	481	488	494	500	
Productivity Kg/rai	205	205	207	209	211	213		1000	1015	1030	1046	1061	1077	
Production Tons 1,000	3557	3623	3691	3761	3835	3910		463	480	495	510	524	538	
IRRIGATED LAND														
Area Rai 1,000	1020	2045	1070	1095	1120	1145		-	-	-	-	-	-	
Productivity Kg/rai	304.5	307.5	310.5	313.5	316.5	319.5		-	-	-	-	-	-	
Production Tons 1,000	311	321	332	343	354	366		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area Rai 1,000	18540	18715	18900	19095	19300	19505		463	473	481	488	494	500	
Crops Tons 1,000	4318	4438	4563	4690	4822	4957		463	483	501	519	536	553	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	826	826	826	826	826	826		1600	1600	1600	1600	1600	1600	
Incremental VA M. Baht	0	99.12	202.4	307.3	416.3	527.8	1552.9	0	32.0	60.8	89.6	116.8	144.0	443.2
COSTS														
Irrigation Canals M. Baht	-	1.45	2.90	4.35	5.80	7.25	21.75	-	-	-	-	-	-	0
Farm District M. Baht	-	0.65	1.30	1.95	2.60	3.25	9.75	-	-	-	-	-	-	0
Fertilizers M. Baht	-	16.0	32.0	48.0	66.0	84.0	246.0	0	2.0	4.0	6.0	8.0	10.0	30.0
Infrastructure M. Baht	-	14.18	29.16	44.96	61.56	78.17	228.0	0	0.81	1.46	2.03	2.51	3.00	9.81
Change Agent M. Baht	-	-	-	-	-	-	0	0	0.75	0.75	0.75	0.75	0.75	3.75
Total M. Baht	-	32.28	65.36	99.26	135.96	172.7	505.6	0	3.56	6.21	8.78	11.26	13.75	43.56
Govt. Total M. Baht		16.28	33.36	51.26	69.96	88.7	259.6	0	2.06	3.21	4.28	5.26	6.25	21.06
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.07	-	-	-	-	-	-	10.17
Government	-	-	-	-	-	-	5.98	-	-	-	-	-	-	21.0
SUMMARY														
V.A. Total M. Baht	-	3666	3769	3874	3983	4094	19386	-	773	802	830	858	885	4148
ADDITIONAL INPUTS														
Unirrigated Rai 1,000	-	-	-	-	-	-	840	-	-	-	-	-	-	37
Irrigated Rai 1,000	-	-	-	-	-	-	125	-	-	-	-	-	-	0
Fertilizer Tons 1,000	-	-	-	-	-	-	123	-	-	-	-	-	-	15

CROP MODEL - PLAN D
No Change Plan

	VEGETABLES							OTHER CROPS AGGREGATE 1/						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons 1,000	0	1.0	2.0	3.0	4.0	5.0		0	7.7	15.3	23.0	30.6	38.3	
Crops Tons 1,000	0	3	6	9	12	15		-	-	-	-	-	-	
UNIRRIGATED LAND														
Area Rai 1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Productivity Kg/rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production Tons 1,000	332	355	382	411	444	479		-	-	-	-	-	-	
IRRIGATED LAND														
Area Rai 1,000	-	-	-	-	-	-		-	-	-	-	-	-	
Productivity Kg/rai	-	-	-	-	-	-		-	-	-	-	-	-	
Production Tons 1,000	-	-	-	-	-	-		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area Rai 1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Crop Tons 1,000	332	358	388	420	456	494		-	-	-	-	-	-	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	500	500	500	500	500	500		-	-	-	-	-	-	
Incremental VA M. Baht	0	13.0	28.0	44.0	62.0	81.0	228.0	0	82.9	151.8	226.3	304.1	398.3	1154.4
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Farm District M. Baht	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizers M. Baht	0	2.0	4.0	6.0	8.0	10.0	30.0	0	16.6	32.7	49.3	65.7	82.0	246.3
Infrastructure M. Baht	0	2.03	4.54	7.05	10.04	13.04	36.7	0	15.5	23.5	33.6	44.1	56.3	173.0
Change Agent M. Baht	0	0.3	0.3	0.3	0.3	0.3	1.5	0	4.8	4.8	4.8	4.8	4.8	24.0
Total M. Baht	0	4.33	8.84	13.35	18.34	23.34	68.2	0	36.9	61.0	87.7	114.6	143.1	443.3
Govt. Total M. Baht	0	2.83	5.84	8.85	12.34	15.84	45.7	0	24.6	36.5	50.7	65.3	81.6	258.6
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.34	-	-	-	-	-	-	2.60
Government	-	-	-	-	-	-	4.99	-	-	-	-	-	-	4.46
SUMMARY														
V.A. Total M. Baht	-	179	194	210	228	247	1058	-	1510	1580	1653	1735	1819	8297
ADDITIONAL INPUTS														
Unirrigated Rai 1,000	-	-	-	-	-	-	161	-	-	-	-	-	-	695
Irrigated Rai 1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	0
Fertilizer Tons 1,000	-	-	-	-	-	-	15	-	-	-	-	-	-	114.9

1/ For individual calculation see relevant tables.

CROP MODEL - PLAN E.
Recommended Plan

	All Crops						
	1971	1972	1973	1974	1975	1976	Total
FERTILIZER							
Tons-1,000	82	103.7	126.3	149.0	172.6	197.3	
Crops, Tons-1,000	-	-	-	-	-	-	
UN-IRRIGATED LAND							
Area, Rai-1,000	22084	22291	22408	22548	22704	22880	
Productivity Kg/Rai	-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-	
IRRIGATED LAND							
Area, Rai-1,000	1020	1070	1120	1170	1220	1270 1/	
Productivity Kg/Rai	-	-	-	-	-	-	
Production Tons-1,000	-	-	-	-	-	-	
PRODUCTION TOTAL							
Area, Rai-1,000	23104	23361	23528	23718	23924	24150	
Crops Tons-1,000	-	-	-	-	-	-	
INCREMENTAL BENEFIT							
Value Added/ton Baht	-	-	-	-	-	-	
Increment V.A. M. Baht	0	227.0	443.0	667.2	899.2	1142	3378
COSTS							
Irrigation Canals M. Baht	0	2.9	5.8	8.7	11.6	14.5	43.5
Farm Distr. M. Baht	0	1.3	2.6	3.9	5.2	6.5	19.5
Fertilizer M. Baht	0	44.6	90.7	137.3	185.7	236.0	694.3
Infrastructure M. Baht	0	20.77	34.28	49.97	66.37	84.1	255.8
Change Agent M. Baht	0	5.85	5.85	5.85	5.85	5.85	29.25
Total M. Baht		75.42	139.2	205.7	274.7	347.3	1042
Government Total M. Baht		41.97	71.10	102.8	135.5	170.3	522
BENEFIT/COST							
Overall	-	-	-	-	-	-	3.24
Government	-	-	-	-	-	-	6.47
SUMMARY							
V.A. Total M. Baht	-	6128	6345	6567	6804	7045	32889
ADDITIONAL INPUTS							
Un-Irrigated Rai-1,000	-	-	-	-	-	-	796
Irrigated Rai-1,000	-	-	-	-	-	-	250
Fertilizer Tons-1,000	-	-	-	-	-	-	388.9

1/ Plus 100,000 rai double cropping.

CROP MODEL - PLAN E.
Recommended Plan

	Rice							Fruit						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	82	94	107	120	134	149		0	1.0	2.0	3.0	4.0	5.0	
Crops, Tons-1,000	450	517	588	661	739	819		0	3	6	9	12	15	
UN-IRRIGATED LAND														
Area, Rai-1,000	17522	17522	17522	17522	17522	17522		463	463	461	459	456	453	
Productivity Kg/Rai	203	205	207	209	211	213		1000	1015	1030	1046	1061	1077	
Production Tons-1,000	3557	3592	3627	3662	3697	3732		463	470	474	479	482	484	
IRRIGATED LAND														
Area, Rai-1,000	1020	1070	1120	1170	1220	1270		0	10	20	30	40	50 1/	
Productivity Kg/Rai	304.5	307.5	310.5	313.5	316.5	319.5		1000	1015	1030	1046	1061	1077	
Production Tons-1,000	311	329	348	367	386	406		0	10	21	31	42	54	
PRODUCTION TOTAL														
Area, Tons-1,000	18542	18592	18642	18692	18742	18792		463	473	481	489	496	503	
Crops, Tons-1,000	4318	4438	4563	4690	4822	4957		463	483	501	519	536	553	
INCREMENTAL BENEFIT														
Value Added/ton Baht	826	826	826	826	826	826		1600	1600	1600	1600	1600	1600	
Increment V.A. M. Baht	0	99.12	202.4	307.3	416.3	527.8	1552.9	0	32.0	60.8	89.6	116.8	144.0	443.2
COSTS														
Irrigation Canals M. Baht	0	2.9	5.8	8.7	11.6	14.5	43.5	-	-	-	-	-	-	- 2/
Farm Distr. M. Baht	0	1.3	2.6	3.9	5.2	6.5	19.5	-	-	-	-	-	-	- 2/
Fertilizer M. Baht	0	24.0	50.0	76.0	104.0	134.0	388.0	0	2.0	4.0	6.0	8.0	10.0	30.0
Infrastructure M. Baht	0	4.05	8.10	12.15	16.20	20.25	60.75	0	0	-0.24	-0.40	-0.73	-1.13	-2.50
Change Agent M. Baht	-	-	-	-	-	-	0	0	0.75	0.75	0.75	0.75	0.75	3.75
Total M. Baht	0	32.25	66.50	100.7	137.0	175.3	511.7	0	2.75	4.51	6.35	8.02	9.62	31.25
Government Total M. Baht	0	14.25	29.0	43.75	59.0	74.75	220.7	0	1.25	1.51	1.85	2.02	2.12	8.75
BENEFIT/COST														
Overall	-	-	-	-	-	-	3.03	-	-	-	-	-	-	14.2
Government	-	-	-	-	-	-	7.04	-	-	-	-	-	-	50.6
SUMMARY														
V.A. Total M. Baht	-	3666	3769	3874	3983	4094	19386	-	773	802	830	858	885	4148
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	0	-	-	-	-	-	-	14
Irrigated Rai-1,000	-	-	-	-	-	-	250	-	-	-	-	-	-	50 1/
Fertilizer Tons-1,000	-	-	-	-	-	-	194	-	-	-	-	-	-	15

1/ Double cropping

2/ There should be a portion of the cost of the irrigation, but no attempt has been made to allocate it.

CROP MODEL - PLAN E.
Recommended Plan

	Vegetables							Other Crops Aggregate 3/						
	1971	1972	1973	1974	1975	1976	Total	1971	1972	1973	1974	1975	1976	Total
FERTILIZER														
Tons-1,000	0	1.0	2.0	3.0	4.0	5.0		0	7.7	15.3	23.0	30.6	38.3	
Crops, Tons-1,000	0	3	6	9	12	15		-	-	-	-	-	-	
UN-IRRIGATED LAND														
Area, Rai-1,000	474	489	510	531	557	585		3625	3817	3915	4036	4169	4320	
Productivity Kg/Rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production, Tons-1,000	332	348	368	389	414	441		-	-	-	-	-	-	
IRRIGATED LAND														
Area, Rai-1,000	0	10	20	30	40	50 1/		-	-	-	-	-	-	
Productivity Kg/Rai	700	711	721	732	743	754		-	-	-	-	-	-	
Production, Tons-1,000	0	7	14	22	30	38		-	-	-	-	-	-	
PRODUCTION TOTAL														
Area, Rai-1,000	474	499	530	561	598	635		3625	3817	3915	4036	4169	4320	
Crops, Tons-1,000	332	358	388	420	456	494		-	-	-	-	-	-	
INCREMENTAL BENEFIT														
Value Added/Ton Baht	500	500	500	500	500	500		-	-	-	-	-	-	
Increment V.A. M. Baht	0	13.0	28.0	44.0	62.0	81.0	228.0	0	82.9	151.8	226.3	304.1	389.3	1154.4
COSTS														
Irrigation Canals M. Baht	-	-	-	-	-	-	- 2/	-	-	-	-	-	-	0
Farm Distr. M. Baht	-	-	-	-	-	-	- 2/	-	-	-	-	-	-	0
Fertilizer M. Baht	0	2.0	4.0	6.0	8.0	10.0	30.0	0	16.6	32.7	49.3	65.7	82.0	246.3
Infrastructure M. Baht	0	1.22	2.92	4.62	6.80	8.99	24.55	0	15.5	23.5	33.6	44.1	56.3	173.0
Change Agent M. Baht	0	0.3	0.3	0.3	0.3	0.3	1.5	0	4.8	4.8	4.8	4.8	4.8	24.0
Total M. Baht	0	3.52	7.22	10.92	15.10	19.29	56.05	0	36.9	61.0	87.7	114.6	143.1	443.3
Government Total M. Baht	0	2.02	4.22	6.42	9.10	11.79	33.55	0	24.6	36.5	50.7	65.3	81.6	258.6
BENEFIT/COST														
Overall	-	-	-	-	-	-	4.07	-	-	-	-	-	-	2.60
Government	-	-	-	-	-	-	6.80	-	-	-	-	-	-	4.46
SUMMARY														
V.A. Total M. Baht	-	179	194	210	228	247	1058	-	1510	1580	1653	1735	1819	8297
ADDITIONAL INPUTS														
Un-Irrigated Rai-1,000	-	-	-	-	-	-	111	-	-	-	-	-	-	695
Irrigated Rai-1,000	-	-	-	-	-	-	50 1/	-	-	-	-	-	-	0
Fertilizer Tons-1,000	-	-	-	-	-	-	15	-	-	-	-	-	-	114.9

1/ Double Cropping

2/ There should be a portion of the costs of the irrigation, but no attempt has been made to allocate it.

3/ For individual calculation se relevent tables.

6.3 Summary of Results

The following table summarizes the main results of the use of the model to determine the outcome of the five different plans.

SUMMARY OF RESULTS

	Incremental Fertilizer Tons 1000	Total Land Rai, 1000	Cost		Benefit/Cost	
			Overall M. Baht	Govt. M. Baht	Overall	Govt.
Plan A. Maximum Irrigation	267.9	24,425	1,148	672.8	2.94	5.02
Plan B. Maximum Fertilizer	383.9	23,995	1,032	444.7	3.27	7.60
Plan C. All New Land	0	27,053	946.1	946.1	3.57	3.57
Plan D. No Change	267.9	24,960	1,061	585.0	3.18	5.77
Plan E. Recommended	338.9	24,150	1,042	522.0	3.24	6.47

Comments

1. The highest overall benefit/cost is obtained by allowing crop production to expand to land which is not now used.

2. From a consideration of government costs the highest benefit/costs results from the plan to increase the use of fertilizer to the maximum. This may conflict with the farmers immediate interest because of the risks involved in investment in fertilizers.

3. The plan to expand the amount of irrigated land to a maximum has the lowest overall benefit/cost and the second lowest considering only government expenditures.

4. The policy of allowing the farmer to meet the production targets by expanding into new land (without using additional fertilizers or irrigation) has the least overall cost (basically farmer cost) but the maximum cost to the government.

5. The policy in (4) also reduces land reserves at an unacceptably high rate.

6. The additional new land which would be used in the "no change" situation causes it to be less desirable and more expensive for the government than the recommended plan.

7. The recommended plan in most respects appears less desirable than the "Maximum Fertilizer" plan, but the latter is largely dependent on the farmer. It is believed that the recommended plan is more realistic and consequently more likely to succeed.

V. AGRICULTURE APPENDIX

FOREWORD

This appendix should be read in conjunction with Volume I of the "Northeast Thailand Economic Development Study", prepared by the NEED Planning Advisory Group. The material in this appendix basically is supporting data and details on which the recommendations for agricultural development in Northeast Thailand during the Third Plan period were based.

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V. AGRICULTURAL APPENDIX

A. INDIVIDUAL NORTHEAST AGRICULTURAL COMMODITY ANALYSIS

1. Rice: Effects of Fertilizer and Insecticide on Rice Production

In order to develop some ratios concerning the effects of fertilizer and insecticide on rice production in the Northeast, an analysis was made of the rice balance sheet and the rice production projections made by the ADB Nongwai study team.

Table 1 shows total Thai fertilizer imports, total value, value per ton, Northeast total expenditure on fertilizer, total tons of fertilizer used in the Northeast, total rice area in the Northeast and fertilizer per rai used in the Northeast.

TABLE 1

Fertilizer Usage 1965 - 69

Thai Fertilizer Imports 1965-69							
	(1) Quantity 000 Tons	(2) Value Million Baht	(3) Ave. Value Per Ton ฿ (2) ÷ (1)	(4) N.E. Exp. on Ferti. Million ฿	(5) (For Rice) Tons Used in N.E. 000 Tons. (4) ÷ (3)	(6) Total Rice Area N.E. 000 Rai	(7) Fert. per rai in N.E. Kg. (5) ÷ (6)
1965	88.95	145.43	1635	46.91	28.691	15,332	1.82
1966	141.42	204.22	1444	92.84	64.29	19,630	3.27
1967	217.95	345.44	1585	66.67	42.06	14,095	2.98
1968	263.49	443.07	1682	84.54	50.26	17,874	2.81
1969	265.63	399.45	1504	95.48	63.48	20,187	3.41
			(Average) 1570 Value per kg. 1.57 Baht				

Source: (1), (2) Dept. of Customs Import Data
(4) (6) Rice Balance Sheet
(3) (5) (7) NEED PAG calculations

Table 2 illustrates the same things but for insecticide.

Assuming that present fertilizer and insecticide applications are spread evenly over the Northeast, the present level of insecticide use is insignificant. Fertilizer application is also low.

Using data from Tables 1 and 2, and the information concerning rice production from the ADB Nongwai Study, an attempt was made to develop relationships concerning the amounts of fertilizer and insecticide used and increased rice production.

TABLE 2

Agrochemical Usage 1965 - 69

	Agrochemical Imports 1965 - 1969						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Quantity 000 Tons	Value Million ฿	Ave. Value Per Ton 000 Baht	N.E. Exp. on Insect. Mill. ฿ (for rice)	(For Rice) Tons Used in N.E.	Total Rice Area N.E. 000 Rai.	Insect. per Rai in N.E. -- Kg.
1965	6.75	89.66	13.28	1.91	143.8	15,332	.009
1966	9.01	208.32	23.12	4.43	191.6	19,630	.01
1967	11.77	179.59	15.26	3.18	208.38	14,095	.015
1968	14.14	198.15	14.01	4.03	287.65	17,874	.016
1969	15.71	230.68	14.68	4.56	310.62	20,187	.015
			Ave. Around 14,000 ฿/Ton Value per kg. 14 ฿/Ton				

Source: (1) (2) Dept, of Customs Import Data
(4) (6) Rice Balance Sheet
(3) (5) (7) NEED PAG Calculation

Appears that present levels of insecticide applications in the N.E. are insignificant.

Fertilizer and Insecticide Adjustment:

The average fertilizer import price is 1.57 baht/kilogram. Interviews and data contained in the Manderstam report suggest that the average retail price in the Northeast is 2.00 baht per kilo or an average markup of 27 percent. For calculating fertilizer usage, the 2.00 baht per kilo figure was used.

Because insecticide follows a distribution system similar to fertilizer, the same 27 percent markup was applied to the insecticide port price in order to get an average Northeast retail price. The average port price is 14 baht per kilo which makes the average NE retail price 17.78 baht per kilo.

The above data illustrates, albeit roughly, the present rice production situation in terms of fertilizer and insecticide in the Northeast. It is quite possible that fertilizer and insecticide usage is concentrated in certain areas, but this has not yet been broken out.

In order to develop input - output relationships between fertilizer and insecticide inputs and rice production output, the present usage data was applied to the Nongwai situation. In Nongwai, the ADB agronomist developed a table on improved rice yields and the necessary cost inputs to achieve them. This is illustrated in Table 3.

TABLE 3

Improved Rice Yields and Necessary Baht Inputs

Proposed Yield Kg/rai	340	450	550
Seed Cost (baht)	5	5	5
Fertilizer Cost	60	75	85
Agrochemical Cost	20	40	60
Incidentals	10	20	30
Total Costs	95	140	180

Source: ADB Nongwai Study

Present rice yields in the Nongwai area are 180 to 200 kilograms per rai.

The present production situation in the Nongwai area in terms of production and inputs is:

1. Present production averages 190 kg. per rai;

2. Present average fertilizer cost is roughly 5 baht per rai or 2.5 kgs/rai (based on Table 1);

3. Present average insecticide cost is 0.2 baht per rai which equals about .012 kilograms per rai. This is an insignificant amount.

Improved Production Situation:

The improved production situation, as defined by the Nongwai team with its implications in terms of additional fertilizer quantities (kilos) and insecticide quantities (kilos) necessary, is shown in Table 4.

Table 5 converts the incremental production quantities into value using a value figure of .8 baht per kilogram of rice which is an assumed value based on a mix of glutinous and non-glutinous rice. The incremental baht return is compared to the incremental baht cost of fertilizer and insecticide to determine the benefit-cost relationship.

Because the present insecticide expenditures are insignificant, the insecticide cost per kilogram is spread over total production per rai rather than incremental.

Conclusion

One important result of the above analysis is the relationship developed between incremental fertilizer application and incremental rice yields. The total amount of agrochemicals necessary at different yields is also illustrated.

The incremental fertilizer/production relationship is:

Proposed Yield Kgs/rai	Incremental Fertilizer Necessary Kgs.	Incremental Production Increase Per Kilo of Fertilizer
340	27.5	5.5 Kgs.
450	35.0	7.4 "
550	40.0	9.0 "

TABLE 4

Improved Production Situation - Incremental Input and Quantity Returns

1 Proposed Yield Kgs/rai	2 Incremental Fertilizer Cost (baht)	3 Implied Add'l Ferr. (kgs) ② ÷ 2.00	4 Amount of Production (kgs) over average ① - 190	5 Kg. Incremental Production per kgs of Incremental Fertilizer ④ ÷ ③	6 Incremental Insecticide Cost - Baht	7 Implied Incremental Insecticide kgs. ⑥ ÷ 17.78	8 Kg. Insecticide per kg. of Total Rice ⑦ ÷ 1
340	55	27.5	150	5.5	20	1.1	.002
450	70	35	260	7.4	40	2.2	.005
550	80	40	360	9.0	60	3.4	.006

Source: ① ⑥ ADB Nongwai Study

② ADB Nongwai Study Data minus present usage

③ ④ ⑤ ⑦ ⑧ NEED PAG Calculations.

TABLE 5

Incremental Costs and Benefits

(1) Incremental Yield per rai (above 190 kg average)	(2) Incremental kg. return per kg. of incremental fertilizer	(3) Value of incremental return @ .8 ฿/kg.	(4) Cost of 1 kg of fertilizer	(5) Cost of necessary insecticide to cover column(2)*	(6) Total Cost per add per kg.	(7) Benefit Cost Ratio
150	5.5	฿ 4.4	฿ 2.00	฿ .33	2.33	4.4/2.33 = 1.89
260	7.4	฿ 5.9	฿ 2.00	฿ .67	2.67	5.9/2.67 = 2.21
360	9.0	฿ 7.2	฿ 2.00	฿ .99	2.99	7.2/2.99 = 2.41

Source: ADB Nongwai Study and NEED PAG Calculations.

* Calculated by dividing total insecticide expenditure per rai by total production per rai to get insecticide cost per kilo of production and multiplying that by column(2) Insecticide cost per kilo of rice at each production level in at 340 gks. 0.06 baht, at 450 kgs 0.09 baht, and at 550 kgs 0.11 baht.

TABLE 6

Total Input Output Relationship

Production Level Kilos/rai	Total Fertilizer Quantity Input kgs/rai	Total Cost of Fertilizer per rai	Total Agrochem. Quantity Input kg/rai	Total Cost of Agrochemcial per rai
190 (present level)	2.5 kg.	5.0 baht	0.012 kg.	0.2 baht
340	30.0	60.0	1.112	20.2
450	37.5	75.0	2.212	40.2
550	42.5	85.0	3.412	60.2

Source: ADB Nongwai Study and NEED PAG Calculations.

Because the Nongwai study was in an area which will be irrigated, it is assumed that irrigation is implied in order to attain the fertilizer per production relationship illustrated.

Because present fertilization levels are very low relative to what is proposed in the Nongwai study, it can be assumed that proposed production levels will be attained with the proposed fertilizer inputs even if present fertilization is near zero.

Assuming that the Nongwai area now uses the Northeast average in fertilizer for rice, the final total fertilizer quantity necessary for different levels of rice production is illustrated in Table 6. The necessary level of agrochemical input is also shown.

Table 7 illustrates the the incremental return on a baht per rai basis using the data from Tables 1 - 6

TABLE 7

Incremental Return Per Rai
at Different Production Levels

Incremental Fertilizer Application Kg/rai	Insecticide Application Kg/rai	Incremental Yield Kg/rai	Incremental Fertilizer Cost ฿/ rai	Insecticide Costs ฿/rai 1/	Incremental Return ฿/rai @ 0.8 ฿/kg.	Net Return ฿/rai
27.5	1.1	150	55	20	120	45
35.0	2.2	260	70	40	208	98
40.0	3.4	360	80	60	288	148

Source: Data from Tables 1 - 6

1/ This is the full baht per rai cost covering total production. If broken down and allocated only to the incremental yield portion, the allocated insecticide cost at each production level would be 8.8 baht, 23.1 baht, and 39.3 baht.

2. Maize

a. Historical Production

Table 1 illustrates area planted, area harvested, total production, and yield per rai for Thailand for the period 1928 through 1967.

Area harvested has increased every year since 1947 and for the period 1953 through 1967, it increased from 295,000 rai to 4,403,000 rai. Yield per rai increased steadily until 1964 when it fell suddenly and leveled off around 300 kilograms per rai. Since 1964, total production has continued to increase but only because of new land being brought under cultivation. The yield average was off.

This implies one of two things:

1. Increasingly marginal land is being brought under production which has a lower yield per rai and this pulls down the overall average; or

2. Old corn land is yielding less and less and is offsetting the high yields of new land being brought under production.

According to Mr. Sopin Tongpan of Kasetsart University, most corn is grown without using fertilizer. This suggests that the drop in yield is due to alternative 2 since "in tropical and subtropical soils such as in Thailand which have low organic matter content, fertility is quickly depleted if a highly extractive crop like corn is grown as a monocrop."1/

Almost 90 percent of Thai maize is produced outside the Northeast in the upper Central Plan Changwads of LopBuri, Nakhon Sawan, Saraburi, Petchabun, Phichit, Phitsanulok, Sukothai and Kampaengphet. Most Northeastern corn is grown in Nakhon Ratchasima which is adjacent to the other maize producing changwads.

Table 2 illustrates harvested area by region.

1/ ADB Compac Report.

TABLE 1

Maize in Thailand
Area Planted, Production and Yield per Rai 1928-67

Year	Area Planted (000 Rai)	Area Harvested (000 Rai)	Production (1,000 MT)	Yield Per Rai Kg.
1928-36	42	41	5.1	124
1937-46	67	64	8.2	128
47	144	136	17.2	126
48	137	132	17.2	130
49	218	202	25.7	127
50	226	211	26.9	127
51	259	256	41.7	163
52	281	271	44.8	165
53	298	295	51.1	173
54	331	326	62.3	191
55	347	345	67.5	196
56	514	510	114.8	225
57	606	597	136.8	229
58	792	783	186.3	238
59	1,249	1,241	317.2	256
60	1,785	1,779	543.9	306
61	1,916	1,863	598.3	321
62	2,050	2,009	665.4	331
63	2,612	2,428	857.7	353
64	3,449	3,384	935.3	276
65	3,605	3,510	1,021.3	291
66	4,083	3,689	1,122.4	304
67	-	4,403	1,277.5	290
68	-	4,423	1,217.4	279
69	-	4,883	1,407.1	288

Source: 1928 - 66 Agriculture Statistics of Thailand - 1966-1967 Dept. of Agriculture, Ministry of Agriculture. 1968-69 Manderstam Report.

TABLE 2

Harvested Area by Region, 1966

Region	Harvest Area Rai
South	77,296
Central	3,018,622
North	186,423
Northeast	406,500
Thailand	3,688,841

b. Present Production Situation

The yield per rai has leveled off, and as more marginal land comes under production coupled with continued non-fertilization of existing maize land, the yield per rai will drop.

In order to keep production up to meet potential export demand, the soil must be fertilized in order to bring yields back to former levels or better. However, the cost of the fertilizer must be offset by the increased return so that an incentive is provided to use the fertilizer. The following are cost and return studies dealing with this problem.

Department of Agricultural Economics, Kasetsart University
Agro-Economic Studies of Production Management Systems for Corn

This study is based on experiments at Farm Suwan at Pak Chong. The experiments use corn variety CMS PB5 and different combinations and amounts of nitrogen and phosphorus. The results show that some combinations result in positive financial returns while others result in losses.

Table 3 illustrates the fertilizer combination, the total yield and the incremental yield.

TABLE 3

Response to Nitrogen and Phosphorus ($N - P_2O_5$)

of Maize Variety CMS PB5 1969 rainy season

Fertilizer Combination $N - P_2O_5$ Kgs/hect.	Kgs/rai	Total Yield Kgs/hect.	Total Yield Kgs/rai	Incremental Yield Kg/hect.	Incremental Yield Kg/rai
0 - 0	0 - 0	3,522	563.5	-	-
100 - 0	16 - 0	3,953	632.5	431	69
0 - 120	0 - 19.2	4,047	647.5	525	84
150 - 180	24 - 28.8	3,961	633.8	439	70
0 - 240	0 - 38.4	4,282	685	760	122
100 - 240	16 - 38.4	3,843	615	321	51
250 - 300	40 - 48	4,141	663	619	99

Source: Agro-Economic Studies of Production Management Systems for Corn and Sorghum Dept. Of Agricultural Economics, Kasetsart University, June 1971.

Using the data from Table 3, ratios were developed showing kilograms of incremental maize production per kilogram of fertilizer application. This is illustrated in Table 4.

Table 5 illustrates the incremental costs and returns of the different combinations of fertilizer application shown in Table 3.

Some of the assumptions made in Table 3 can be questioned or do not necessarily apply in other areas in the Northeast. Specifically, the average cost of fertilizer in the Northeast is roughly 2.00 baht per kilo rather than 1.30 baht per kilo,

and the value of labor for fertilizing and harvesting is questionable when applied to the whole Northeast. Also, the before-fertilizer yield of 563 kilograms per rai is almost twice as high as the national average.

Assuming that the incremental ratios would remain fairly constant in terms of incremental production output per incremental fertilizer input, an adjustment was made in the cost of fertilizer to see how that would affect final return. Table 6 illustrates the maize situation with the cost of fertilizer at 2.00 baht per kilo rather than 1.30, as in Table 5.

TABLE 4

Incremental Maize Yield/Incremental Fertilizer Application

Incremental Yield Per Rai Kgs.	Incremental Fertilizer Application Per Rai		Ratio Kgs. Yield/Kg. Fert.
	Fert. Combination $N - P_2O_5$	Total Fert/Rai Kgs	Kgs.
69	16 - 0	16	4.3
84	0 - 19.2	19.2	4.4
70	24 - 28.8	52.8	1.3
122	0 - 38.4	38.4	3.2
51	16 - 38.4	54.4	0.94
99	40 - 48	88	1.1

Source: NEED PAG Calculations from Table 3.

TABLE 5

Incremental Costs and Returns
for Application of Different Combinations of
Nitrogen and Phosphorus to Maize Variety CMS PB 5
at Farm Suwan, Pak Chong, 1969 Rainy Season 1/

Fertilizer Combination N - P_2O_5 Kg/hect	Incremental Costs Baht/ha	Incremental Costs Baht/rai	Incremental Returns Baht/ha	Incremental Returns Baht/rai	Net Return (loss) Baht/ha	Net Return (loss) Baht/rai
100 - 0	204.97	32.80	344.80	55.17	139.83	22.37
0 - 120	247.36	39.58	429	67.20	172.64	27.62
150 - 180	546.27	87.40	351.20	56.19	(195.07)	(31.21)
0 - 240	432.05	69.13	608	97.28	175.95	28.15
100 - 240	545.32	87.25	256.80	41.09	(288.52)	(46.16)
250 - 300	895.43	143.27	495.20	79.23	(400.23)	(64.04)

1/ The assumptions in the Table 5 figures are:
(a) Fertilizer costs = 1.30 baht/kg.
(b) Interest @ 6% for 6 months
(c) No equipment Costs
(d) Labor: 10 baht per application of 100 kgs of fert.
Harvest costs = 1/6 of incremental value of maize produced
(e) Value of maize = 0.80 baht/kg.

Source: Agro-Economic Studies of Production Management Systems for Corn and Sorghum, Dept. of Ag. Eco, Kasetsart University, June 1970.

TABLE 6

Incremental Costs and Returns for Application
of Different Combinations of Nitrogen and Phosphorus
to Maize Variety CMS PB 5 at Farm Suwan,
Pak Chong, 1969 Rainy Season

Fertilizer Combination N - P_2O_5 kg/hect.	Kg/rai	Incremental Costs Bht/ha	Incremental Costs Bht/rai	Incremental Returns Bht/ha	Incremental Returns Bht/rai	Net Return (loss) Baht/ha	Net Return (loss) Baht/rai
100 - 0	16 - 0	275	44	345	55	70	11
0 - 120	0 - 19.2	331	53	420	67	89	14
150 - 180	24 - 28.8	778	124	351	56	(427)	(68)
0 - 240	0 - 38.4	624	100	608	97	(16)	(3)
100 - 240	16 - 28.4	784	125	257	41	(527)	(84)
250 - 300	40 - 48	128	205	495	79	(786)	(126)

The assumptions in the Table 6 figures are:
(a) Fertilizer costs = 2.00 baht/kg
(b) Interest @ 6% for 6 months
(c) No equipment costs
(d) Labor: 10 baht per application of 100 kgs. of fert.
Harvest costs = 1/6 of incremental value of maize produced.
(e) Value of maize = 0.80 baht/kg.

Source: (Except for fertilizer cost)
Agro-Economic Studies of Production Management Systems for Corn and Sorghum Dept. of Ag. Economic, Kasetsart University, June 1970.

Table 7 illustrates the return per hectare and rai costing out only fertilizer with no costs assigned to labor and interest. Fertilizer is valued at 2.00 baht/kg. and maize at 0.8 baht/kg.

The rough picture which emerges from Tables 6 and 7 is that the incremental return from the incremental yield due to fertilizer does not increase beyond relatively minimal amounts of fertilizer application. The optional return would appear to result from some fertilizer combination between 100 kg. N. application and 240 kg. P_2O_5 application per hectare. Usually, as the amount of fertilizer applied increases, the net return lessens and finally shows a loss. The application of 0 kg. Nitrogen and 120 kg. Phosphorus per hectare now appears to yield the best return.

Implications of ADB Nongwai Study

The ADB Nongwai team prepared a table illustrating proposed yields and the necessary inputs to achieve those yields in the Nongwai study area. The Nongwai results are shown in Table 8.

The implication of Table 8 is that maize yields without fertilizer must be extremely low since 100 baht worth of fertilizer is necessary to bring yields to 300 kgs/rai which is roughly the national average without fertilizer input.

If one assumes the average value of fertilizer to be two baht per kilo, than 50 kilos of fertilizer per rai are necessary for a 300 kilo yield, 60 kgs. for a 450 kg. yield and 70 kilos for a 600 kilo yield.

The yield to input ratios are shown in Table 9.

The ratios implied by the Nongwai study are more favorable than those shown in other studies. The reasons for this are not explained by the Nongwai team. Because the Nongwai area is to be an irrigated area, it is assumed that the fertilizer needs were based on the assumption of having irrigation. Also, the Nongwai study does not cost out many other important production inputs so the final return figure is distorted.

Because the Kasetsart study is much more detailed, it appears to be a better reference source for maize production data than the Nongwai Study.

For reference purposes, other maize production data is shown in Annex 1 to this paper.

TABLE 7

Incremental Costs and Returns for Maize at 2.00 Baht/kg.
Fertilizer and No Labor or Interest Charges

Fertilizer Combination $N - P_2O_5$ Kg. hect.	Fer Incremental Costs Baht/ha.	Incremental Costs Baht/rai	Incremental Returns Baht/ha.	Incremental Returns Baht/rai	Net Return (Loss) Baht/ha	Net Return (Loss) Bht/rai
100 - 0	200	32	345	55	145	23
0 - 120	240	38	420	67	180	29
150 - 180	660	106	351	56	(309)	(50)
0 - 240	480	77	608	97	128	20
100 - 240	680	109	257	41	(423)	(68)
250 - 300	1,100	176	495	79	(605)	(97)

The assumptions in Table 7 are:
(a) Fertilizer costs = 2.00 baht/kg
(b) No labor or interest charge
(c) Value of maize = 0.80 baht/kg.

Source: NEED PAG Calculations and Kasetsart Study op. cit.

TABLE 8

Proposed Maize Yields and Necessary Inputs
for Nongwai Area

Proposed Yield (kg/rai)	300	450	600
Seed Cost	2	2	2
Fertilizer Cost	100	120	140
Agrochemical Cost	-	50	60
Incidentals	8	18	28
Total Cost	110	190	230
Gross Production Value @ .9 baht/kg.	270	400	540
Net Return	160	210	310

Source: ADB Nongwai Study

TABLE 9

Maize Yield to Fertilizer Input Ratios in Nongwai

Proposed Yield Kgs/rai	Necessary Fertilizer kgs.	Production per Kilo of Fertilizer Kgs.
300	50	6
450	60	7.5
600	70	8.6

Source: NEED PAG Calculations from Nongwai Study Data.

c. Maize Market Situation

Thailand Market: The maize in Thailand is relatively small compared to total Thai maize production. It was estimated that the feed industry in Thailand in 1969/70 absorbed 75,000 tons of maize. The percentage estimate is five percent to 10 percent of total production for the Thai feed industry.[1/] There are very few other Thai outlets for maize apart from seed requirements and losses due to various damages. These are estimated at three and four percent of total production, respectively.

Export Market: Thailand has produced maize mainly for export. Thai maize exports by quantity and by country of destination are shown in Table 10. Table 11 breaks down recipient countries by percentage of total exports.

Thai maize exports grew significantly in the 1960's, and simultaneously, the export markets were diversified with dependence on the Japanese market declining. Between 1960 and 1969, Thai maize exports grew at an average annual compound rate of 12.2 percent. In 1960, the Japanese share was 86 percent, while in 1969, it was 33 percent.

Thailand is the major Asian exporter of maize accounting for 91 percent of total Asian exports in 1968. However, Thai exports fill only 25 percent of total Asian demand. Table 12 and 13 illustrate major Asian maize exports and imports for the years 1962 through 1968.

Japan is the major Asian importer. A breakdown of Japanese maize suppliers is shown in Table 14.

1/ Thai Corn Export Problems by Sopin Tongpan, Kasetsart University.

TABLE 10

Thailand Corn Exports By County of Destination 1950 - 69
(1000 MT)

Year	Japan	Hong Kong	Singapore	Malaysia	Taiwan	Others	Total
1950	-	1	11	-	-	1	13
1951	5	-	13	-	-	2	23
1952	10	1	14	-	-	1	25
1953	13	1	19	1	-	1	35
1954	30	1	6	-	-	-	37
1955	18	34	11	4	-	1	68
1956	37	18	13	6	-	6	81
1957	36	3	10	15	-	-	64
1958	130	4	15	14	-	-	163
1959	189	10	18	20	-	-	237
1960	441	11	35	25	2	1	515
1961	405	44	82	31	1	4	567
1962	230	103	92	46	-	1	472
1963	453	112	79	50	10	32	744
1964	845	108	74	51	10	27	1115
1965	560	82	82	82	9	17	804
1966	826	77	142	67	57	49	1218
1967	671	83	100	67	144	27	1091
1968	665	131	146	111	395	32	1481
1969	476	127	149	108	429	161	1450

Source: 1950-68 Agricultural Data Book.
1969-Bd. of trade, Bd. of Trade Bulletin # 2/1970.

TABLE 11

Per Cent of Total Thai Maize Exports Going to Various Markets, 1960 - 69

Year	Japan	Hong Kong	Singapore	Malaysia	Taiwan	Others	Total
1960	86	2	7	5	-	-	100
1961	71	8	15	5	-	1	100
1962	49	22	19	10	-	-	100
1963	61	16	10	7	1	5	100
1964	76	10	7	5	-	2	100
1965	70	10	10	7	1	2	100
1966	68	6	12	5	5	4	100
1967	62	8	9	6	13	2	100
1968	45	9	10	7	27	2	100
1969	33	9	10	7	30	11	100

Source: Thai Corn Export Problems by Sopin Tongpan, Kasetsart University

d. Future Market Situation

Thailand National Market: The future Thai market for maize is very dependent upon the development of a sizeable beef industry in Thailand. The size of the beef industry, in turn, depends upon the increase in meat consumption in Thailand and beef exports.

The 1962 household expenditure survey showed meat consumption at 11.2 kilos per year, per person, in Thailand, while an FAO study showed an income elasticity of one for meat.

The prospects for exports of Thai beef are not promising. The major area market is Japan, and at present, Japan refuses to import Thai beef due to foot and mouth disease in Thailand. Japan only imports from countries which have been free of foot and mouth disease for five years and have been so certified by the International Office of Epizootiology in Paris. Over the five year plan period, major beef exports to Japan cannot be expected.

The growth of meat consumption in Thailand will be the major factor affecting national maize consumption.

Maize Export Market: As shown in Table 11, Thailand diversified its markets during the 1960's with Japan and Taiwan being the most important. During the 1970's, two major markets should remain Japan and Taiwan.

Japan plans to raise 10 million beef and dairy cattle by 1985,[1] this would all have to be a feed lot operation, therefore, requiring feed grains. If one assumes the average live weight of all 10 million animals to be 400 kilos per animal, and a daily feed consumption of three percent of live weight[2], then per animal consumption will be 12 kilos, or total animal daily consumption of 120,000,000 kilos or 120,000 tons. Annual consumption will be 43,800,000 tons of feed grain. This would represent a significant growth since present maize and sorghum imports into Japan are between eight and nine million tons. This would represent an annual growth rate of 10.4 percent (1969-1985).

If this figure is accepted, the feed grain market in Japan will grow significantly during the next 15 years.

No comparable data is available on Taiwan.

1/ Manderstam Report.

2/ Based on feedlot consumption in the U.S.A. as noted by ADB Compac.

TABLE 12

Unmilled Maize (Corn)
Exports by Year (Major Asian)

Country:	Quantity (100 Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Burma Qty.	232	215	85	285	125	UNK	-
Value	112	104	48	82	72	UNK	-
Cambodia Qty.	1344	1149	1485	816	1333	UNK	876
Value	788	688	811	509	815	UNK	446
China Mnl. Qty.	8	1096	1696	2445	1463	752	502
Value	4	557	1007	1252	887	480	302
Singapore Qty.	254	268	139	109	94	120	57
Value	169	181	93	81	67	81	32
Thailand Qty.	4724	7440	11577	8044	12185	10908	14808
Value	2415	3991	6546	4657	7307	6517	7481

North America accounts for over 50% of world corn exports. It is followed by Europe and South America. Individual countries with large exports are the USA, Argentina, Mexico, Romaniz, France, and South Africa.

Total Qty:	6562	10168	14982	11699	15200	11780	16248
Total Value:	3488	5521	8505	6581	9148	7078	8279
Average Value Per Tons	$ 53	$ 54	$ 57	$ 56	$ 60	$ 60	$ 51
Export Percent Qty:	72	73	77	69	80	93	91
of Thailand Value:	69	72	77	71	80	92	90
Average Price/ton in Thailand	$ 51	$ 54	$ 57	$ 58	$ 60	$ 60	$ 50

Source: FAO Trade Yearbook 1969

TABLE 13

Unmilled Maize (Corn)
Imports by Year (Major Asian)

Country:	Quantity (100 Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
China Mnl. Qty.	4912	134	3772	718	202	1365	-
Value	3001	84	2705	488	144	960	-
Taiwan Qty.	22	59	86	563	648	1336	3609
Value	14	37	124	406	419	893	2111
Hong Kong Qty.	1239	1215	921	738	931	928	1421
Value	683	696	542	473	579	564	788
India Qty.	875	610	1186	1750	127	599	178
Value	516	383	834	1199	91	425	17
Japan Qty.	23162	26455	32290	34335	35977	39602	51445
Value	13375	15846	20869	23148	24330	27098	30768
S. Korea Qty.	227	163	107	7	29	111	97
Value	159	113	54	5	27	87	75
Malaysia Qty.	841	922	662	527	703	619	839
Value	549	600	435	364	473	410	493
Singapore Qty.	1438	1339	91	105	159	43	19
Value	855	802	56	69	103	31	11

Europe is the major importing region followed by Asia. Major importers are Italy, Japan, Yugoslavia, Spain, West Germany, and the Natherlands.

Total Qty:	32716	30897	39115	39071	38776	44603	57608
Total Value:	19152	18561	25619	26152	26166	30468	34263
Average Value	$ 59	$ 60	$ 65	$ 67	$ 67	$ 68	$59.50

Source: FAO Trade Yearbook 1969.

TABLE 14

Total Japanese Maize Imports and Shares
of Different Supplying Countries

Year	Total Import 1000 M.T.	Exporting Countries Percentage				
		U.S.	Argentina	S. Africa	Thailand	Others
1960	1354	14	31	19	23	13
1961	1831	28	15	24	25	17
1962	2316	45	2	37	10	16
1963	2645	40	3	29	16	12
1964	3229	48	-	19	22	11
1965	3443	67	-	1	17	15
1966	3598	62	-	-	21	17
1967	3960	40	2	18	18	22
1968	5144	49	-	26	12	13

Source: Thai Export Problems by Sopin Tongpan, Kasetsart who got it from Table 106 in the 1969 Agricultural Data Book; For the Far East and Oceania, USDA, ERS - Foreign - 270, September 1969.

It cannot be assumed, however, that increasing Thai feed grain exports will be easy. Several factors point to future difficulties for feed grain exports. These are:

1. Continued competition can be expected from the U.S.A., South Africa and Argentina.

2. New competition will occur with exports from Indonesia where Japan is encouraging and aiding the development of a feed grain industry.

3. Australia may soon enter the feed grain export market.

4. Continuing world wheat surpluses are expected to affect the feed grain market.

   a. As countries become self-sufficient or surplus in wheat, they will encourage more coarse grain production and this could increase the quantities of coarse grain available for export.

   b. As wheat surpluses increase, there will be increasing pressure to utilize wheat as a feed grain. Wheat surpluses should make wheat more competitive.

In summary, large market potential appears to exist for exports, but competition exists. Quality and price of maize, contract fulfillment, credit and ease of bargaining will all be necessary to keep Thailand competitive. In addition, good information on markets and competition will be very necessary.

ANNEX 1

Maize Production Data - Thailand Present Situation

	ADB Compac Survey-1970		Rockefeller Survey-1967	
	Tron	Lomsak	Pak Chong	Chaibadan
Yield (Tan)	25	26	24	24
Gross Income/Rai @ 10 Baht/Tan	250	260	240	240
Variable Costs				
Land Preparation	60	70	54	47
Planting Material	4	4	5	5
Planting	40	20	13	16
Thinning	0	10	0	0
Fertilizer	0	0	0	0
Fertilizer Application	0	0	0	0
Weeding	50	30	45	40
Insectiude	30	5	0	0
Rooting	0	0	0	0
Harvesting	35	39	26	17
Husking & Shelling	13	13	13	12
Drying	0	0	4	5
Transport	13(to House)	0	0(to 13 Mkt.)	0(to 7 Mkt.)
Total Variable Costs	245	191	173	149
Gross Margin	5	69	67	91
Fixed Cost - Land Rent, Land Tax, Depr.	-	-	144	112
Net/Rai	-	-	(77)	(21)

1 tan = 15 kg.
Source: ADB Compact Study

Production Costs of Maize - Bahts/Rai

Expenses	Kasetsart Study	USOM Study	Bangkok Bank Study
Seed 2.5 kg/rai	5	1.8	5.5
Cultivation	51 - 56	70	60
Planting	13 - 16	19	-
Weeding	44 - 41	40	35
Fertilizer	-	34	-
Pesticides	-	32	-
Irrigation	-	28	-
Harvesting	21 - 25	82.5	30
Drying	3 - 4		
Shelling	12 - 14	56.25	20
Transport	12 - 23	20.2	30
Land Rent	96 - 102	13.55	
Land Tax	2 - 2	.9	52
Depreciation	4	-	
Interest			
Yield Kg/rai	353 - 436	750	450
Farm Price Baht/kg	.6 - .8	.92	.8
Gross Return Baht/rai	212 - 349	690	360
Return Baht/rai	(62) 67	225	120

Source: Manderstam Study

Note: No date is given for these numbers nor is any backup data presented to explain assumptions.
The USOM study is estimates of irrigated land in the Northeast while other studies are in corn belt.

3. Sorghum

a. Historical Position

Sorghum production in Thailand has declined since 1966. Table 1 illustrates 1966 production by region and average yields.

According to the Manderstam Report, production had fallen to 50,000 tons in 1969 and area planted was 200,000 rai. This implies a fall in average yield per rai from 317 kgs. to 250 kgs.

The major reasons for the decline in sorghum production are serious disease and insect problems--expecially the shoot fly. Fungus during the wet season is also a problem.

TABLE 1

Sorghum Production in Thailand,1966

	Central	N.E.	North	South	W.K.
Area Planted--Rai	316,854	29,111	5,768	7,594	359,000
Production--Metric Tons	99,937	10,184	1,755	1,975	113,850
Yield kg/rai	317	350	304	260	317

Source: Manderstam Report

b. Production

The Department of Agricultural Economics, Faculty of Economics and Business Administration of Kasetsart University carries out some production experiments with sorghum at Farm Suwan in Pak Chong during the 1969 rainy season. Experiments were carried out with four different combinations of Nitrogen and Phosphorus and with three different varieties of sorghum. Table 2 illustrates the fertilizer combination and the variety used and present yields and incremental yields attained during the Pak Chong sorghum experiments.

Table 3 breaks down the results shown in Table 2 into incremental costs, incremental returns and the net result for the three types of seed under different fertilizer combination

Table 2

Sorghum Yield Experimental Results

Farm Suwan, Pak Chong Rainy Season 1969

Fertilizer Treatment Combination $N - P_2O_5$		Seed Variety IS 9278 (V) Total Yield		Incremental Yield		Grain Weight Kgs. Seed Variety IS 8411 (V_7) Total Yield		Incremental Yield		Seed Variety IS 84 (NSC) (V_{10}) Total Yield		Incremental Yield	
Kg/ha	Kg/rai	Kg/ha	Kg/rai	Kg/ha	Kg/rai	Kg/ha	Kg/rai	Kg/ha	Kg/rai	Kg/ha	Kg/rai	Kg/ha	Kg/rai
0-0	0-0	1059	169	-	-	1572	252	-	-	1847	296	-	-
50-50	8-8	1549	248	490	78	2004	321	432	69	2263	362	416	66
100-100	16-16	2318	371	1259	202	2352	376	780	124	2776	444	929	148
150-150	24-24	2394	383	1335	214	2270	363	698	111	2679	429	832	133
200-200	32-32	1979	317	920	148	2330	373	758	121	2338	374	491	78

Source: Agro-Economic Studies of Production Management Systems for Corn and Sorghum, Department of Agricultural Economics, Kasetsart University June, 1970.

conditions. The cost and return assumptions upon which the results in Table 3 are based are:

1. The cost of fertilizer = 1.30 baht per kilo.
2. There is a six percent interest charge for six months.
3. No equipment costs.
4. The cost of labor for fertilizer application is 10 baht per 100 kilograms of fertilizer.
5. The harvest cost equals 1/6 of the total value of the incremental production.
6. The market value per kilo of sorghum is 0.75 baht.

Some of the assumptions made in Table 3 (Assumption A) can be questioned or do not necessarily apply in other areas in the Northeast. Specifically, the average cost of fertilizer in the Northeast is roughly 2.00 baht per kilo, rather than 1.30 baht per kilo, and the value of labor for fertilizing and harvesting is questionable when applied to the whole Northeast.

Table 3

Incremental Costs and Returns from Sorgum (Assumption A)

Fertilizer Combination $N - P_2O_5$		Incremental Costs		Incremental Returns		Net Return (Loss)	
Kg/Ha	Kg/rai	Baht/ha	Baht/rai	Baht/ha	Baht/rai	Baht/ha	Baht/rai
			Variety IS 9278				
50-50	8-8	209	33	368	59	159	26
100-100	16-16	453	72	944	151	491	79
150-150	24-24	610	98	1001	160	391	62
200-200	32-32	706	113	690	110	(16)	(3)
			Variety IS 8411				
50-50	8-8	202	32	324	52	122	20
100-100	16-16	393	63	585	94	192	31
150-150	24-24	531	85	524	84	(7)	(1)
200-200	32-32	686	110	569	91	(117)	(19)
			Variety IS 84(NSC)				
50-50	8-8	200	32	312	50	112	18
100-100	16-16	412	66	697	110	285	45
150-150	24-24	547	88	624	100	77	12
200-200	32-32	653	104	368	59	(285)	(45)

Source: Agro-Economic Studies of Production Management Systems for Corn and Sorghum, Department of Agricultural Economics, Kasetsart University, June, 1970.

Based On: Different Combinations of Nitrogen and Phosphorus on Sorghum Varieties IS 9278, IS 8411, and IS 84(NSC) at Farm Suwan, 1969 Rainy Season.

Table 4 (Assumption B) illustrates the return per hectare and rai costing out only fertilizer with no costs assigned to labor and interest. Fertilizer is valued at 2.00 baht/kg. and sorghum at 0.75 baht/kg.

On an incremental cost and return basis, the most favorable results are attained from seed variety IS 9278 with a fertilizer application of 100 kgs. of Nitrogen and 100 kgs. of Phosphorus per hectare (16 of N. and 16 of P_2O_5 per rai). The incremental yield is 1259 kgs. per hectare (202 kgs. per rai) with a net return of 544 baht per hectare or 87 baht per rai (Assumption B). This is a higher return per rai than was attained by maize under any fertilizer combination (see Table 7 in Memo on Maize Information dated February 1, 1971).

Table 4

Incremental Costs and Returns from Sorghum (Assumption B)

Fertilizer Combination N - P_2O_5		Incremental Costs		Incremental Returns		Net Return (Loss)	
Kg/ha	Kg/rai	Baht/ha	Baht/rai	Baht/ha	Baht/rai	Baht/ha	Baht/rai
			Variety IS 9278				
50-50	8-8	200	32	368	59	168	27
100-100	16-16	400	64	944	151	544	87
150-150	24-24	600	96	1001	160	401	64
200-200	32-32	800	128	690	110	(110)	(18)
			Variety IS 84(11)				
50-50	8-8	200	32	324	52	124	20
100-100	16-16	400	64	585	94	185	30
150-150	24-24	600	96	524	84	(76)	(12)
200-200	32-32	800	128	569	91	(231)	(37)
			Variety IS 84(NSC)				
50-50	8-8	200	32	312	50	112	18
100-100	16-16	400	64	697	112	297	48
150-150	24-24	600	96	624	100	24	4
200-200	32-32	800	128	368	59	(432)	(69)

Assumption: Fertilizer Valued at 2.00 baht/kg. Sorghum Valued at 0.75 baht/kg. No other costs taken into account.

Source: NEED PAG calculations based on Agri-Economic Studies op. cit., Table 3.

Based on: Different Combinations of Nitrogen and Phosphorus on Sorghum Varieties IS 9278, IS 84 (11) and IS 84 (NSC) at Farm Suwan 1969 Rainy Season.

Given the above test results, it would appear that sorghum might hold more promise than maize in the Northeast. However, disease and insects were the major reasons for the recent decline in sorghum production and unless the present test varieties can resist these problems, there is little likelihood of an increase in sorghum production in the Northeast. Another possible way to combat the disease - pest problem,is through the use of agrochemicals. However, no test data is available to show what costs are associated with overcoming this problem.

c. Sorghum Market Situation

Because sorghum is a feed grain with uses similar to maize, the sorghum market situation is the same as that for maize both for the Thai market and the international market. (For a full discussion of the market situation, see Page 15 of the memo on Maize Information dated February 1, 1971.) In summary, however, world demand for sorghum is rising. Japanese imports rose from .2 million tons in 1960 to 2.5 million tons in 1969, or an annual compound growth rate of 32 percent. At present, the U.S. and Argentina account for most Japanese imports. Future exports can be expected from Australia, Indonesia and Mexico.

Sorghum, as a feed, does not fatten animals as well as maize. Therefore, to be competitive, it must sell at a price five-to-ten percent below that of maize.1/ This should be taken into account when calculating export potential and determining sales price and production costs. In 1969, the average CIF price in Japan was $56 per ton, down from $59 in 1968.

4. Soybeans and Oilseeds

a. Historical Situation

In 1969, there were roughly 300,000 rai of soybeans harvested in Thailand. The Northeast percentage of this total was insignificant. Table 1 illustrates soybean production and harvested area for Thailand in 1966.

The soybean area planted in the Northeast has fluctuated significantly since 1960. This is illustrated in Table 2.

Soybean production in the Northeast was stagnant during the 1960's. This occurred despite a vegetable oil trade deficit

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1/ Estimate made by FAO in Commodity Review & Outlook, 1968-69

for Thailand and the vegetable oil industry working well under capacity.

b. Production Situation

Because of the limited production in the Northeast, almost no production cost information has been developed. Experiments conducted by the Ministry of Agriculture are now underway in selected areas of the Northeast, but no results have been published.

Given the present strength of the market for soybeans (see following market discussion), it appears that there must be some constraint on the production side which prevents an expansion of production.

The two major problems which appear to have hindered soybean production expansion thus far are:

1. Disease and Pests

   a. Little leaf--a disease which turns reproductive organs into dwarf leaves. Native soybean varieties are particularly susceptible to this.

   b. Leaf roller larvae.

   c. Leaf eating catepillars.

   d. Leaf hoppers

   e. Aphids.

   f. Bean bugs. 1/

2. Low oil and protein content of the bean. Some local varieties have oil contents between six and twelve percent. Beans cannot compete on the world market unless oil contents are in the 20-to-22 percent range.

The ADB Nongwai team estimated the various production inputs necessary to attain different yields per rai in the Nongwai area. These estimates are shown in Table 3.

The implications of Table 3 on an incremental basis are shown in Table 4. Incremental production is based on the average Northeast production figure of 135 kg. per rai which is a

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1/ ADB Compac Report

Table 1

Soybean Production in Thailand - 1966

Region	Harvested Area Rai	Average Yield Kg/Rai
South	878	110
Central	200,983	154
North	69,340	167
Northeast	4,547	135
Thailand	275,748	157

Source: ADB Compac Study

Table 2

Soybean Planted Area in Northeast Thailand

Year	1960	1961	1962	1963	1964	1965	1966	1967	1968
Planted Area (rai)	5619	3513	2900	3397	1895	3828	4778	2355	2294

Source: Ministry of Agriculture

figure without fertilization.

Table 4 illustrates the incremental cost and return situation only taking fertilizer into account. Because disease and insects are a serious threat to soybeans, no incremental returns from fertilizer can be anticipated without agrochemical input.

TABLE 3

Soybean Production and Inputs

Proposed Yield Kg/rai	160	220	300
Gross Production Value @ 2 Bht/Kg.	320	440	600
Seed Cost	20	20	20
Fertilizer Cost	70	85	100
Agrochemicals	30	40	50
Incidentals	10	15	20
Total Variable Costs	130	160	190
Net Return	190	280	410

Source: ADB Nongwai Study

Table 4

Incremental Costs and Returns With

Fertilizer Application

(1) Fertilizer Application Per Rai Baht	(2) Total Yield Kg/rai	(3) Incremental Yield(2) - 135 Kg/Rai	(4) Incremental Fertilizer Costs Baht/Rai	(5) Incremental Return Baht/Rai	(6) Net Return (Loss) (5)-(4) Baht/Rai
0	135	-	-		
70	160	25	70	50	(20)
85	220	85	85	170	85
100	300	165	100	330	230

Assumptions: (1) Fertilizer costs 2.00 baht per kilo

(2) Price of soybeans is 2.00 baht per kilo

Source: NEED PAG Calculations from Table 3.

Table 5 compares the incremental returns (from Table 4) to the incremental costs of fertilizer and agrochemicals.

In spite of the fact that the present level of agrochemical expenditures is near zero, all agrochemical expenditures cannot be considered incremental because the amount recommended for application must be sufficient for the total production, not just the incremental portion. Therefore, agrochemical expenditures are pro-rated. Fertilizer application results only in the incremental production. Therefore, all fertilizer costs are incremental since present fertilizer application is zero.

TABLE 5

Incremental Costs and Returns from Fertilizer and Agrochemical Aplication

(1) Incremental Yield above 135 kg. average	(2) Incremental Fertilizer Costs	(3) Agrochemical Costs Prorated over Total Product. 1/	(4) Incremental Return 2/	(5) Net Return (Loss) (4)-[(3)+(2)]
Kg/Rai	Baht/Rai	Baht/Rai	Baht/Rai	Baht/Rai
25	70	4.7	50	(24.7)
85	85	15.5	170	69.5
165	100	27.6	330	202.4

1/ The calculation for attaining (3) are shown below:

(1) Total Production Levels Kgs.	(2) Total Agro-chemical Costs-Baht	(3) Cost Per Kg. Baht	(4) Incremental Yield/Rai Kg.	Agrochemical Cost for Incremental Yield per rai (3) x (4) Baht
135	-	-	-	-
160	30	.188	25	4.7
220	30	.182	85	15.5
300	50	.167	165	27.6

2/ Assumes Value of soybeans to be 2.00 baht per kilogram

Source: NEED PAG calculations from Tables 3 + 4 and ADB Nongwai study.

Tables 4 and 5 are done on a cost or baht basis. Table 6 was developed in order to determine what quantities of fertilizer are necessary to attain certain yields and what amounts of agrochemicals are necessary to protect total production. The input-output relationship on a per kilogram input of fertilizer is shown as well as the necessary agrochemical input to protect one kilogram of soybean output.

c. Thai Oil Industry Situation

There are roughly 85 factories in Thailand which process oilseeds and rice bran. Fifty percent of them are in the Bangkok-Thonburi area. These factories have a total capacity to produce 150 tons of oil per day or about 45,000 tons per year. Present production levels are about 30,000 tons per year. 1/

The oil industry is composed of many small mills with only two mills of significant size. The Vivathana factory has a capacity of 150 tons of raw material per day.

The industry is working under capacity and yet Thailand is a net importer of vegetable oil. In 1968, the trade deficit in vegetable oils was over 20 million baht. Table 7 illustrates Thai vegetable oil imports and exports from 1957 through 1968.

Even though Thailand is a net importer of vegetable oil, it is an exporter of oilseeds. The reason for this seems to be that due to strong external demand for oilseeds, exporters are able to pay a higher price for seeds than local processors. Exporters also deal in large volumes of many products and are able to use this as leverage to get middlemen to sell oilseeds to them, rather than local processors. 2/

d. Market Situation

National Demand: The 1962 Household Expenditure Survey showed the National per capita consumption average of fats and oils to be one kilogram. The Manderstam Report said that in 1966, per capita consumption was 1.82 kg., or total 1966 consumption of 60,000 tons. An FAO survey showed that land and

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1/ Manderstam Report.

2/ Investor Magazine, January 1969.

TABLE 6

Improved Production Situation

Input Output Relationships Per Rai Quantities Involved

(1) Total Yield	(2) Incremental Yield (1)-135	(3) Total Fertilizer Cost	(4) Implied Quantity of Fertilizer (3)÷2.00	(5) Kgs. of Incremental Production per kg. of fertilizer (2) ÷ (4)	(6) Insecticide Cost	(7) Implied Quantity of Insect. (6)÷17.78	(8) Kg. Insecticide per kg. of Total Productic (7) ÷ (1)
Kg.	Kg.	Baht	Kg.	Kg.	Baht	Kg.	Kg.
135	-	-	-	-	-	-	-
160	25	70	35	0.7	30	1.7	.01
220	85	85	43	2.0	40	2.3	.01
300	165	100	50	3.3	50	2.8	.01

NOTE: See Rice Section for explanation of 2.00 baht cost for fertilizer and 17.78 baht for cost of insecticide

Source: (1) (3) (6) ADB Nongwai Study

(2) (4) (7) (8) NEED-PAG Calculations

TABLE 7

Vegetable Oil Imports and Exports
Thailand

Year	Imports		Exports		Trade Balance	
	Litres	Baht	Litres	Baht	Litres	Baht
1957	624,928	6,015,683	1,062,756	8,564,863	+437,828	+2,549,180
1958	1,079,493	8,496,350	818,191	6,277,676	-261,302	-2,218,674
1959	2,097,240	16,474,335	1,504,430	10,758,045	-592,810	-5,716,290
1960	951,197	7,837,450	248,194	1,886,230	-703,003	-5,951,220
1961	863,388	7,636,771	1,466,917	11,231,229	+603,529	+3,594,458
1962	1,680,916	11,944,555	2,416,841	16,925,716	+735,925	+4,981,161
1963	1,131,250	9,447,728	1,021,406	5,972,445	-109,844	-3,475,283
1964	2,979,570	20,779,190	833,942	3,921,658	-2,145,628	-16,857,532
1965	2,306,604	18,618,948	1,255,678	6,835,609	-1,050,926	-11,783,339
1966	1,554,140	13,218,788	2,593,337	12,889,810	+1,039,197	-328,978
1967	2,439,092	18,667,399	1,377,837	8,711,581	-1,061,255	-9,955,818
1968	2,580,333	21,271,123	152,386	773,762	-2,427,947	-20,497,361

Source: Department of Customs

TABLE 8

Projected Oil and Fat Consumption in Thailand

Year	Population (000s)	Per Capita Consumption Kg.	Total Demand Metric Tons
1972	39,926	1.82	72,665
1973	41,175	1.82	74,938
1974	42,501	1.82	77,352
1975	43,858	1.82	79,822
1976	45,233	1.82	82,324

Source: NEED PAG Calculations

oil consumption in Thailand have an elasticity of 1.0 to income growth.

One can assume from the above that consumption is increasing, but whether it is as high as Manderstam reports is uncertain.

If, over the plan period, consumption of fats and oils remains at 1.82 kg., than total demand will be as shown in Table 8.

Consumption in Thailand could vary a great deal from Table 8. Present oil consumption in Japan is 7 kgs. per capita, per year, and total consumption is growing at 100,000 tons per year. Table 8 would have to be considered a conservative estimate.

Of the total vegetable oil and fat consumption in Thailand, roughly 50 percent appears to be fat consumption and 50 percent oil. However, the trend is away from fat (lard) and into vegetable oil.

A conservative estimate of the demand for vegetable oil in Thailand over the plan period would be 50 percent of the total fat and oil demand shown in Table 8. This 50 percent assumption is shown in Table 9.

The amount of raw oilseeds necessary to supply the demand estimate shown in Table 9 depends upon the oil content of the seeds. Table 10 illustrates some average oil contents of different oilseeds, as well as the protein content of the resulting oilcake.

The oilseed production mix will determine how much total production is necessary to meet the oil demand.

Most oilcake is used as part of an animal feed mix. At the present time, the consumption of animal feed concentrate in Thailand is very low.

The Manderstam Report estimates total consumption to be around 125,000 tons per annum. The reason for this is that most animals in Thailand are grazed and not fed in feedlots, resulting in low demand for concentrates and oilcake. At present, Thailand is a net exporter of oilcake. Until a feedlot industry and more extensive poultry raising are underway, demand for oilcake will remain below productive capacity. Table 11 illustrates total Thai oilseed cake exports and soybean cake exports for the period 1962 through 1968.

What is now happening in Thailand is that while the vegetable oil market is growing, there is nothing to indicate that the oilcake market in Thailand is expanding. If local industry meets the oil demand, it will have a cake surplus and be forced

TABLE 9

Vegetable Oil Demand Over the Plan Period

Year	Total Demand Metric Tons	Vegetable Oil Demand (50% of Total) Metric Tons
1972	72,665	36,333
1973	74,938	37,469
1974	77,352	38,676
1975	79,822	39,911
1976	82,324	41,162

Source: NEED PAG Calculations

TABLE 10

Oil and Protein Content of Various Oilseeds

Oilseed	Percent Oil Content	Percent Protein Content of Cake or Meal
Soybean	17 - 18%	46%
Groundnut	45%	52%
Cottonseed	16%	41%
Coconut (Copra)	64%	22%
Rapeseed	35%	36%
Palm Kernal	47%	18%
Linseed	34%	36%
Sesame	45%	40%
Castor	45%	-
Sunflower	35 - 40%	43%

Source: Manderstam Report

to export. Exports of cake do occur, but whether or not all surplus cake can be exported is unknown.

TABLE 11

Thai Oilseed Cake Exports

Year	Total Oilseed Cake Exports		Soybean Cake Exports	
	Quantity 10 Metric Tons	Value U.S.$ 1,000	Quantity 10 Metric Tons	Value U.S.$ 1,000
1962	1,819	1,352	33	29
1963	2,096	1,269	468	363
1964	2,974	2,122	872	648
1965	2,689	2,055	195	147
1966	2,832	2,186	289	247
1967	1,660	1,209	247	221
1968	3,633	2,059	283	282

Source: FAO 1969 Trade Yearbook

International Demand: Because the Far East, as a region, now runs a deficit in soybeans and vegetable oil, the following data is concerned mainly with the Far East. It is felt that this market is the most accessible to Thailand and the one on which present marketing efforts should be concentrated. Oilseed cake is also covered because it results from the oil process.

(i) Soybeans:

The Far East regional deficit has increased steadily from 1,070,390 tons valued at $102,298,000 in 1962, to 2,312,600 tons valued at $254,432,000 in 1968. This is illustrated in Tables 12 and 13. Value per ton grew from $103 in 1962, to $125 in 1967, but then fell to $114 in 1968.

Thailand exports have been insignificant. The market is dominated by mainland China exports and the U.S.A.

TABLE 12

Soybeans

Exports by Year (Major Asian)

Country	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Cambodia Qty:	352	665	407	851	67	270	-
Value	228	487	362	954	87	350	-
China Mnl. Qty:	34,218	33,210	49,841	57,616	55,010	56,441	57,074
Value	43,490	43,540	61,200	76,745	71,625	72,200	73,200
Hong Kong Qty:	896	541	223	576	846	402	313
Value	986	646	307	771	918	485	442
Laos Qty:	6	10	2	4	2	UNK	-
Value	7	14	1	3	1	UNK	-
Singapore Qty:	653	730	747	811	706	855	433
Value	819	906	907	1,089	890	1,026	970
Thailand Qty:	191	440	432	161	561	590	349
Value	239	486	450	217	703	727	446

The U.S.A. Accounts for 85% to 90% of total World Exports

Total Qty:	36,316	35,596	51,652	59,983	57,192	58,558	58,169
Total Value:	45,769	46,079	63,227	79,779	74,251	74,788	75,058
Average Value: Per Ton ($)	$126	$129	$122	$133	$130	$128	$129
Export Percent Qty:	1%	1	1	-	1	1	.6%
of Thailand Value:	1%	1	1	-	1	1	.6%
Average Price/Ton in Thailand	$125	$106	$104	$135	$125	$123	$128

Source: FAO Trade Yearbook, 1970.

TABLE 13

Soybeans

Imports by Year (Major Asian)

Country	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Taiwan Qty:	6,243	18,246	18,183	16,140	16,450	35,114	38,492
Value	6,941	19,702	20,452	19,217	19,761	43,284	44,315
Hong Kong Qty:	2,088	1,870	1,249	327	2,033	2,201	1,872
Value	2,250	1,998	1,378	375	2,139	2,648	2,180
Japan Qty:	129,311	154,436	160,715	184,747	216,847	216,980	242,077
Value	132,709	167,946	184,524	225,774	272,007	272,038	274,142
S. Korea Qty:	2,006	816	817	19	15	2,576	3,840
Value	2,180	883	1,055	49	12	3,231	4,900
Malaysia Qty:	1,802	1,690	1,883	1,813	1,807	1,769	1,883
Value	2,152	2,021	2,302	2,472	2,406	2,279	2,281
Philippine Qty:	13	547	227	1,992	2,265	UNK	-
Value	13	549	241	2,316	2,267	UNK	-
Singapore Qty:	1,712	1,927	1,558	1,999	1,266	1,436	1,265
Value	1,822	2,107	1,695	2,463	1,653	1,936	1,672
	Europe Accounts for Roughly 60% of Total World Imports and Asia between 30% and 35%						
Total Qty:	143,175	179,532	184,632	207,037	240,683	260,076	289,429
Total Value	148,067	195,206	211,647	252,726	300,245	325,416	329,490
Average Value Per ton ($):	$103	$109	$115	$122	$125	$125	$114

Source: FAO Trade Yearbook, 1970.

The most important market is Japan. Japan has strong demand for oil and oilcake with the latter being important in the development of the livestock industry.

In 1968, Japanese raw soybean demand was 2.7 million tons. Of this, only 60,000 tons came from Japanese farms. The major sources were the U.S.A. and mainland China. This is shown in Table 14.

The edible oil market in Japan is expected to grow at a rate of 100,000 tons of oil a year 1/ and the livestock industry in Japan has been projected to be 10 million head by 1985.2/ This would require large amounts of oil since Japan has only feedlot industry.

Japan now has an oil industry which can process 3.8 million tons of oilseeds per year. Because of this, Japan imports raw oilseeds almost exclusively. Only small amounts of palm oil and tung oil are allowed in. Thailand can work to attain a part of the raw seed market, but it is doubtful that Japan will allow imports of oil or oilcake.

Total raw oilseed imports into Japan are now about 3.5 million tons. Of this, 2.7 are soybeans,or 77 percent. Total oil consumption now is 700,000 tons, assuming a 22 percent oil yield from the soybeans equals 594,000 tons of oil. Therefore, the remaining 800,000 tons of oilseeds yield 100,000 tons of oil or yield 12.5 percent oil.

At present, 86 percent of the oil consumed in Japan comes from soybeans. If this percentage is maintained, then the 100,000 tons of oil a year growth means 86,000 tons of soybean oil a year. To get this will require additional imports of 391,000 tons of raw soybeans a year. The implications of this in terms of total raw soybean requirements are shown in Table 15.

It is possible that soybean imports will decline if other vegetable seeds become more competitive. However, the whole oilseed market in Japan will grow very rapidly over the plan period. Some of the other kinds of oilseeds imported by Japan and their sources are:

1. Kapok Seeds: imports of 2,500 tons monthly from Indonesia and Thailand.

1/ Haruhiko Seto, Project Manager, Japanese Soybean Project in Thailand.

2/ Manderstam Report.

TABLE 14

Major Sources of Soybeans to Japan

Year	Soybean Source	Quantity 1,000 Tons	Average Per Ton
1968	U.S.A.	2,000	$113.79
	Mainland China	417	$110.58
1969	U.S.A.	2,140	$107.81
	Mainland China	377	$112.37

Source: Haruhiko Seto, Project Manager, Japanese Soybean Project in Thailand

TABLE 15

Projected Japanese Raw Soybean Imports

Year	Estimated Total Raw Soybean Imports Million Tons
1968	2.7
1969	3.1
1970	3.5
1971	3.9
1972	4.3
1973	4.7
1974	5.1
1975	5.5
1976	5.9

Source: Haruhiko Seto and NEED PAG calculations

2. Cottonseed: 250,000 tons annually with 85 percent from Africa. Japan prefers Thailand as a source due to faster delivery. Formerly, Thai exports were 80,000 tons to Japan, but fell due to disease.

3. Peanuts: Japan wants peanut cake, but not oil.

4. Sesame: Japan buys 35,000 tons annually, mostly from Africa. African sesame oil content is 50 to 53 percent, while Thai sesame oil content is only 42 to 43 percent.

5. Castor Bean: Japan imports roughly 50,000 castor beans annually with a large portion coming from Thailand. Other suppliers are Mainland China and Indonesia.

Due to the growing consumption of edible oil and the growth of feedlots, the oilseed market in Japan will grow rapidly over the plan period. If soybean imports remain 77 percent of total oilseed imports, then total imports will be as illustrated in Table 16.

Next to Japan, the most important soybean importer in the Far East is Taiwan. Imports have grown from 62,000 tons in 1962, to 385,000 tons in 1968 (see Table 13). Taiwan is developing a livestock industry and,for this reason, demand for feed products will remain strong as Taiwan has a limited area for producing feed grains.

Taiwan and Japan accounted for 96 percent of total Far Eastern imports of raw soybeans in 1968. These are the markets in which Thailand must concentrate.

TABLE 16

Total Japanese Oilseed Imports

Year	Soybean Imports Million Tons	Total Oilseed Imports Million Tons
1968	2.7	3.5
1969	3.1	4.0
1970	3.5	4.5
1971	3.9	5.1
1972	4.3	5.6
1973	4.7	6.1
1974	5.1	6.6
1975	5.5	7.1
1976	5.9	7.7

Source: Table 16, NEED/PAG calculations keeping soybeans as 77 percent of total.

(ii) Oilseed Cake:

Oilseed cake exports are much higher than imports in the Far East. A major cake exporter is India, the bulk of whose exports is groundnut meal. Europe is the major importer of oilseed cake.

Tables 17 through 22 illustrate the Asian export-import situation for all oilseed cake and meal, soybean cake and meal, and cottonseed cake and meal.

The market situation for processed meal is not promising as the large importers prefer to buy raw seeds and process them locally. The major oilcake market is in Europe and any Thai marketing efforts will have to be directed toward this area.

(iii) Vegetable Oils:

The vegetable oil market is in a state of flux. The trend for some oils shows strong demand while others are questionable. The Asian import-export data for cottonseed oil and soybean oil are shown in Tables 23 through 26.

The overall trend for soybean oil shows regional demand outstripping supply although the composition of the major importers changes each year.

The regional soybean deficit in 1962 was 87,883 tons valued at $29,031,000. In 1968, the deficit was 159,676 tons valued at $50,010,000. The major importers are India, Pakistan and South Vietnam.

The cottonseed oil situation shows an Asian surplus due to large exports from Mainland China. Excluding China leaves an area deficit. The overall size of the import market is small, being slightly over $2 million in 1968.

It appears that export potential in oils does exist over the plan period, but mainly in soybean oil. Good market intelligence will be necessary to assure that sales efforts are directed toward the appropriate market.

TABLE 17

All Oilseed Cake and Meal
Exports by Year (Major Asian)

Country:	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Burma Qty.	26729	28025	20806	19229	10300	11400	9900
Value	17929	19274	22423	10029	6940	7550	6500
Ceylon Qty.	1117	373	1754	981	29	4	18
Value	687	265	1010	674	10	1	7
China Mnl. Qty.	453	919	1936	2932	2599	3158	3210
Value	356	580	1350	2180	2190	2090	2300
India Qty.	72748	90899	95782	118657	83897	73679	85893
Value	56837	71484	78057	79554	70521	60245	67945
Indonesia Qty.	7615	9376	15730	12580	14280	16530	16091
Value	3394	4088	4380	5400	5000	5900	1958
Japan Qty.	1479	1894	1073	69	461	3331	720
Value	1026	1157	677	77	482	2091	669
Pakistan Qty.	5342	5109	4145	4707	7148	7433	6000
Value	2649	3059	2452	3088	4717	4962	3575
Philippine Qty.	14087	16828	19312	18493	23485	20030	20790
Value	8742	12400	12063	12118	16817	12500	13514
Singapore Qty.	2122	1563	904	961	852	2942	1941
Value	1768	1274	769	807	792	1986	1444
Thailand Qty.	1819	2096	2974	2680	2832	1660	3633
Value	1352	1269	2122	2055	2186	1209	2059
Total Qty:	133511	157082	164416	181289	145883	140167	148196
Total Value:	94470	114850	115303	115982	109655	99534	99971
Average Value Per Ton: ($)	$71	$73	$70	$64	$75	$71	$67.50
Export Percent Qty:	1%	1	2	1	2	1	2
of Thailand Value:	1%	1	2	2	2	1	2
Average Price/Ton in Thailand	$74	$61	$71	$77	$77	$73	$57

Source: FAO Trade Yearbook 1970.

TABLE 18

All Oilseed Cake and Meal

Imports by Year (Major Asian)

Country:	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Hong Kong Qty.	600	712	560	857	1002	1085	1035
Value	495	569	443	773	962	1016	1074
Japan Qty.	2589	16459	10151	15212	15409	7877	16898
Value	1938	5466	9133	12613	12767	7286	12702
India Qty.	-	-	307	724	444	912	562
Value	-	-	186	648	356	583	394
Malaysia Qty.	3504	3218	2765	2738	2901	3270	3707
Value	2858	2594	2261	2414	2566	2574	2967
Philippine Qty.	1104	515	644	626	533	3460	3882
Value	979	481	615	615	603	3589	3589
Singapore Qty.	6667	4710	2064	2819	1985	2079	3288
Value	3922	3222	1638	2446	1843	1818	3373
	The major importer is Europe. It accounts for around 90% of world imports.						
Total Qty:	14464	15704	16491	22976	22274	18683	29372
Total Value	10192	12332	14276	19509	19097	16777	24099
Average Value Per Ton ($)	$70	$79	$87	$85	$86	$90	$82

Source: FAO Trade Yearbook 1970

TABLE 19

Soybean Cake and Meal

Exports by Year (Major Asian)

Country	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Japan Qty.	19	41	4	46	261	292	236
Value	23	49	5	57	318	348	280
Thailand Qty.	33	468	872	195	289	247	283
Value	29	363	648	147	247	221	282
	North America accounts for the bulk of world exports.						
Total Qty:	52	509	876	241	550	539	519
Total Value:	52	412	653	204	565	569	562
Average Value Per Ton ($) :	$100	$81	$75	$85	$103	$106	$108
Export Percent Qty:	63	92	100	81	53	46	-
of Thailand Value:	56	88	99	72	44	39	-
Average Price/Ton: in Thailand	$88	$78	$74	$75	$85	$89	$100

NOTE: In 1968 for the first time South Korea showed soybean cake and meal exports. It exported 1610 metric tons valued at $120,000.

Source: FAO Trade Yearbook 1970.

TABLE 20

Soybean Cake and Meal

Imports by Year (Major Asian)

Country	Quantity (10 Metric tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Jpan Qty.	1582	151	1326	4632	741	228	1531
Value	1422	177	1464	4872	792	261	1631
Philippine Qty.	1104	514	644	625	533	3460	3882
Value	979	480	615	612	603	3500	3589
	Europe absorbs over 90% of total world imports.						
Total Qty.:	2686	665	1970	5257	1274	3688	5413
Total Value:	2401	657	2079	5484	1395	3761	5220
Average Value Per Ton: ($)	$89	$99	$106	$104	$109	$102	$96

Source: FAO Trade Yearbook 1970

TABLE 21

Cottonseed Cake and Meal

Exports by Year (Major Asian)

Country:	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Burma Qty.	1489	1048	960	846	500	500	600
Value	1047	724	647	634	340	350	420
India Qty.	2601	6986	7949	10459	13396	13786	11651
Value	1769	4524	5511	7868	8844	9793	7733
Pakistan Qty.	1497	1680	2075	1700	3736	3908	2500
Value	958	1202	1478	1114	2510	2703	1625
	Major exporting countries are Turkey, India, the Sudan, Syria, Uganda, and Argentina.						
Total Qty:	5587	9714	10984	13005	17632	18194	14751
Total Value:	3774	6450	7636	9616	11694	12846	9778
Average Value Per Ton: ($)	$68	$66	$70	$74	$66	$71	$66

Source: FAO Trade Yearbook 1970

TABLE 22

Cottonseed Cake and Meal

Imports by Year (Major Asian)

Country:	Quantity (10 Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Japan Qty.	-	1249	474	310	1019	322	395
Value	-	1117	431	259	850	207	275
	Europe accounts for almost all of the world imports. The largest European importers are Denmark, Great Britain, West Germany and Sweden.						
Total Qty.:	-	1249	474	310	1019	322	395
Total Value:	-	1117	431	259	850	207	275
Average Value Per Ton: ($)	-	$89	$91	$84	$83	$64	$70

Source: FAO Trade Yearbook 1970

TABLE 23

Cottonseed Oil

Exports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
China Mnl. Qty:	-	-	-	22191	43552	28563	36629
Value	-	-	-	6800	12550	7820	9600
Hong Kong Qty:	-	-	-	20	692	255	180
Value	-	-	-	6	199	68	45
Japan Qty:	69	18	8	35	25	17	70
Value	21	8	5	16	12	9	32
Singapore Qty:	25	2	18	2	2	101	216
Value	9	2	9	2	1	29	59
Total Qty:	94	20	26	22248	44271	28936	37095
Total Value:	30	10	14	6824	12762	7926	9736
	The major exporting region is North and Central America followed by Asia and Africa.						
Average Value Per Ton: ($)	$319	$500	$538	$307	$288	$274	$262

Source: FAO Trade Yearbook 1970.

TABLE 24

Cottonseed Oil

Imports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Hong Kong Qty.:	8	17	22	620	1145	416	1495
Value	4	8	10	171	318	127	377
India Qty:	1195	3	-	4928	-	-	-
Value	372	1	-	1534	-	-	-
Japan Qty:	3666	7443	12253	2119	4369	2526	2318
Value	1355	2385	3680	729	1428	851	742
S. Korea Qty:	302	-	16	-	26	20	39
Value	122	-	7	-	12	19	32
Malaysia Qty:	33	36	18	515	605	-	2068
Value	14	20	9	142	166	-	575
Pakistan Qty:	18493	12911	13063	9378	9600	2	-
Value	7015	3668	3987	3586	3006	1	-
Philippine Qty:	423	211	1228	1063	51	UNK	-
Value	152	63	220	192	7	UNK	-
Singapore Qty:	6	2	21	645	794	514	1879
Value	3	1	10	188	226	135	494
S. Vietnam Qty:	776	2491	3008	1719	UNK	UNK	-
Value	333	770	1259	724	UNK	UNK	-
	The UAR is a major importer of cottonseed oil followed by Venezula, the United Kingdom Canada, and Costa Rica.						
Total Qty:	24902	23114	29629	20987	16590	3478	7799
Total Value:	9370	6916	9182	7266	5163	1135	2220
Average Value per ton:	$376	$299	$310	$346	$311	$326	$285

Source: FAO Trade Yearbook 1970

TABLE 25

Soybean Oil

Exports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Cambodia Qty:	-	138	139	51	-	-	-
Value	-	11	12	6	-	-	-
China Mnl. Qty:	1016	2540	2500	3000	4000	3000	-
Value	325	726	710	920	1220	930	-
Taiwan Qty:	-	7	352	771	119	273	10
Value	-	2	108	240	38	89	3
Hong Kong Qty:	606	511	1138	2380	108	57	85
Value	191	142	299	757	35	17	23
Japan Qty:	8115	2811	4524	5580	4716	5020	6658
Value	2458	827	1270	1646	1344	1407	1486
Philippine Qty:	-	500	2125	-	811	UNK	-
Value	-	106	431	-	189	UNK	-
Singapore Qty:	16	74	35	17	123	213	61
Value	6	23	10	4	48	62	14
Total Qty:	9753	6581	10813	11799	9877	8563	6814
Total Value:	2980	1837	2840	3573	2874	2505	1526

North America accounts for roughly 80% of world exports.

Average Value per ton:	$305	$279	$263	$303	$291	$293	$224

Source: FAO Trade Yearbook 1970

TABLE 26

Soybean Oil

Imports by Year (Major Asian)

Country	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Burma Qty:	-	-	42600	1021	34500	13500	2000
Value	-	-	11100	339	11500	4400	600
Ceylon Qty:	-	-	-	-	27	408	17
Value	-	-	-	-	14	217	26
Taiwan Qty:	3359	999	7510	1003	1250	4743	767
Value	1016	308	1864	231	226	1565	230
Hong Kong Qty:	31713	14989	26953	14253	1836	4382	7148
Value	9047	3844	6691	4303	563	1240	1682
India Qty:	1220	138	406	40504	33007	51587	35937
Value	479	45	97	12295	11701	20488	12054
Japan Qty:	337	1316	501	510	134	109	-
Value	109	344	97	143	41	34	-
S. Korea Qty:	233	167	85	4	206	29	680
Value	75	114	30	2	89	10	195
Malaysia Qty:	47	75	66	62	289	188	1187
Value	16	26	21	20	106	60	311
Pakistan Qty:	59900	98431	76136	91049	23620	34822	101300
Value	21000	29296	21440	30323	7330	10546	31000
Philippine Qty:	347	311	220	66	576	UNK	1200
Value	91	69	50	13	127	UNK	250
Singapore Qty:	28	10	2	88	171	176	399
Value	9	3	1	31	77	75	133
Thailand Qty:	2	8	28	102	47	92	160
Value	1	3	1	31	77	75	55
S. Vietnam Qty:	450	2614	789	1476	11123	14580	15695
Value	168	750	226	604	4579	5500	5000
Total Qty:	97636	119058	155296	150138	106786	124616	166490
Total Value:	32011	34802	41618	48335	36430	44210	51536
	Asia (including Iran and Israel) is the largest importer (about 33%) followed by Europe (30%), Africa, and South America.						
Average Value Per Ton:	$328	$292	$268	$322	$341	$355	$310
Average Price/Ton: in Thailand	$500	$375	$36	$304	$1638	$815	$344
Import Percent Qty:	-	-	-	-	-	-	-
If Thailand Value:	-	-	-	-	-	-	-

Source : [illegible]

TABLE 27

National Demand for Vegetable Oil Over Plan Period

Year	Metric Tons of Oil	Metric Tons of Raw Seeds[1/]
1972	36,333	121,100
1973	37,469	124,884
1974	38,676	128,907
1975	39,911	133,023
1976	41,162	137,193

Source: Table 9.

Over the long run, oil exports could face the same problem as oilcake exports, namely, countries prefer to buy or raise the raw material and then process it in-country, rather than import a processed good.

International Demand: The major oilseed markets for Thailand over the third-plan period will be Japan and Taiwan. The market potential in these countries is:

Taiwan: 1962 soybean imports were 62,000 tons and by 1968, the figure was 385,000 tons. This is a growth rate of 35 percent a year. It is doubtful that such a rate could be maintained, and for plan purposes, it was assumed that the growth rate would fall to 17 percent per year. This rate results in total soybean import figures, as shown in Table 29.

1/ Assumes an oil content of 30 percent, assuming a mix of the seeds shown in Table 10.

TABLE 28

Japanese Oilseed Demand

Year	Raw Soybean Imports Million Tons	Other Oilseed Imports Million Tons	Total Oilseed Imports Million Tons
1972	4.3	1.3	5.6
1973	4.7	1.4	6.1
1974	5.1	1.5	6.6
1975	5.5	1.6	7.1
1976	5.9	1.8	7.7

Source: Table 16

TABLE 29

Taiwan Soybean Imports @ 17% Growth Rate

Year	Total Raw Soybean Imports 1,000 Metric Tons	Total Oilseed Imports 1,000 Metric Tons 1/
1968	385	500
1969	450	585
1970	527	685
1971	616	800
1972	721	937
1973	844	1097
1974	987	1283
1975	1155	1501
1976	1352	1758

1/ Soybeans will represent only a portion of total oilseed imports into Taiwan. The total imports column is based on soybeans representing 77% of total oilseed imports as they do in Japan.

Source: Table 13 and NEED PAG Calculations.

TABLE 30

Summation of National, Japanese and Taiwan Raw Oilseed Demand Over the Third Plan Period

Year	National Demand	Japanese Demand (000 Metric Tons)	Taiwan Demand	Total Demand
1972	121.1	5,600.0	937.0	6,658.1
1973	124.9	6,100.0	1,097.0	7,321.9
1974	129.0	6,600.0	1,283.0	8,012.0
1975	133.0	7,100.0	1,501.0	8,734.0
1976	137.1	7,700.0	1,758.0	9,595.1

Source: NEED/PAG Addition

Present oil processing capacity in Thailand is sufficient to meet projected oil demand in Thailand as projected in Table 9. Present capacity is not, however, sufficient to meet national demand and export sizeable quantities of oil.

A market for raw oilseeds will exist over the plan period. Whether Thailand will be able to participate in this market will depend on the quality of Thai oilseeds (Thai soybeans have lower oil and protein content than present U.S. and Mainland China soybeans; Thai sesame has a lower oil content than sesame from Africa), the terms of credit, the dependability of supply and the honoring of contracts.

The oilcake and oilseed market will be difficult to enter as countries prefer to process beans in-country. It is possible that government negotiations and trade treaties will be necessary to facilitate this trade. A special study should be made of the oilcake market situation in Europe as it appears to be strong and Thailand is not participating in it.

5. Cotton

a. Historical Production

Table 1 illustrates the area planted, the total seed

cotton[1/] production, yield per rai, the price per kilo of seed cotton each year, and the total market value of the seed cotton production.

TABLE 1

Cotton--Production and Value, Thailand

Year	Area Planted 1000 rai	Production Seed Cotton Tons	Yield Per Rai Kgs.*	Seed Cotton Price Per Kg. Baht.	Total Seed Cotton Market Value Million Baht
1961	358	38,300	119	4.38	167.8
1962	371	41,300	124	3.67	151.6
1963	456	48,600	118	3.35	162.8
1964	419	49,100	130	2.80	137.5
1965	471	59,800	141	4.08	244.0
1966	630	88,000	141	4.08	359.0
1967	630	80,000	141	4.10	328.0
1968	724	95,000	128	4.05	340.2
1969	500	45,000	100	4.05	182.3

*Yield per rai based on harvested area which historically is 10 percent less than planted area.

Source: Division of Agricultural Economics, Ministry of Agriculture, 1969, data from Manderstam Report and Bangkok Post of December 17, 1970.

Cotton production is concentrated in 15 changwads in the Central Plain, North and the Northeast. Historically, the Northeast has accounted for roughly 30 percent of the cotton production of the whole kingdom. Table 2 shows Northeast production and its percentage of the whole kingdom total. Table 3 breaks down the Northeast by changwad for area planted into cotton, total production and average yield per rai for the period 1961 through 1964.

Historically, Loei has accounted for roughly 60 percent of total Northeast cotton production. On a yield per rai basis, Loei is the most productive changwad,followed by Udorn, Korat, Ubon, Mahasarakam and Roi-et.

1/ Cotton as picked, including seed.

Table 2

Seed Cotton Production in Northeast Thailand

Year	Area Planted 1,000 Rai	Production Tons	Average Yield Kg./Rai 1/	Per Cent of Total Thai Production
1961	130.5	15,161	129	39.5%
1962	130.0	14,689	126	35.5%
1963	116.3	13,546	129	27.8%
1964	121.8	15,483	141	31.5%
1965	121.8	15,863	144	26.5%
1966		17,298		19.6%
1967		20,871		26.0%
1968		25,024		26.3%

1/ Yield per rai based on harvested area which historically is 10% less than planted area.

Source: Division of Agricultural Economic, Ministry of Agriculture and NEED-PAG Calculations.

Table 3

Seed Cotton Production in the Northeast by Changwads 1961 - 1964

Changwad	1961		1962		1963		1964		
	Area Planted Rai	Production Ton	Area Planted Rai	Production Ton	Area Planted Rai	Production Ton	Area Planted Rai	Production Ton	4 years Average Yield Kg/Rai
Kalasin	3,294	329.4	3,610	361.0	1,326	108.4	1,384	207.6	106
Khon-Kaen	6,751	675.1	19,586	1,956.8	10,206	1,020.6	6,902	894.6	104.5
Chai-yaphom	6,268	626.3	6,641	647.6	4,219	379.3	1,363	122.4	96
Nakorn-panom	1,054	105.4	1,682	168.2	4,292	358.9	5,277	527.7	94
Korat	2,451	302.5	2,779	326.3	2,731	311.6	8,701	1,035.1	118.3
Buri-rum	-	-	-	-	3,100	248.0	208	31.2	85
Mahasa-rakam	14,014	1,583.0	9,405	1,095.2	7,110	771.5	7,106	692.7	110.2
Roiet	3,662	439.4	2,344	281.2	2,992	299.2	3,434	343.4	110
Loei	71,612	8,592.0	58,700	7,044.0	65,000	8,450.0	68,867	9,661.2	128
Sri-sakot	5,501	659.5	1,982	237.2	1,298	64.9	697	62.3	108
Sakol-nakorn	6,821	675.2	4,754	469.1	3,019	300.9	3,050	304.7	99
Surin	3,110	373.2	3,812	465.0	838	80.8	565	44.3	116
Nong-kai	1,500	150.0	3,005	300.5	1,700	170.0	3,950	395.0	100
Udorn	2,316	276.1	10,134	1,196.8	5,620	702.5	7,878	945.3	120.5
Ubol	2,111	373.6	1,503	149.3	2,832	278.8	2,413	214.7	115.5
Total	130,465	15,160.7	129,937	14,689.2	116,283	13,545.4	121,795	15,482.2	

Source: Division of Agricultural Economics, Ministry of Agriculture

b. Present Production Situation

Total cotton production in Thailand and the Northeast is affected by disease and insects. Yields are below potential due to these problems. Applications of fertilizer can increase production, but unless the proper amount of agrochemical (insecticide) is applied at the right time, the increased production will not be realized. The sharp production drop in 1969 was due mainly to disease and pests.

The two most popular varieties now raised are Reba and Albar. Agrochemical treatment is now usually performed using a knapsack apparatus. This is satisfactory while cotton is small but at a height of 1 meter, 3 knapsack sprayers are necessary to cover one rai in one day. This limits the amount of cotton a farmer can grow and expect to cover efficiently. The Manderstam Report estimates that a family farm cannot handle more than five to ten rai efficiently.

Due to the disease and insect problem, any production improvement plan must include a large allowance for agrochemicals and the problem of inadequate spraying procedures must be addressed. Estimates ranging from 300 baht/rai to 600 baht/rai to cover agrochemical costs have been made. The most common estimate is nine or ten sprayings, per crop, at a total agrochemical cost of between 400 baht and 500 baht, per rai.

The ADB Nongwai Study established input criterias (in baht) for proposed levels of cotton production. This is illustrated in Table 4.

At present, very little fertilizer is used in cotton production, but many farmers have used agrochemicals. The agrochemical input has not always been effective mainly because of poor methods of application and lack of 100 percent participation of farmers in the cotton areas, thus giving places of refuge to the pests and disease.

All available data indicates that very little fertilizer is being used in cotton production and roughly 50 percent of the cotton producers are using agrochemicals.

The present production and input situation is:

1. Average yields are 120 kg/rai.

2. Fertilizer input costs are five baht per rai, or 2 1/2 kilos per rai (fertilizer at 2 baht/kilo).

3. Average insecticide costs are 200 baht per rai, or 11.2 kilograms per rai (at 17.78 baht per kilo).

TABLE 4

Improved Cotton Yields and Necessary Baht Inputs

Proposed Yield Kg/rai			
Variable Costs:	220	300	400
Seed	5	5	5
Fertilizer	85	100	125
Agrochemical	400	500	600
Incidentals	50	75	100
Total	540	680	830

Source: ADB Nongwai Study, 1970.

c. Improved Production Situation

The improved production situation, as defined by the Nongwai Study, with its implications of additional fertilizer and insecticide quantities (kilos) necessary, is shown in Table 5.

Table 6 illustrates the incremental costs and returns on a per rai basis while Table 7 breaks the incremental costs and returns down to a per kilo basis. Finally, Table 8 shows the full cost analysis on a per rai basis.

The cost and return data are useful for planning and resource allocation. It must be remembered, however, that the returns shown for the fertilizer-agrochemical inputs assume efficient and total input application. Present application methods will have to be improved and all farmers will have to adopt the better methods. Serious study will have to be made of aerial agrochemical application and programs geared to getting all producers to participate in utilizing improved production techniques.

Table 5

Improved Production Situation - Incremental Input and Quantity Returns Per Rai

(1) Proposed Yield Kg/rai	(2) Incremental Fertilizer Cost Baht/rai	(3) Add'l Fertilizer Kgs/rai (2) ÷ 2.00	(4) Amount of Production Over Average (1) - 120 kgs	(5) Kg. of Incremental Production Per kg. of Incremental Fertilizer	(6) Incremental Insecticide Cost Baht	(7) Incremental Insecticide Kgs (6) ÷ 17.78	(8) Insecticide Cost Per Kilo of Incremental (6) ÷ (4)
220	80	40	100	2.5	200	11.2	2.0
300	95	47.5	180	3.8	300	16.9	1.7
400	120	60	280	4.7	400	22.5	1.4

Note: Present average yields are 120 kg/rai.
Present fertilizer inputs average 5 baht or $2\frac{1}{2}$ kg. per rai.
Present insecticide applications average 200 baht or 11.2 kg. per rai.
Columns (2) and (6) are determined by subtracting present expenditures from the values in Table 4.

Source: ADB Nongwai Study and NEED PAG Calculations.

Table 6

Incremental Return Per Rai at Different Production Levels

Proposed Total Yield: Kg/Rai	Incremental Yield: Kg/rai	Incremental Fertilizer Per Rai Kgs	Incremental Fertilizer Per Rai Baht	Incremental Insecticide Per Rai Kgs	Incremental Insecticide Per Rai Baht	Total Incremental Costs: Baht/rai	Incremental Return @ 4 Baht/Kg: Baht/Rai	Net Return: Baht/rai
220	100	40	80	11.2	200	280	400	120
300	180	47.5	95	16.9	300	395	720	325
400	280	60.0	120	22.5	400	520	1120	600

Source: Table 5 and NEED PAG Calculation

Table 7

Incremental Costs and Returns on a Per Kilo Basis

(1) Incremental Yield Per Rai (above 120 kg) Average Kg.	(2) 1/ Incremental Kg. Yield per Kg. Incremental Fertilizer Kg.	(3) Value of Incremental Yield @ 4 Baht/kg Baht	(4) Cost of 1 kg. Fertilizer Baht	(5) Incremental Insecticide Cost Necessary to Cover Incremental Yield due to 1 kg Fert. application Baht 2/	(6) Total Cost Per Kilo of Incremental Yield (4) + (5)	(7) Benefit/Cost Ratio (3) ÷ (6)
100	2.5	10.0	2.0	5.0	7.0	10/7 = 1.4
180	3.8	15.2	2.0	6.5	8.5	15.2/8.5 = 1.8
280	4.7	18.8	2.0	6.6	8.6	18.8/8.6 = 2.2

1/ From Table 5

2/ Values determined in line (8) Table 5 times line (2) in this table.

Source: NEED PAG Calculations.

Table 8

Full Cost and Return Analysis Per Rai

tal Yield	Total Return at 4 Bh/kg.	Total Fertilizer Input and Costs Per Rai		Total Insecticide Input and Costs Per Rai		Total Cost/Rai	Net Return
g./Rai	Baht/Rai	Kg.	Baht	Kg.	Baht	Baht	Baht/Rai
0 (Present)	480	2.5	5	11.2	200	205	275
0	880	42.5	85	22.4	400	485	395
0	1200	50.0	100	28.1	500	600	600
0	1600	62.5	125	33.7	600	725	875

urce: Tables 4-7 and NEED PAG Calculations

d. Cotton Market Situation

Thailand Market: Thailand is a net importer of cotton fiber. Table 9 illustrates raw cotton fiber imports and exports and the net trade balance. The total annual deficit is over 200 million baht.

The quantity of imports is significant to result in a fairly large market for local cotton producers. However, before local cotton can compete successfully, it must be comparable to imports in price and quality.

Comparative Prices: As shown in Table 1, the price per kilo of seed cotton has varied from 4.38 baht in 1961 to 2.80 baht in 1964, and back to 4.10 baht in 1967.

Assuming a ratio of 35 percent of fiber from seed cotton, the actual cost of fiber at different seed cotton price levels is shown in Table 10.

An increase in the production of cotton in Thailand, coupled with an improvement in quality, should result in substantial foreign exchange savings for Thailand.

Table 9

Cotton Imports and Exports for Thailand

Year	Imports		Exports		Trade Balance		
	Tons	Baht	Tons	Baht	Tons	Baht	
1957	102	492,847					
1958	833	6,215,792	11	44,904	- 822	-6,170,888	58
1959	2,041	15,906,988	20	129,787	- 2021	-15,777,201	59
1960	4,923	59,149,264	106	459,844	- 4817	-58,689,420	60
1961	8,730	110,999,709	292	1,031,040	- 8438	-109,968,669	61
1962	8,154	100,739,993	321	875,728	- 7833	- 99,864,265	62
1963	9,490	112,418,215	614	2,727,646	- 8876	-109,690,569	63
1964	10,481	124,398,720	260	868,945	-10221	-123,529,775	64
1965	24,723	291,578,946	167	612,134	-24556	-290,966,812	65
1966	24,406	297,434,447	484	1,489,192	-23922	-295,945,255	66
1967	24,728	277,592,423	375	1,586,280	-24353	-276,006,143	67
1968	22,738	230,389,976	3,794	7,124,465	-18944 1/	-223,265,511	68

1/ Equal to 54,126 tons of seedcotton on 65% seed 35% fiber breakdown.

Source: Department of Customs.

Table 10

Actual Cost of Fiber at Different Seed Cotton Price Levels

Cost of Seed Cotton	Cost of Fiber
2.00 Baht/kilo	5.71 Bht/kilo
3.00 "	8.57 "
3.50 "	10.00 "
4.00 "	11.42 "
4.20 "	12.00 "
4.50 "	12.85 "

Source: NEED-PAG Calculations

Imported cotton fiber has had the following CIF prices according to the Department of Customs:

Year	Cost
1963	10.97 Bht/kilo
1964	11.80 "
1965	15.84 "
1966	12.21 "

Source: Department of Customs

Import duty of 0.33 baht/kilo must be added to all above prices.

Table 11 compares the price of local fiber per kilo to the price of imported fiber per kilo (including import duty).

Table 11

Local Versus Import Prices of Fiber

Year	Local Fiber Price	Imported Fiber Price
1963	9.58 baht/kilo	11.30 baht/kilo
1964	8.00 "	12.13 "
1965	11.67 "	16.17 "
1966	11.67 "	12.54 "

Source: Department of Customs

The price of local cotton remains under the import price. The high level of imports must therefore be due to lack of local supply to meet demand and the higher quality of imported fiber.

International Demand: The Far Eastern regional deficit for raw cotton fiber grew steadily from 951,330 metric tons valued at $619,620,000 in 1962 to 1,227,080 metric tons valued at $791,310,000 in 1968.

Average value per ton of Asian imports fell from $630 in 1962 to $587 in 1967, and then rose to $617 in 1968.

The largest importers by percentage in 1968 were:

(i) Japan: 54 percent (of total quantity)

(ii) Hong Kong: 13 percent

(iii) Taiwan: 6 percent

(iv) Philippines: 3 percent.

The basis for these numbers is shown in Tables 12 and 13.

Table 12

Raw Cotton
Exports by Year (Major Asian)

Country	Quantity (10 Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Burma Qty:	2001	1214	1133	1603	447	350	148
Value	898	545	566	846	241	161	76
Cambodia Qty:	375	186	-	-	-	-	-
Value	129	61	-	-	-	-	-
China Mnl. Qty	820	-	3	-	-	381	786
Value	415	-	2	-	-	210	440
India Qty:	4994	6580	5098	4122	2669	4386	3598
Value	2509	2643	2403	2247	1410	1892	1771
Japan Qty:	67	90	148	129	153	277	101
Value	39	56	93	83	80	146	63
Laos Qty:	4	3	-	1	-	-	-
Value	-	-	-	-	-	-	-
Pakistan Qty:	7676	14189	16552	12402	8895	13446	20896
Value	3932	6886	7309	6452	4169	6099	9989
Singapore Qty:	38	67	138	256	357	476	470
Value	21	31	67	136	189	242	268
Thailand Qty:	-	22	-	-	14	2	337
Value	-	9	-	-	8	1	206
Total Qty:	15975	23707	23072	18513	12535	19318	26336
Total Value:	7951	10231	10440	9764	6097	8751	12813

North America leads all regions in cotton exports followed by Africa, Asia, The USSR, and South America.

Average Value Per 10 Metric Tons:	$4977	$4315	$4525	$5274	$4864	$4530	$4865
Average Value Per	-	$4090	-	-	$5714	$5000	$6112

Source: FAO Trade Yearbook 1969.

Table 13

Imports by Year (Major Asian)

Country	Quantity (10 Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
China Mnl. Qty:	6749	14314	10523	16850	10702	8817	6440
Value	3707	8329	6100	9900	5940	4780	3500
Taiwan Qty:	4921	6634	5447	6463	7040	8763	8735
Value	2882	4008	3105	3617	3816	4456	4564
Hong Kong Qty:	10523	12404	13188	13352	15190	14283	19630
Value	5985	6942	7413	7366	8067	7285	10350
India Qty:	15593	11275	14287	12361	7884	15199	14457
Value	12181	9018	11781	10874	7143	12490	12515
Japan Qty:	60222	70731	69179	70227	70401	75347	80782
Value	37670	43435	43203	43304	41385	43235	50224
N. Korea Qty:	1080	998	950	1065	1094	1107	1333
Value	593	581	551	626	608	610	750
S. Korea Qty:	6241	6477	6410	7068	7412	9076	8644
Value	3418	3815	3729	4084	4277	4933	4905
Malaysia Qty:	8	33	138	250	355	UNK	485
Value	5	15	67	133	187	UNK	266
Philippine Qty:	4055	3764	2946	2505	4249	3254	5075
Value	2348	2114	1627	1578	2327	1786	2740
Singapore Qty:	29	19	130	228	366	481	531
Value	18	10	75	131	196	245	308
Thailand Qty:	774	925	1040	2471	2421	2472	2227
Value	473	536	596	1402	1420	1334	1083
S. Vietnam Qty:	913	820	1588	1727	1358	1128	705
Value	633	556	1093	1189	1024	1031	739
Total Qty:	111108	128394	125826	134567	128472	139927	149044
Total Value:	69913	79359	79340	84204	76390	82185	91944
Average Val. per 10 Metric Tons:	$6292	$6180	$6305	$6257	$5946	$5873	$6168
Average Thai Value 10 Metric Tons:	$6111	$5795	$5730	$5674	$5865	$5396	$4863

Source: FAO Trade Yearbook 1969.

The net exporters and major sources of world supply are North, Central and South America, Africa (particularly Egypt and Congo Kinshasa), and the USSR.

Over the long term, certain problems cloud the future demand situation for cotton. These are:

1. Imports into developed countries are declining due to synthetics.

2. Developing countries are attempting to become self-sufficient.

3. Developing country importers quite often lack foreign exchange to pay for imports.

In spite of the negative factors, over the third five-year plan period, Thailand should be able to sell any surplus it might produce. It appears unlikely that Thailand actually will produce a surplus given the deficit situation within the country.

If a surplus does occur, then the most important potential customer is Japan and initial trade efforts should be directed toward that country.

Processing Capability in Thailand: The cotton gin situation in Thailand is illustrated in Table 14.

TABLE 14

Cotton Gins in Thailand - 1970

Region	Types of Ginnery			Number of Gins Installed		
	Roller	Saw	Total	Single Roller	Double Roller	Saw
Central	44	10	54	1071	16	16
Northeast	16	2	18	442	19	2
North	3	-	3	74	-	-
	63	12	75	1587	35	18

Source: Manderstam Report, 1970.

According to Manderstam, 32 gins were inactive in 1969. Factory capacity varies between 8 and 95 tons of seed cotton per year, based on two, eight-hour shifts for 150 days.

The indications are that present ginning capacity could handle over three times present seed cotton production levels in Thailand. Farm production could be expanded without requiring further investment in ginning capacity.

6. Tobacco

a. Tobacco Production

There are four types of tobacco grown in Thailand. These are: Virginia, Burley, Turkish and indigenous. The Northeast produces Virginia, Turkish and indigenous varieties.

The Thai Tobacco Monopoly plays a major role in the production, purchase and export of Virginia and Burley tobacco. It

is also responsible for tobacco imports to be used in blending. The TTM collects sales tax and duties,but does not fix retail prices.

Virginia tobacco is the most important commercial tobacco variety grown in the Northeast. Table 1 illustrates Northeast and whole kingdom production data on Virginia. Total production in the Northeast has remained fairly constant while area under production has declined. The land decline has been offset by increasing yields. In the kingdom,as a whole, productivity per rai has fallen, while land under cultivation has increased.

Within the Northeast, Virginia is found in Khon Kaen, Nongkai and Nakhon Panom. The major producing area is North Thailand.

The implication of Table 1 is that better farm management techniques and inputs are being used in the Northeast in order to increase yields. This does not appear to be true in the country as a whole.

Table 2 illustrates the production situation for Turkish tobacco. This is grown mainly in Khon Kaen, Mahasarakam and Roi-et.

The Northeast is the only region which produces Turkish tobacco. There is no burley produced in the Northeast.

Local variety tobacco is produced in the Northeast. Table 3 shows Northeast area and production and whole kingdom area and production of local variety. For local variety, the yield per rai in the Northeast is below the national average. Local variety tobacco is consumed locally and is not handled by the Tobacco Monopoly.

Production inputs are not applied to local variety because it is not produced to enter regular commercial channels. The natural production capability of the Northeast does not appear to be as high as the national average (see Table 3). However, the Northeastern commercial tobacco producer has responded very well to produce Virginia tabacco. As shown in Table 1, Northeastern yields of Virginia are above the national average.

Exact production cost data for tobacco are not available. However, the efficiency of Virginia type production is higher in the Northeast than in the rest of Thailand. Based on historic yield increase figures, it appears that both the

TABLE 1

Virginia Tobacco Production Data for Northeast and Whole Kingdom

Year	Northeast			Whole Kingdom			Percent NE/WK	
	Rai (1,000)	Production 1,000 Kg.	Yield Per Rai (Kg.)	Rai (1,000)	Production 1,000 Kg.	Yield Per Rai (Kg.)	Rai	Production
1960/61	12.7	729.3	57.4	110.0	8,833.1	80.3	11.6	8.3
61/62	12.8	756.1	59.1	96.6	8,656.3	89.6	13.1	8.7
62/63	11.3	720.8	63.8	93.0	8,643.5	92.9	11.7	8.3
63/64	10.7	677.3	63.3	94.7	8,606.5	90.9	11.3	7.9
64/65	10.0	709.5	71.0	105.7	8,856.5	83.8	9.4	8.0
65/66	9.8	627.2	64.0	99.8	7,620.7	76.4	9.8	8.2
66/67	9.1	726.5	79.8	107.5	7,767.3	72.3	8.5	9.4
67/68	8.6	734.5	85.4	119.5	8,304.9	69.5	7.2	8.8
68/69	7.0	581.2	83.0	131.5	8,816.4	62.3	5.3	7.1
69/70	7.0	716.5	102.4	127.9	9,348.5	73.1	5.5	7.7

Source: Thailand Tobacco Monopoly and NEED PAG Calculation.

TABLE 2

Northeast Turkish Tobacco Production

Year	Rai	Production (Tons)	Yield Per Rai (Kgs.)
1960/61	434	34.0	78.3
1961/62	750	54.2	72.3
1962/63	928	75.0	80.8
1963/64	1,067	92.5	86.7
1964/65	1,420	128.3	90.4
1965/66	1,005	145.3	144.6
1966/67	1,188	217.4	183.0
1967/68	1,102	161.8	146.8
1968/69	815	91.0	111.7
1969/70	784	91.3	116.5

Source: Thailand Tobacco Monopoly

producers and the land respond to improve production techniques and that increased inputs will increase yields.

The wholesale prices of local and Virginia tobacco are shown in Table 4.

TABLE 3

Local Tobacco Variety Production - Northeast and Whole Kingdom

Year	Whole Kingdom			Northeast		
	Area Planted (1000 rai)	Production (Tons)	Yield/rai (kgs)	Area Planted (1000 rai)	Production (Tons)	Yield/rai (kgs)
1960	257	65,300	254	112	20,554	184
1961	159	39,700	250	104	17,358	167
1962	163	39,300	241	62	9,589	155
1963	160	38,000	238	75	12,960	173
1964	214	53,900	252	74	11,107	150
1965	347	67,900	196	92	14,668	160
1966	430	80,000	188	97	15,422	159

Source: Agricultural Statistics of Thailand, 1966. Division of Ag. Econ., Min. of Agriculture.

TABLE 4

Wholesale Prices for Local and Virginia Tobacco

Year	Wholesale Local Price: Baht/Kg.	Wholesale Virginia Price: Baht/Kg.
1960	7.43	13.04
1961	8.06	15.35
1962	6.85	13.73
1963	7.32	14.64
1964	7.11	14.22
1965	5.68	11.37
1966	6.70	13.41

Source: Ag. Statistics of Thailand, 1966, Division of Ag. Econ., Min. of Agriculture.

b. Market Situation

Thailand Market: Thailand is a net importer of tobacco. The varieties of tobacco imported are Virginia and Turkish. These come from the U.S., Turkey and Greece. Table 5 illustrates the import-export situation and shows the net balance. The value per unit of imports is much higher than the value per unit of exports.

Thai exports are basically of a native variety which is exported to Europe for use as cigar fillers.

Table 6 compares baht per kilo prices of imported tobacco and Thai produced Virginia. Historically, Thai Virginia has value of less than 50 percent of the imported value. The fact that imports are rising implies a quality differential and/or a production shortage of Thai Virginia and Turkish.

In 1968, the tobacco trade deficit was 214 million baht. This could be a ready market for Thai tobacco if it could be produced in suitable quantity and with quality comparable to the imports.

Although production cost data is lacking, it appears that the Northeast would be the appropriate area for promotion of increased production of Virginia and Turkish varieties because it now produces both these varieties with higher yields per rai than elsewhere in Thailand. If a quality comparable to imports can be developed, the price of local Virginia could rise almost 100 percent and still be below the import price. In other words, production inputs can be increased significantly

TABLE 5

Tobacco Imports and Exports*
Thailand

Year	Imports			Exports			Trade Balance	
	Metric Tons	Million ฿	Bht/Ton	Metric Tons	Million ฿	Bht/Ton	Metric Tons	Mill. ฿
1957	5,394	180	33,370	6,728	100	14,858	+1334	-80
1958	5,300	179	33,773	5,781	85	14,705	+481	-94
1959	6,631	154	23,227	1,235	16	12,903	-5396	-138
1960	3,938	93	23,604	1,696	21	12,352	-2242	-72
1961	5,755	181	31,423	1,133	12	10,619	-4622	-169
1962	3,875	126	32,474	2,628	30	11,406	-1247	-96
1963	3,673	121	32,970	3,750	41	10,933	+77	-80
1964	4,957	162	32,661	6,147	79	12,845	+1190	-83
1965	5,308	161	30,320	6,001	89	14,833	+693	-72
1966	8,414	258	30,677	7,880	115	14,593	-534	-143
1967	8,494	260	30,588	8,562	147	17,172	+68	-113
1968	11,647	412	35,364	10,356	198	19,111	-1291	-214

* Tobacco leave

Source: Department of Customs

TABLE 6

Import Versus Thai Virginia Comparative Prices

Year	Imported Tobacco Baht/kg.	Thai Virginia Wholesale Price Baht/kg.
1960	23.6	13.0
1961	31.4	15.3
1962	32.5	13.7
1963	33.0	14.6
1964	32.7	14.2
1965	30.3	11.4
1966	30.7	13.4

Source: Table 4 and 5.

in order to raise quality and the price will remain competitive with imports.

International Market: The Far East, as a region, is a net exporter of tobacco in terms of quantity, but recently the region has been a net importer in terms of value. Tables 7 and 8 show regional exports and imports.

The major import into the region is Virginia tobacco. If Thailand could develop a quality Virginia as an import substitute, it should also be able to sell it within the region due to geographic advantage. Major area importers are: Japan, Singapore, Malaysia, South Vietnam and Hong Kong.

The most important step for entering this market is the development of a comparable quality Virginia. This should be a major goal of the Thai Tobacco Monopoly.

7. Vegetables

a. Production

Vegetable production in the Northeast tends to be on small plots and is labor intensive. Many plots are well fertilized, treated with agrochemicals and are irrigated (often with hand carried cans). Vegetables are multicropped. Present production locations tend to be around urban areas and across the Mekong from Vientienne. Many of the original vegetable producers were Vietnamese, but now many Thai's have also moved into production.

There is very little production cost data available for vegetables, but comparative area, yield and total production data do exist. Table 1 illustrates area planted, area harvested, average yield, total production, average wholesale price, and market value for vegetables, excluding tomato and onion. Tomato production, national and Northeast, is shown in Table 3. Table 4 illustrates the Northeast percentage of the Whole Kingdom totals.

The Northeast produces less than one-third of the national total of vegetables and Northeastern productivity is slightly below the national average, but not significantly.

The Northeast does not appear to be at a significant production advantage or disadvantage relative to the whole kingdom. Historically, vegetable producers have adopted production inputs such as fertilizers and agrochemicals.

TABLE 7

Tobacco, Unmanufactured
Exports by Year (Major Asian)

Country	Quantity (Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Cambodia Qty:	-	391	272	147	73	UNK	-
Value	-	4	3	10	6	UNK	-
Ceylon Qty:	174	82	-	-	-	427	608
Value	15	10	-	-	-	58	86
China Mnl. Qty:	3695	3936	4708	4555	7586	11427	22956
Value	162	836	270	300	630	1010	2140
Taiwan Qty:	3857	1351	1867	2777	4876	2848	3113
Value	188	88	97	176	285	137	183
India Qty:	63453	67898	71711	61950	35611	55739	52078
Value	3929	4776	4698	4550	2788	4361	4405
Indonesia Qty:	11500	12900	19500	13100	12400	10200	8587
Value	1616	1893	2182	1737	2379	1500	1368
Japan Qty:	7498	6941	6952	7269	8872	5889	6747
Value	692	721	783	862	1082	717	803
N. Korea Qty:	10305	7745	3700	8100	5100	1793	4500
Value	452	465	212	518	422	160	420
S. Korea Qty:	101	305	373	1350	9958	10847	10881
Value	7	20	14	85	647	664	764
Philippine Qty:	24142	24770	33431	24571	22146	24029	22931
Value	1175	1385	1813	1359	1068	1310	1485
Singapore Qty:	1176	1487	659	735	929	688	1210
Value	105	131	83	76	78	67	200
Thailand Qty:	2628	3782	5695	6172	7880	8562	9934
Value	146	197	369	446	553	708	931

North America is the leading export region followed by Europe and Asia.

Total Qty:	128529	141588	148868	130726	115431	132449	143545
Total Value	8487	10526	10524	10119	9938	10692	12785
Export Percent Qty:	"2%	3	4	5	7	6	7
of Thailand: Value:	2%	2	4	4	6	7	7
Average Price/Ton in Thailand	$556	$521	$648	$723	$702	$827	$939
Average Price/Ton of Total	$660	$743	$707	$774	$861	$807	$890

Source: FAO Trade Yearbook 1970.

TABLE 8

Tobacco, Unmanufactured
Imports by Year (Major Asian)

Country	Quantity (Metric Tons) & Value (10,000 U.S. Dollars)						
	1962	1963	1964	1965	1966	1967	1968
Ceylon Qty:	1647	1167	616	748	497	138	138
Value	122	133	68	59	72	17	30
Taiwan Qty:	1594	2201	1170	1939	2168	6276	1644
Value	295	403	233	352	446	1114	169
Hong Kong Qty:	8852	8316	8498	8210	7047	6962	4627
Value	839	879	877	841	751	693	524
India Qty:	1076	551	764	79	93	700	330
Value	268	136	170	3	3	208	53
Japan Qty:	17509	15824	29091	24958	32081	29610	27253
Value	3227	3068	4709	4465	6153	5688	5066
Laos Qty:	438	702	585	10[illegible]	752	UNK	768
Value	18	46	36	85	69	UNK	42
Malaysis Qty:	4511	5561	4049	5200	5957	5038	9187
Value	598	707	580	714	811	750	767
Philippine Qty:	1166	2265	514	903	1740	2720	3618
Value	145	116	65	83	198	300	602
Singapore Qty:	4019	4153	3406	4199	3634	3864	21701
Value	461	521	453	532	456	521	1006
Thailand Qty:	3875	3673	4960	5619	8833	9309	11648
Value	603	576	780	824	1300	1382	1984
S. Vietnam Qty:	2581	2503	2589	4813	3935	5242	7529
Value	394	418	415	755	696	1028	693

Europe accounts for roughly 60% of total world imports followed by North America and Asia. Australia imports around 12,000 tons annually and New Zealand 3,000 tons.

Total Qty:	47268	46916	56179	58376	66737	59859	88443
Total Value:	6970	7003	7756	8713	10955	11701	10900
Average Value/Ton:	$1475	$1493	$1381	$1492	$1642	$1955	$1232
Thai Import Qty:	8%	8%	9%	10%	13%	16%	13%
Share Percent Value:	9%	8%	10%	12%	12%	12%	18%
Average Price/Ton in Thailand:	$1556	$1568	$1573	$1466	$1472	$1485	$1703

Source: FAO Trade Yearbook 1970...

Various estimates have been made concerning return per rai on vegetables. The general feeling is that the return is quite high--perhaps higher than any other crop. However, vegetables are labor intensive and require capital inputs. Not all producers are willing to do the work and invest the capital necessary.

Tables 1 and 2 give some indication of average gross return per rai. Such returns allow for fairly substantial input costs. Input-output relationships are, however, not available.

b. Market Situation

The major Thai market for Northeast vegetables is the Northeast. Northeastern urban centers are the most important markets. The Household Expenditure Survey[1/] places Northeast consumption at 17.2 kgs. per person, per year. This would be a total demand of roughly 200,000 tons of vegetables with a population of 12 million. Total vegetable production (including tomatoes, onions and shallots) has exceeded this amount since 1966.

The implied vegetable surplus has moved to Bangkok and Laos. Total exports appear to be between 15,000 and 40,000 tons per year.

The Laos deficit is not met only by the Northeast. Vegetables from other regions of Thailand enter Laos.

The market for Northeast vegetables will be growing Northeast urban centers, Laos and Bangkok. Due to lower transport costs and less travel time (thus cutting losses due to perishability). Northeastern vegetables should be able to replace other regional vegetable exports to Laos.

8. Kenaf

Many reports have been written concerning kenaf in Thailand. Three of these are:

1. An Economic Study of the Production and Marketing of Thai Kenaf by Chaiyong Chuchart, Norman L. Wake and Sachee Suthasathien, and published by ASRCT in 1967.

2. Kenaf in Thailand by Erwin J. Sholton of Checchi and Company, October, 1968.

1/ 1962.

TABLE 1

Vegetable Production Data - Composite - Whole Kingdom

Year	Area Planted 1,000 rai	Area Harvested 1,000 rai	Average Yield Kg/rai	Production 1,000 Tons	Average Wholesale Price ฿/Kg.	Market Value Million Baht	Average Baht Return Per Rai Baht
1965	702	685	814	558	1.74	971	1,383
1966	1,121	1,098	842	925	1.81	1,674	1,493

Source: Agricultural Statistics of Thailand, 1966 Division of Ag. Econ., Min. of Agriculture.

Note: The vegetables included in this composite are: Chinese Kale, Cabbage, Cauliflower, Chines Cabbage, Chinese Green, Stringbean, Egg Plant, Pimpkin, Sweet Potato, Potato, Yam Bean, other potatoes.

TABLE 2

Vegetable Production Data - Composite - Northeast

Year	Area Planted 1,000 rai	Area Harvested 1,000 rai	Average Yield Kg/rai	Production 1,000 Tons	Average Wholesale Price ฿/Kg.*	Market Value Million Baht	Average Baht Return Per Rai Baht
1965	179	175	777	135.9	1.74	236.5	1,321
1966	266	260	751	195.2	1.81	353.3	1,328

* National Average Wholesale Price

Source: Agricultural Statistics of Thailand, 1966 Division of Ag. Econ., Min. of Agriculture.

TABLE 3

Tomato Production - Northeast and Whole Kingdom

Year	Area Planted 100 Rai		Production 100 tons		Average Yield Kg/rai	
	W.K.	N.E.	W.K.	N.E.	W.K.	N.E.
1965	28	8.1	11.9	2.99	425	369
1966	39	11.7	18.1	5.27	464	450

Source: Agricultural Statistics of Thailand, 1966, Div. of Ag. Econ., Min. of Ag.

TABLE 4

Tomato Production - Northeast and Whole Kingdom - Percentage

Year	Area Planted N.E. % of W.K.		Production N.E. % of W.K		Average Yield N.E. % of W.K.	
	Vegetables	Tomato	Vegetables	Tomato	Vegetables	Tomato
1965	25%	29%	24%	25%	95%	87%
1966	24%	30%	21%	29%	89%	97%

Source: Tables 1, 2, and 3 NEED PAG Calculations

3. Government Policies for the Thai Kenaf Industry, an economic analysis by Dr. Eldon D. Smith of the University of Kentucky team, published in August, 1969.

Because so much is written about kenaf, only a few highlights will be mentioned here. Detail questions should refer to the complete studies.

a. Kenaf Production

Almost all Thai kenaf is produced in the Northeast. The peak production year was 1966 when 3,300,000 rai of land were planted in Kenaf with a total production of 661,371 metric tons or an average yield per rai of 213 kgs. Since 1966, production has fallen to around 200,000 tons. In 1966, Thai production was about 12 percent of the total world production of jute and allied fibers,and about 23 percent of the production of India and Pakistan.

The production situation now is:

1. Present production power techniques used for kenaf production are basically hand labor and buffaloes.

2. Seed input comes from the previous crop rather than selected seed. This has resulted in gradual crop deterioration.

3. Row planting and thinning is often not practiced and, instead, broadcast planting and no thinning is followed. This reduces yields per rai.

4. Roughly 20 percent of the producers use fertilizer. This is chemical fertilizer. Almost no one uses manure or compost. Chemical fertilizer is applied in two equal doses, 30 and 60 days after germination. Fertilizer application increases yields by 25 percent at best and according to Sholton, a farm price for kenaf of less than 2.00 baht per kilo of "Mixed Grade" fiber makes fertilizer application uneconomical.

5. Almost no agrochemicals (insecticides) are used in kenaf production.

6. There is almost no crop rotation and harvesting techniques are such that some potential yield is lost.

7. Retting facilities are often inadequate and generally there is a water shortage.

Under present production conditions, fiber yields average 200 kgs per rai. Experiments utilizing proper production methods and fertilizer have attained yields of 400 kgs. per rai.

Cost and return studies for kenaf production get varying results. Total costs range upward from 100 baht per rai. Sholton states that at a price of ฿1.50 per kilo of "Mixed Grade" fiber, a farmer will st grow kenaf. However, at this price level, a farmer will not use inpu such as fertilizer and insecticide (at their present price levels).

Grading: Almost all kenaf sold off the farm is "Mixed Grade". There is a very small price differential among grades resulting in no incentive to the farmer to try to improve the quality of his kenaf.

The quality of Thai kenaf being exported is often subject to criticism and it appears that much kenaf is sold as top grade which is really of inferior quality. The grading problems and the role of the Office of Commodity Standards which is part of the Ministry of Economics Affairs is discussed in the Smith Report and the November, 1970, issue of Investor Magazine. The reputation of Thai kenaf overseas suffers due to present grading practices.

b. Market

The Thai internal market for kenaf is between 60,000 to 70,000 tons. This is converted into gunny sacks, for which there is an annual Thai demand for about 40 million sacks. Present sack production is around 50 million sacks of which six million are exported. It appears that a surplus is accumulating. There are now 11 gunny bag factories in Thailand with a total input capacity of 115,000 tons of kenaf and an output capacity of 82 million sacks. Exports of kenaf bales were 473,000 metric tons valued at 1,613 million baht in 1966. By 1968, the figure had fallen to 289,000 metric tons valued at 674 million bahts.1/

There are various reasons for the decline. Among them are:

1. Continued competition from India and Pakistan.

2. Competition from synthetics.

3. Poor quality control in Thailand leading to a poor reputation for Thai kenaf in export markets.

The future situation of Thai kenaf is uncertain. The major uses of kenaf are:

1. Sacks and bags.

2. Tufted primary backing.

3. Tufted secondary backing.

4. Woven carpet backing.

1/ Department of Customs

Demand projections for kenaf vary, but few are optimistic. The sack and bag demand for kenaf is expected to decline due to synthetics. The other three demands will continue and perhaps increase,but competition will be keen.

The key issue determining the future demand situation of Thai kenaf will be the quality of the product. Thai kenaf will have to compete with all other natural products on the basis of price and quality. The Thai government can influence this situation by assistance, through its extension service, to alleviate some of the production problems described previously. The Thai Government can also impose stricter quality control measures on exports to improve the image of Thai kenaf abroad.

From the information available, it appears that demand over the plan period will be around 60,000 to 70,000 tons of kenaf for Thai consumption, and exports between 200,000 to 250,000 tons. Total production requirements should be between 260,000 and 320,000 tons per annum. The export figure could be overly optimistic as the FAO Study Group on Jute, Kenaf and Allied Fibers projects 1971-72 world imports of jute and kenaf to be between 771,000 and 794,000 metric tons, a drop from the 1970-71 figures of 809,000-864,000 metric tons due to a fall in demand in Europe and Japan.[1/]

9. Groundnuts

a. Groundnut Production

National groundnut production statistics are shown in Table 1. Table 2 illustrates Northeastern area planted and production.

Field surveys by the ADB Compac team showed almost no use of fertilizers and insecticides in groundnut production. ADB Compac recommends the testing of phosphorus and potassium, but not nitrogen. Seed innovation, prior to planting, with rhizobium is also recommended.

Ta Pra has conducted tests with chemical sprays and raised yields from 180 kg. per rai to 334 kg. per rai on test No costs have yet been established.

Input-output studies on groundnuts are lacking. Almost no experimentation has been done with this crop. Farmers plant it as a sideline and it receives no special emphasis.

The Northeast percentage of the Whole Kingdom total groundnut area and production is shown in Table 3. As a percentage of total production, the Northeast has declined. This is due to a rapid increase in the North. No analysis has been done on regional relative or comparative advantages.

1/ Bangkok Post, February 23, 1971. Page 14.

Table 1

Groundnut Production Data - Whole Kingdom

Year	Area Planted 1000 rai	Area Harvested 1000 rai	Average Yield Kg/rai	Production 1000 tons	Equivalent in Shelled* 1000 tons	Bangkok Wholesale Price Baht/kg.	Market Value Million Baht
1960	736	725	210	152	91.2	4.19	382.1
1961	521	516	209	107.9	64.7	3.31	214.2
1962	544	533	211	112.4	67.4	3.60	242.6
1963	520	511	221	112.9	67.7	3.67	248.4
1964	546	541	222	119.8	71.9	4.00	287.5
1965	621	596	219	130.6	78.4	4.10	321.3
1966	982	957	230	219.9	131.9	3.66	482.9
1967	-	-	-	150.0	90.0	—	—
1968	-	-	-	130.7	78.4	—	—

* Converted at 60%

Source: Agricultural Statistics of Thailand, 1966, Div. of Ag. Econ., Min, of Ag., and more recent Ministry of Agriculture Data for 1967-68 production.

Table 2

Groundnut Production - Northeast

Year	Area Planted 1,000 rai	Area Harvested 1,000 rai *	Production 1,000 tons	Yield Kg/rai
1960	208	203.6	41.1	201.9
1961	179	175.2	35.3	201.5
1962	131	128.3	26.1	203.4
1963	161	157.6	37.7	239.2
1964	142	139.0	32.2	231.7
1965	164	160.6	35.1	218.6
1966	170	166.4	33.9	203.7
1967	-	—	31.7	-
1968	—	—	31.2	—

* Determined by applying factor derived from Table 1 - Factor is .979

Source: Agricultural Statistics of Thailand, 1966, Div. of Ag. Econ., Min. of Ag. and more recent Ministry of Agriculture Data for 1967-1968 production.

TABLE 3

Northeast as Percent of Whole Kingdom
Groundnut Area and Production

Year	Area Planted N.E. % of W.K.	Production N.E. % of W.K.
1960	28%	27%
1961	34%	33%
1962	24%	23%
1963	31%	33%
1964	26%	27%
1965	26%	27%
1966	17%	15%
1967	--	21%
1968	--	24%

Source: Tables 1 and 2 and NEED/PAG Calculations

b. Market Situation

When processed, groundnuts yield cake, meal and oil. In processing, groundnuts yield 45 percent oil. The cake and meal resulting from processing contains about 50 percent protein. Groundnut oil is an edible oil and the cake and meal is used for animal feed. The high protein content makes groundnut cake and meal well suited for animal feed because a high protein content results in high yielding dairy cattle and hens and in rapid production of lean meat in cattle.

Oilcake production,in general, has risen rapidly since 1955. Total world production has risen from 27 million tons in 1955 to almost 50 million tons in 1968 (or a compound annual growth rate of 4.9 percent). During the same period, groundnut oilcake production rose from 2.4 million tons to 3.7 million tons (or compound annual growth rate of 3.4 percent).

The major reason for the production growth is due to demand generated by increased human consumption of meat and dairy products, thus creating a demand for animal feed. Imports from 1955 through 1968 rose from 8.3 million tons to 21.6 million tons[1/] or an annual compound growth rate of 7.6 percent. Groundnut cake[1/]

1/ Includes cake equivalents of oilseed imports.

exports over the same period increased from 1.0 million tons to 2.3 million tons, or an annual compound growth rate of 6.6 percent.

Groundnut production and exports percentage increases have been below total oilcake production and import percentage increases because while groundnut cake has been in demand, oil has not. Groundnuts yield a high percentage of oil and the problem arises of what to do with it. In 1955, the "ideal" bean to fit western European and Japanese demand would contain 60 percent oil and 40 percent cake. By 1967, the ideal was 28 percent oil and 72 percent cake.

The major exporters of raw groundnuts, groundnut cake and meal, and groundnut oil are Niger, Nigeria, Senegal, Gambia and India. The major importers are the European Economic Community, Portugal, United Kingdom, Hungary, Denmark and some to Japan.

The future market situation appears to be one of continued increase for oilcake without an equal increase for oil. This places groundnuts at a competitive disadvantage with oilseeds such as soybeans whose cake and oil content approaches the "Ideal".

10. Livestock

a. Production Situation

The national data on total number of buffaloes, cattle and swine are shown in Table 1.

Table 2 illustrates the livestock population in the Northeast and what percentage of the national total that represents.

TABLE 1

Number of Livestock in Thailand

Year	Buffaloes/1000 Head	Cattle/1000 Head	Swine/1000 Head
1947	5,466	4,972	UNK
1956	5,743	4,637	3,031
1960	6,666	5,265	4,231
1961	6,749	5,099	5,246
1962	6,915	5,441	4,389
1963	7,087	5,347	4,467
1964	6,877	5,236	4,291
1965	6,691	5,104	4,805
1966	6,878	5,167	4,045

Source: Agricultural Statistics of Thailand, 1966
Ministry of Agriculture.

TABLE 2

Northeast Livestock Population

Year	Buffalo 1000 Head	Buffalo % of Total	Cattle 1000 head	Cattle % of Total	Swine 1000 Head	Swine % of Total
1956	2,697	47%	3,030	65%	1,005	33%
1960	2,950	44%	2,262	43%	1,170	28%
1961	3,194	47%	2,252	44%	1,806	34%
1962	3,244	47%	2,450	45%	1,637	37%
1963	3,331	47%	2,359	44%	1,984	44%
1964	3,227	47%	2,278	44%	1,525	36%
1965	3,304	49%	2,300	45%	1,715	36%
1966	3,401	49%	2,370	46%	886	22%

Source: Agricultural Statistics of Thailand, 1966
Ministry of Agriculture and NEED/PAG Calculations.

The Northeast has roughly 50 percent of total Thai buffalo and cattle and 33 percent of total swine.

The present production situation in the Northeast is quite unsophisticated. With few exceptions, animals just graze at random on dry rice paddies, on natural pasture areas or on wooded areas around rice fields. The only improved pasture is on the Chokchai ranch near Pakchong.

During the dry season, most animals are fed rice straw or crop wastes. Grazing over dry fields continues. The nutritional value of the feed is very low. There is often public land near many villages where all villagers can graze their animals.

The amount of total grazing land in the Northeast is not really known. The World Bank study on the Northeast done in 1963 by Hans Platenius gave the figures shown in Table 3.

TABLE 3

Land Utilization in Northeast Thailand

	1000 rai	Percent of Total
Land in Farm	22,585	21.6
Forest and Grazing Land	64,165	61.5
Swamps and Lakes	369	0.4
Unclassified	17,269	16.5
	104,415	100.0

Source: 1963 World Bank Study on Northeast Thailand
by Hans Platenius

The figures in Table 3 are approximate and constantly changing as forests are cleared and the land cultivated and worn out land abandoned. However, it appears to be roughly correct as recent NEED/PAG investigations yield approximately the same results for land under cultivation.

From Table 3, it appears that there is considerable land available for grazing. If one assumes that of the 64 million rai in forest and grazing land, 50 million rai can actually be grazed (this is discounting 14 million rai of forest and grazing land which could be too steep, now farmed, etc., all unclassified land, and farm land grazing during the dry season), then in 1966, the total buffalo and cattle population in the Northeast (5,771,000 head) had 8.7 rai apiece to graze on.

The land-to-animal ratio is not a constant. The amount of land necessary to feed an animal varies depending on such factors as (1) the quality of animal desired (2) the quality of "weatherability" of the pasture, (3) the availability of feedlots and feed grains and others.

Present livestock grazing is on natural grass in thin forests where the cost of raising cattle is very low. To raise cattle by more intensive pasturing methods would involve land clearing, planting improved pasture, maintaining the pasture, building fences and making hay or silage to carry animals through the dry season.1/ To make the investment required to carry out the above will require a fairly high price level for meat.

The pasture situation and improvement problems do not apply to swine as swine do not require grazing land.

Factors of Production

Data on livestock factors of production are lacking. Feed conversion ratios, annual weight gain, breeding practices and the like are very hard to determine.

Some data which does exist and is relevant to the production situation is:

1. Buffaloes are generally sold for meat at age 7 to 8 years when they weigh roughly 400 kgs. The animal is usually bought by a merchant coming to the village who pays 4 baht a kilo liveweight.2/

1/ World Bank Report, 1963, by Hans Platenius

2/ ADB Nongwai Study

2. Cattle reach a mature body weight of 350 kgs. at age 4 years. This is 18 months later than Tha Pra. They are sold for meat at age 7 or 8 for 4 baht a liveweight kilo to a trader coming to the village.1/

3. Table 4 illustrates the average liveweight sale and dressing out percentages as determined by the ADB Nongwai Team.

4. Grass pastures are unable to provide the animal protein requirement during the dry season. This results in inadequate levels of nutrition which affects animal growth and fertility rates.

"For normal growth, 350 kg. heifers and steers require about 9 kg. of total feed (pasture feed) (90 percent dry matter) per animal, per day, containing 0.4 kg. digestible protein. A nursing cow, weighing 450 kg. has higher requirements; 12 kg. of total feed containing 0.6 kg. of digestible protein."2/

One breeder cow needs about 200 kg. of digestible protein annually. 2/

5. Feedlot Feeding: Under feedlot conditions in the USA, cattle can consume from two to three percent of their liveweight in daily feed, depending on age and condition. A 450 kg. nursing cow can consume 12 kg. daily. Ten kg. a day should suffice for a 450 kg. bull. 3/

Pasture Yields

Pak Chong experiments with Para grass pasture show yields of 16 tons of forage per rai annually (with six cuttings). Protein content of the cut forage was 1.5 percent or 240 kgs. per rai; equivalent to 160 kg. of digestible protein (digestible protein is about 2/3 crude protein). 4/

1/ ADB Nongwai Study

2/ ADB Compac Report on Livestock

3/ Ibid.

4/ Ibid.

TABLE 4

Liveweight Sale Weights & Dressing Out Percentages

Animal	Liveweight Sale Weight Kgs.	Dressing Out Percentage
Buffalo	400	50 percent
Cattle	300	50 percent
Pig	200	67 percent

Source: ADB Nongwai Study

Townsville Lucerne yields 2,000 kg. of dry matter per growing season containing 11 percent crude protein or 147 kg. of digestible protein. The advantage of a legume like Townsville Lucerne is that protein is available through the dry season as seed or as dry hay which includes the seed. Also, nitrogen is added to the soil.1/

In California, tests were conducted on irrigated pastures to check weight gain per acre. Two grazing trials took place, each lasting 200 days. An average of 2.7 animals were grazed per one acre. The pasture used was a three-year old stand of orchard grass, rye grass, ladino clover and stocking clover. The grazing treatments were: (1) one field continuously grazed with half the field irrigated Tuesday and the other half on Thursday; and (2) a five field rotational grazing treatment with seven day grazing per field and a 28-day recovery period for the forage between grazings. The fields were irrigated weekly.

On the continuous grazing fields cattle gained an average of 1.76 pounds per day while the five field rotational average gain was 1.53 pounds per day. However, more beef could have been produced per acre by rotational grazing than by continuous grazing. Table 5 illustrates the results of the California irrigated pasture grazing tests.

The final result of the California study was that in return per acre, irrigated pastures could compete favorably with other crops. However, for this to be true, there must be careful control of livestock stocking rates, there must be efficient irrigation practices and high-yielding, well-adapted, palatable forage must be used. 2/

1/ Ibid.

2/ All information on the California irrigated pasture test from "California Agriculture" magazine, July, 1969. Published by Division of Agricultural Sciences, University of California.

TABLE 5

Irrigated Pasture Grazing Test Results

	Grazing Treatment	
	5 Fields Rotation	One Field Continuous
Initial Weight (lbs)	540	530
Final Weight (lbs)	847	881
Average Daily Gain (lbs)	1.53	1.76
Total Gain (Lbs)	306	351
Live Weight Gain Per Acre (lbs)	826	950
Carcass Grade	Average Good	Average Good

Note: Ten animals took part in each test. The trials lasted 200 days (March 23 to October 15). There was an average of 2.7 animals per acre.

Source: "California Agriculture" Magazine, July, 1969.

Other Production Constraints

Before optimal livestock production can occur, there are several presently existing production constraints which must be overcome (apart from pasture improvement). These are:

1. Foot and mouth disease is prevalent throughout the Northeast.

2. Thai livestock grow slowly and have low fertility rates--probably due to inadequate nutrition.

3. High calf mortality. Disease problems such as white scours and hemorrhagic septicemia exist.

4. Brucellosis exists (contagious abortion). This causes premature birth of the calf, often resulting in death.

5. Anthrax also exists and causes sudden death.

6. Adequate housing and yards for livestock are very scarce. Good drainage is very important and adequate canals to treat cattle.[1/]

In order to compare present livestock production practices to possible improved pasture situations, Table 6 was developed. The six production constraints listed above are ignored in this table. It is assumed that they can be overcome if it appears economically feasible to raise cattle.

Feed lots are not included in Table 6 since feed lots are used as the final fattening stage between pasture feeding and the slaughterhouse.

From Table 6, it appears that the highest gross return per rai would be from irrigated pasture. Para grass is second, followed by Townsville Lucerne and the natural pasture situation. The difference between Para grass and Townsville Lucerne is questionable since Townsville Lucerne can provide protein through the dry season. Para grass has a much higher forage yield per rai, per year, which offsets, to a certain extent, the protein advantage of Townsville Lucerne.

All costs are excluded. Pasture development costs, maintenance and irrigation must be calculated where necessary.[2/] Proper pastures also require good pasture management if they are to perform optimally.

Sales price was held at 4 baht per kilo liveweight to the farmer. Proper grading and quality improvement could raise this level.

The purpose of Table 6 is to give some illustration of the relative positions of different pasture situations. Different inputs will affect the final returns. The production constraints listed will also have to be overcome before returns can be realized.

Finally, demand will be a key factor affecting livestock as no pasture improvement or production constraint resolution efforts will be feasible if demand is not significant.

1/ ADB Compac Report

2/ ADB Compac estimates pasture establishment, housing and yards to cost 540 baht per rai.

Swine Production

Present swine production is mostly on small farms. Feed is basically rice bran plus anything that might be scavenged. It takes roughly one year for an animal to reach 100 kgs.[1/] The ADB Nongwai Study found the average price per kilo liveweight for hogs to be 4 baht. The wholesale price in Bangkok is between seven and eight baht per kilo liveweight. The Livestock Trading Cooperation pays one baht per kilo more for hogs from the Northeast because they are supposed to be superior quality.

Poultry Production

Several poultry breeding operations exist but most poultry still comes from small farms. Mixed feed sales are rising but the average farmer does not yet use mixed feed.

The ADB Nongwai study shows an average chicken liveweight of 1.5 kgs. and an average duck liveweight of 2.0 kgs., with both dressing out at 80 percent of liveweight. Average farm price, live, was 12 baht per chicken and 12 baht per duck (Bangkok retail price is around 20 baht for a dressed chicken).

1/ Manderstam Report.

TABLE 6

Comparative Livestock Production Situation

Production (Feed) Situation	Average Consumption Per Day - Wet Season Kilograms		Total Wet Season Consumption Over Animal Weight Gain Life Kilograms		Average Consumption Per Day - Dry Season Kilograms		Total Dry Season Consumption Over Animal Weight Gain Life Kilograms		Amount of Land Necessary Carry one Animal	Period Necessary To Attain 350 kgs.	Average Gain Per Day	Gross Sales Price*	Gross Return Per Rai Per Year
	Bulk	Protein	Bulk	Protein	Bulk	Protein	Bulk	Protein	Rai	Years	Kgs.	Baht	Baht
Natural Pasture (Present Conditions)	5.4	.12	5950	131	2.9	0	1050	0	8.7	4	.24	1400	40
Para Grass Pasture	6.4	.28	5250	231	6.4	.14	1750	38.5	2.0	3	.32	1400	233
Townsville Lucerne (Pasture & Seeds)	7.0	.31	5250	231	7.0	.31	1750	77	3.0	2.75	.35	1400	170
Irrigated Pasture Selected (Pasture Grass)	16.0	.70	5250	231	16.0	.70	1750	77	1.0	1.2	.80	1400	1167

NOTE: See attached Table 6 footnotes page for explanation of calculations for Table 6.

* : Average farmgate price per kilo is 4 baht.

Source: ADB Compac Report, ADB Nongwai Study, 1963 World Bank Study on the Northeast by Hans Platenius, "California Agriculture" magazine July 1969, and NEED PMG Calculations.

Table 6, Footnote Page

Explanation of Calculations:

For all situations, a feed conversion to animal weight ratio of 20:1 was used. This can be improved upon. This results in an animal needing to eat 7,000 kilograms in order to attain a liveweight of 350 kilograms.

By individual situations, the calculations were:

1. For Natural Pasture:

   Animal eats 7,000 kgs. over 4 years;
   85 percent of total bulk consumption in wet season,
   15 percent of total bulk consumption in dry season.
   Protein: 50 percent of necessary amount during wet season and no protein during dry season. (Protein content should be 4.4 percent of total feed, or 308 kgs. over weight gain life.)

Wet Season Bulk	=	7000 x .85	=	5950 kgs.
West Season Protein	=	5950 x .044 x .5	=	131 kgs.
Dry Season Bulk	=	7000 x .15	=	1050 kgs.
Dry Season Protein	=	1050 x 0	=	0

   4 years = 1460 days, 1096 wet season days, 364 dry season days.

   Wet season has 9 months per year; dry season has 3 months per year.

2. For Para Grass Pasture:

   Animal eats 7,000 kgs. over 3 years. Bulk consumption spread evenly over wet and dry season as grass can be cut and stored.

   3 years = 1095 days

   Protein consumption normal over wet season but only 50 percent of normal over the dry season because protein content falls as grass dries.

3. Townsville Lucerne:

   Animal eats 7,000 kgs. over 2 3/4 years. Slightly less maturation time is necessary due to higher feed protein content during the dry season.

Bulk and protein consumption are spread evenly over the entire period as grass and seeds can be stored.

2.75 years = 1004 days

4. Irrigated Pasture:

The text example has 2.7 animals per acre or slightly more than one animal per rai.

Weight gain is 1.76 pounds per day. Thus, starting at zero, 770 pounds (350 kgs.) could be reached in 438 days (1.2 years). Actual time would be less since an animal does not start at zero weight. One animal per rai is less than the test which implies surplus pasture.

b. Market Situation

Thailand Market: The total amount of consumption of meat in Thailand is unknown. Various figures exist. The 1962 Household Expenditure Survey results on meat consumption by region are shown in Table 7.

If the whole kingdom average from Table 7 is applied to 1970, then total meat consumption in Thailand in 1970 was 11.2 kgs. x 37 million people, or 414,400,000 kgs. of meat. This figure would not include meat consumption by tourists or foreign residents.

The breakdown by type of meat is difficult to ascertain. The three major meat categories are: pork, chicken and beef and buffalo.

The Livestock Trading Cooperation has made estimates of meat consumption in Bangkok by type of meat. The estimates for 1970 are:

1. Swine: 2500 consumed daily in Bangkok.

2. Cattle and Buffalo: 350 consumed daily in Bangkok.

3. Chicken consumption is roughly comparable to or higher than pork consumption.

Based on the above, total Bangkok meat consumption in 1970 would have been:

1. Swine: 2500 head/day dressing out at 70 kgs. meat/hog; 2500 x 70 kg. x 365 days = 63.9 million kgs.

2. Cattle and Buffalo: 350 head/day dressing out at 175 kgs. meat/head: 350 x 175 kg. x 365 days = 22.4 million kgs.

3. Poultry: Poultry consumption is estimated to be equal to or greater than pork consumption.

TABLE 7

Thailand Meat Consumption by Region

	Whole Kingdom	Central	Northeast	North	South
Kilograms/Year	11.2	11.0	8.1	13.2	10.6

Source: 1962 Household Expenditure Survey

Total meat consumption would have been:

63.9 + 22.4 + 65 = 151.3 million kgs. of meat

With total Bangkok population at 3.2 million, this implies per capita meat consumption in Bangkok at 47.3 kgs. per year. This figure is well above the kingdom average of 11.2 kgs. determined in the 1962 Household Expenditure. It is quite probable that the Bangkok average is well above the national average and also the average should have increased since 1962.

If one assumes that average per capita meat consumption rose from 11.2 kgs. in 1962 to 15 kgs. in 1970, than total consumption would have been 555 million kgs. rather than the 414 million kgs. shown previously.1/ The Bangkok total would be 27 percent of that, which is possible.

For total national demand in 1970, 414 million kgs. would be a lower limit and 555 million kgs. should approach the maximum possible. An average of 485 million kgs. might be assumed. Broken down by type of meat, pork, beef and buffalo, the amounts consumed are:

1/ Financial Post, P.6, December 24, 1970, shows annual per capita meat consumption in Thailand to be 18.2 kgs.

Poultry + beef and buffalo + pork = 485 million kgs.

Beef and buffalo + pork = roughly 60 percent of total meat consumption or 291 million kgs. Pork is 75 percent of this, and beef and buffalo, 25 percent.

Therefore, pork = 218 million kgs., and

Beef and Buffalo = 73 million kgs.

1. 218 million kgs. of pork at 70 kg. of meat per carcass = 3,114,286 hogs.

2. 73 million kgs. of beef and buffalo at 175 kg. of meat per carcass = 417,143 animals.

Poultry meat is 194 million kilograms or 100-150 million chickens, ducks and other fowl per year.

Total 1970 Thai national demand was:

1. 3,114,286 hogs.

2. 417,143 cattle and buffalo.

3. 100,000,000 fowl.

Meat consumption should increase at the rate of population growth plus consumption increases as income increases at the same rate according to an FAO study.

Total consumption should increase between four and five percent per year, through 1976. This growth rate implies the following in total animals slaughtered.

Year	Swine	Total Animals Slaughtered Cattle & Buffalo	Poultry
1970	3,114,286	417,143	100,000,000
1971	3,254,000	436,000	104,500,000
1972	3,400,000	455,000	109,202,000
1973	3,554,000	476,000	114,116,000
1974	3,714,000	497,000	119,251,000
1975	3,881,000	520,000	124,617,000
1976	4,056,000	543,000	130,225,000

Source: NEED/PAG Calculations

Export Market: The Far East, as a region, is a net importer of pork, beef and poultry meat. In 1967, the deficit in these items was:

		Deficit Vol.	Value of Deficit	Value Per Unit of Import
1.	Beef	20,241 tons	$19,878,000	$990
2.	Pork	16,445 tons	$ 8,023,000	$495
3.	Poultry Meat	24,326 tons	$14,233,000	$592

Thailand did not export any of the above items in significant quantities. Thailand is not participating in a large area deficit market.

The export-import situation for live cattle and swine and meat of swine, cattle and poultry is shown in Tables 8 through 17.

The most significant importers per meat product are:

1. Beef: Japan, 13,793 tons in 1967 and
13,503 tons in 1968.

Value in 1967 was $13,577,000 and
in 1968 it was $13,112,000

2. Pork: Hong Kong, 15,096 tons in 1967 and
21,805 tons in 1968.

Value in 1967 was $7,507,000 and
in 1968 it was $10,845,000.

In 1968, Japanese imports became significant after several years of almost no imports.

1968 Japan Volume = 10,484 tons

Value = $11,480,000

3. Poultry Meat:

Hong Kong: 13,371 tons in 1967 and
19,582 tons in 1968

Value in 1967 was $6,787,000 and
in 1968 it was $9,234,000

TABLE 8

Bovine Cattle (inc. buffaloes)
Live - For Selected Asian Countries
Exports by Year (Major Exporters)

Country:	Quantity (100 Head) & Value (10,000 U.S. Dollar)					
	1962	1963	1964	1965	1966	1967
Cambodia Qty.	336	401	302	52	121	-
Value	331	369	223	57	109	-
China-mn. Qty.	171	237	461	948	62	1114
Value	153	214	374	766	51	1056
Hong Kong Qty.	36	31	36	35	21	21
Value	37	29	33	27	16	18
Japan Qty.	26	21	18	8	7	18
Value	22	20	22	24	43	26
Malaysia Qty.	18	29	30	18	17	3
Value	21	33	33	27	28	4
Mongolia Qty.	1162	702	744	773	1030	1059
Value	1040	6330	604	620	842	950
Singapore Qty.	28	30	21	35	48	57
Value	33	35	24	41	49	61
Thailand Qty.	616	437	670	582	555	505
Value	491	384	555	490	481	448
Total: Qty.	2393	1888	2282	2451	1861	2777
Value	2108	7414	1868	2058	1619	2563

6 year totals: Quantity = 13,652; Total Value = 17,630; Average = $129*

Average Value per head =	$88	$390	$82	$82	$87	$92
Average Value per head of Thai export	$80	$ 88	$83	$85	$97	$89
Thai Percentage Share of total						
Quantity and Qty:	26%	23%	29%	24%	30%	18%
Value of Exports Value :	23%	5%	30%	24%	30%	17%

* Questionable because of year 1963 - Mongolia - without 1963 Average is $88 per head

Source: FAO Trade Yearbook 1969

TABLE 9

Bovine Cattle - Live

Imports by Year (Major Importers)

Country:	Quantity (100 head) & Value (10,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Hong Kong Qty.	1253	1117	1439	1683	1987	1772
Value	1179	1061	1231	1421	1479	1292
Japan Qty.	8	7	12	16	13	20
Value	57	47	74	96	138	214
Macao Qty.	107	84	92	90	97	70
Value	66	58	61	75	81	57
Malaysia Qty.	92	91	80	93	108	96
Value	116	115	101	117	118	95
Singapore Qty.	106	110	94	113	128	146
Value	101	103	102	121	138	151
Total Qty:	1566	1409	1717	1995	2333	2104
Total Value:	1519	1384	1569	1830	1954	1809
Average Value/head	$97	$98	$92	$92	$90	$90

6 year total Quantity = 11,124 Total Value = 10,065 Average Price + $90.48

Source: FAO Trade Yearbook 1969

TABLE 10

Swine - Live

Exports by Year (Major Asian Exporters)

Country:	Quantity (100 head) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Cambodia Qty.	1067	126	1	-	-	6
Value	3423	365	2	-	-	13
China Mnl. Qty.	7856	12855	17173	18792	19515	18160
Value	20,818	32395	40870	59570	64000	51938
Taiwan Qty.	561	183	69	57	51	135
Value	1922	644	241	186	216	606
Hong Kong Qty.	33	39	2	-	-	-
Value	100	119	5	-	-	-
Indonesia Qty.	103	22	36	76	59	3
Value	135	50	70	150	120	4
Japan Qty.	4	2	7	16	3	-
Value	26	42	51	181	53	-
S. Korea Qty.	331	1150	835	1	-	12
Value	1474	3676	1045	3	-	51
Malaysia Qty.	24	58	139	162	162	36
Value	58	167	164	226	243	57
Singapore Qty.	195	191	455	466	390	188
Value	585	608	1447	1445	1099	509
Thailand Qty.	1100	591	17	2	131	112
Value	3319	1627	20	6	753	437
N. Vietnam Qty.	71	50	125	169	47	16
Value	242	174	434	549	154	50
S. Vietnam Qty.	1067	50	12	25	-	-
Value	3423	78	43	95	-	-
Total Qty:	12412	15317	18871	19766	20358	18668
Total Value:	35525	39945	44392	62411	66638	53665
Average Price/head of all countries	$28.50	$26	$23.50	$32	$33	$29
Average Price/head of Thai stock	$30	$27.50	$11.80	$30	$57	$39.50
Export Percent Qty:	9%	4%	-	-	1%	1%
of Thailand Value:	9%	4%	-	-	1%	1%

6 year Totals Quantity = 105,395 Value = 302,570 Average Price/Head = $ 28.70

Source: FAO Trade Yearbook 1969

TABLE 11

Swine - Live

Imports by Year (Major Asian Importers)

Country:	Quantity (100 head) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Brunei Qty.	52	60	57	64	76	-
Value	144	117	188	227	240	-
Hong Kong Qty.	10303	14016	16943	18292	18759	17603
Value	28814	37229	42488	47195	48453	38741
Japan Qty.	6	13	53	2	6	3
Value	256	248	250	206	279	126
Macao Qty.	739	868	913	844	931	932
Value	1072	1518	1684	1764	1834	1530
Malaysia Qty.	147	138	414	418	330	125
Value	454	473	1368	1385	1033	289
Singapore Qty.	95	65	137	169	147	39
Value	221	197	200	274	218	80
Total Qty:	11342	15160	18517	19789	20249	18602
Total Value	30961	39782	46178	50951	51957	40766
Average Price Per Head-all countries	$27	$26	$25	$26	$26	$22

6 year Totals Quantity = 103,658; Total Value = $260,550; Average Price/Head = $25.13

Source: FAO Trade Yearbook 1969

TABLE 12

Meat of Bovine Animals

Fresh, Chilled, or Frozen

Exports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Hong Kong Qty.	13	5	38	50	36	21
Value	16	8	54	63	31	41
India Qty.	159	150	33	-	-	-
Value	55	60	12	-	-	-
Japan Qty.	13	25	21	51	103	61
Value	41	60	60	70	106	70
Singapore Qty.	448	525	1039	1191	1588	1264
Value	417	649	937	1223	1782	1372
Thailand Qty.	3	2	13	7	-	-
Value	1	2	6	4	-	-
Total Qty:	636	707	1144	1299	1727	1301
Total Value	530	779	1069	1360	1919	1483

Asian exports are insignificant relative to the rest of the world. Europe, South America, and Oceania for outstrips Asia. Africa also exports substantially more.

In 1967 Australia exported 262,463 metric tons of beef and New Zealand 106,203 metric tons. They are in a very good position to supply the Asian market.

Average Price per ton - all countries	$832	$1100	$930	$1050	$1110	$1140
Average Price per ton - Thailand	$333	$1000	$460	$ 572	-	-
Export Percent Qty:	-	-	1%	1%	-	-
of Thailand Value:	-	-	1%	-	-	-

6 year Totals: Qty. = 6,814; Total Value = 7,140; Average Price/Ton = $1,047.84

Source: FAO Trade Yearbook 1969

TABLE 13

Meat of Bovine Animals

Fresh, Chilled, or Frozen

Imports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Ceylon Qty.	23	14	29	29	79	41
Value	17	11	28	26	69	33
Hong Kong Qty.	1717	2763	2582	2715	2890	2478
Value	1286	1986	1101	2384	3104	2697
Japan Qty.	4764	4689	6200	10814	13493	13793
Value	2519	2363	3669	6916	10558	13577
Macao Qty.	-	64	41	76	-	-
Value	-	26	16	29	-	-
Malaysia Qty.	902	1165	1395	1549	1860	1184*
Value	765	979	1247	1570	1970	1199*
Philippine Qty.	1305	1803	2069	1739	1733	-
Value	610	944	1257	1372	1448	-
Singapore Qty.	2978	4952	4239	4727	4707	4046
Value	1923	3162	3172	4018	4638	3855
Total Qty:	11689	15450	16555	21649	24762	21542
Value	7120	9471	11590	16315	21787	21361

The areas importing the most are Europe and North America.

Average Price Per Ton - All Asian Countries:	$610	$610	$700	$781	$880	$990

6 year Totals: Qty. = 111,647; Value = 87,644; Average Price/Ton = $785

* W. Malaysia only

Source: FAO Trade Yearbook 1969

TABLE 14

Meat of Swine -
Fresh, Chilled, or Frozen
Exports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Taiwan Qty.	-	100	17	10	-	1
Value	-	70	12	7	-	1
Hong Kong Qty.	3	2	6	5	18	37
Value	2	2	8	6	14	30
Japan Qty.	42	11	17	11	13	73
Value	9	1	4	3	5	34
Korea Qty.	46	179	17	-	-	-
Value	18	110	8	-	-	-
Malaysia Qty.	12	7	4	1	-	-
Value	6	3	2	1	-	-
Singapore Qty.	201	136	152	209	267	159
Value	119	125	155	229	319	167
Thailand Qty.	-	1	6	9	-	4
Value	-	1	3	7	-	2
Total Qty:	304	436	219	245	298	274
Total Value:	154	312	192	253	338	234

Asian exports are quite small compared to other regions.

In 1966 and 1967 Australia exported 483 and 934 metric tons of swine meat. New Zealand exported 3,299 and 1,126 metric tons in the same years.

Europe is the largest exporting region by far with North America a distant second.

Average Price Per ton all Asian Countries:	$505	$715	$920	$1,030	$1,130	$855
Average Price Per ton in Thailand	-	$1,000	$500	$780	-	$500
Export Percent Qty:	-	-	3	4	-	1
Value :	-	-	2	3	-	1

6 year Totals: Quantity 1,776; value = 1,483; Average Price/Ton = $835

Source: FAO Trade Yearbook 1969

TABLE 15

Meat of Swine

Fresh, Chilled, or Frozen

Imports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Hong Kong Qty.	4462	4445	7242	9828	13348	15096
Value	2206	1964	3900	4642	6374	7507
Japan Qty.	2	6512	4015	70	28	1
Value	1	5486	3130	59	22	1
Malaysia Qty.	330	258	267	174	248	180
Value	198	198	213	154	261	155
Philippine Qty.	-	127	250	62	521	-
Value	-	45	92	35	223	-
Singapore Qty.	346	558	606	805	1007	848
Value	273	449	575	674	751	594
Total Qty.:	5140	11900	12380	10939	15152	16719
Total Value:	2678	8142	7910	5564	7631	8257

Europe and North America are the major importers in the world. Most trade, however, appears to be intraregional.

Average Price Per ton	$520	$685	$640	$510	$505	$495

6 year Totals Quantity = 72,230; Value 40,182; Average Price/Ton = $556.30

Source: FAO Trade Yearbook 1969

TABLE 16

Poultry, Killed or Dressed,
Fresh, Chilled, or Frozen
Exports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Hong Kong Qty.	93	142	102	124	34	79
Value	54	74	63	65	20	47
India Qty.	80	16	1	-	1	-
Value	61	14	1	-	-	-
Japan Qty.	11	11	2	3	30	251
Value	11	10	2	1	9	155
Malaysia Qty.	4	2	3	12	-	-
Value	4	3	3	11	-	-
Singapore Qty.	196	453	605	702	767	641
Value	239	466	547	601	648	538
Thailand Qty.	22	-	5	2	-	-
Value	42	-	2	1	-	-
S. Vietnam Qty.	201	327	395	262	3	-
Value	62	86	105	87	1	-
Total Qty:	607	951	1113	1105	835	971
Total Value:	549	653	723	766	688	740

Europe dominates chicken exports followed distantly by North America.

Average Price Per Ton:	$905	$688	$640	$690	$820	$760
Average Price Per Ton-Thailand	$1900	-	$400	$500	-	-
Export Percent Qty:	4%	-	-	-	-	-
Value:	8%	-	-	-	-	-

6 year Totals: Quantity = 5,582; Value = 4,116; Average Price/Ton = $737.37

Source: FAO Trade Yearbook 1969

TABLE 17

Poultry, Killed or Dressed
Fresh, Chilled or Frozen
Imports by Year (Major Asian)

Country:	Quantity (Metric Tons) & Value (1,000 U.S. Dollars)					
	1962	1963	1964	1965	1966	1967
Ceylon Qty.	69	24	19	3	2	10
Value	59	22	16	3	-	6
Hong Kong Qty.	5757	5898	9728	8941	9369	13371
Value	3167	3304	4737	4545	4934	6787
Japan Qty.	284	3471	5936	6135	7935	8400
Value	246	2550	4099	4602	6044	5912
Macao Qty.	-	408	309	256	142	188
Value	-	117	89	71	41	49
Malaysia Qty.	328	489	755	976	1211	366
Value	354	483	662	785	907	256
Philippines Qty.	2	3	9	13	38	-
Value	1	2	6	10	19	-
Singapore Qty.	904	1891	2118	2604	3194	2962
Value	772	1483	1512	1816	2348	1963
	Europe leads all importers followed by Asia					
Total Qty:	7344	12184	18874	18928	21891	25297
Total Value:	4599	7961	11121	11832	14293	14973
Average Value Per ton:	$626	$653	$589	$625	$653	$592

6 year Total: Qty = 104,518; Value = 64,779; Average Price/Ton = $619.78

Source: FAO Trade Yearbook 1969

Japan: 8,400 tons in 1967 and
16,205 tons in 1968

Value in 1967 was $5,912,000 and
in 1968 it was $11,028,000

Singapore:
2,962 tons in 1967 and
4,329 tons in 1968.

Value in 1967 was $1,963,000
in 1968 it was $2,723,000.

The fact that Thailand is not exporting these items implies lack of productive capability or the non-competitive quality of Thai products.

In the case of beef to Japan, the problem is one of quality. Japan is striving for 90 percent beef self-sufficiency by 1985. In the meantime, the country has adopted very strict import rules on beef. At present, the only countries from which beef is accepted are the U.S.A., Canada, Australia, New Zealand, Taiwan, South Korea, Ireland and Madagascar.

The strictness is to prevent the entrance of foot and mouth disease. This disease could set back the whole Japanese beef production program.

To be accepted as a beef supplier to Japan, the Department of Epizootiology in Paris must certify that the supplying country has been free of foot and mouth disease for five years. Unless Thailand can negotiate an exception to this rule, it will not be able to enter the Japanese market.

It is even questionable whether or not the Japanese market warrants the effort. Imports were 13,000 tons in 1968. That is equivalent to roughly 65,000 head of cattle. That is not a large number in light of the potential competition, especially Australia. A ten percent share of market would only be 6,500 head per year. That is insignificant compared to Thailand consumption.

The pork and poultry meat markets in Hong Kong and Singapore appear to be growing and should be analyzed more carefully. Unlike cattle, they require no large investment in pasture and can be raised by small farmers. These products may be more suitable for Thai exports than beef.

In terms of animals, the 1968 pork and poultry imports by country were equivalent to:

1. Pork (1968 import animal equivalents at 75 kg. carcass weights):

Hong Kong	311,500 hogs
Japan	149,771 hogs
Total	461,271 hogs

2. Poultry meat (1968 fowl equivalents assuming an equal distribution between chicken and ducks and an average dress out weight of 1.75 kgs.):

Hong Kong	11,189,715 fowl
Japan	9,260,000
Singapore	2,473,714
Total	22,923,429

Thailand Tourist Market: Roughly 400,000 tourists visit Thailand annually and each stays an average of four days. Tourists eat an average of two kilos of meat during their four-day stay, resulting in total meat consumption by tourists of 800,000 kilograms per year. Approximately 50 percent of this is beef with pork and chicken equally divided among the remaining 50 percent.

In terms of live animals,the above weight implies 2286 cattle (at 175 kg. carcass weight), 2857 hogs (at 70 kg. carcass weight), and 114,285 chickens and ducks (at an average 1.75 kg. dressed out weight).

B. EXPLANATION OF MARKET DEMAND FIGURES IN NORTHEAST COMMODITY DEMAND TABLE, IN AGRICULTURAL SECTION OF VOLUME I

1. Rice - Based on Rice Model developed at NEDB.

2. Maize- National: 1970 Thai feed industry absorbed 75,000 tons of maize will grow at rate of meat consumption increase in Thailand or 5.0 percent per year.

Japan: 1970 - base year
About six million tons of maize imports. Growth rate to be 10 percent per year in imports.

Taiwan: Taiwan appears to buy almost all its maize from Thailand. Total 1968 maize imports were 361,000 tons.

Growth rate situation similar to Japan. Past growth so rapid that it is not a good indicator. Assume Taiwan at 7.5 percent per annum, as compared to Japan's ten percent.

Hong Kong and Singapore: Hong Kong imports have been stead while Singapore has declined. 1968 imports were 142,100 metric tons and 19,200 metric tons, respectively. During the plan period, imports will average 150,000 metric tons.

Malaysia and Others: Malaysian imports were just about the same in 1968 as 1962 with upward and downward fluctuations in between for the plan period imports of 85,000 tons annually are expected. Others, mainly South Korea and India, should be around 15,000 tons per annum.

3. Sorghum

Can be a substitute for maize if 5-10 percent below maize price. National Demand is projected at 50 percent of maize demand with an annual growth of five percent.

Major market is Japan where imports rose from .2 million tons in 1960 to 2.5 million tons in 1969. A growth rate similar to maize or 10 percent per annum is expected over the plan period.

Taiwan should also be interested in Sorghum. The table assumes the Taiwan maize-sorghum ratio is equal to that of Japan.

Other markets should average 100,000 tons in 1972, with an annual growth rate of five percent based on expected population and income increases.

4. Soybean

The three most significant sources of demand for raw soybeans and soybean products are the Thai national market (some import substitution), Japan and Taiwan. Background data on the quantity projections is contained in the soybean paper.

An average value per unit is difficult to determine because it includes the value of raw soybeans, soybean oil and soybean cake.

Because Thailand is a net vegetable oil importer, only the export value of raw soybeans and cake and meal were considered in determining unit value. Raw soybeans should account for at least 7.5 percent of projected exports and cake and meal 2.5 percent. The price was weighted accordingly to get the unit value of $115 per ton.

The value in Thailand of raw soybeans is roughly $100 per ton, wholesale.

5. Cotton

National: Thailand is a net importer of raw cotton fiber. Thai cotton fiber production, plus cotton fiber imports for the period 1963 through 1968 were:

Year	Thai Fiber Produced Tons	Raw Fiber Imported Tons	Total Used Tons
1963	17,010	8,876	25,886
1964	17,185	10,221	27,406
1965	20,930	24,556	45,486
1966	30,800	23,922	54,722
1967	28,000	24,353	52,353
1968	33,250	18,944	52,194

Over the plan period, cotton consumption will not decrease. The amount of increase will depend on competition from synthetics. For plan purposes, a conservative estimate of 80,000 tons of fiber consumption by 1976 was used. This is an average

annual increase of 5.5 percent. Average value is roughly 12 baht per kilo, or $600 per ton.

The seeds from this production can be channeled to the local vegetable oil and meal market or Japan and Taiwan (see soybean paper for oilseed market discussion).

Japan: Imports of raw fiber should continue increasing at 2.7 percent per annum through the plan period. This has been the rate of increase since 1963. Value per ton will be around $600.

Hong Kong: For the period 1963 through 1968, Hong Kong imports increased at a rate of 9.6 percent per annum. This was due primarily to a large increase in 1968. For plan purposes, a five percent per annum increase was used.

Taiwan: The increase since 1963 has been 5.5 percent per annum. For the plan period, five percent has been used.

India, South Korea, Philippines and Others: India should remain constant at 140,000 tons per annum; South Korea will grow at five percent per annum; the Philippines should remain constant at 40,000 tons; and the others should average 20,000 tons per annum.

It is possible that India will decline as its own cotton production programs come on stream.

5. Tobacco

Thailand imports Virginia and Turkish tobacco. Prior to 1968, imports averaged slightly more than 5,000 tons per year, with an average value of 31,000 baht per ton. In 1968, imports jumped to 11,650 tons, with a value per ton of 35,000 bahts.

Trends in tobacco consumption are unclear. In 1968, Thai imports plus national Virginia production were 20,000 tons. The value of local Virginia is about 14,000 baht per ton.

For the plan period, Thai consumption is projected at a constant 20,000 tons. The value depends on the local production/import mix. Total value should decline as local production replaces imports. For the plan period, an average of 22,000 baht ($1,100) per ton was used.

Local tobacco production and consumption are not considered here.

The Far East region is a net importer of tobacco. The quality of tobacco imports varies a great deal with average price per ton varying accordingly.

Major Far Eastern importers by quality of tobacco imports (based on average import price per ton in 1968) are:

First Quality Country	Price/Ton	Secondary Quality Country	Price/Ton	Third Quality Country	Price/Ton
Japan	$1,860	Taiwan	$1,028	Singapore	$464
Thailand	$1,700	Hong Kong	$1,132		
Philippines	$1,665	South Vietnam	$ 920		
India	$1,606	Malaysia	$ 835		

Japan dominates the first group (excluding) Thailand and her imports have remained steady since 1964. For the plan period, only a one percent annual growth is used. Most of this will be in the Philippines. The average unit price will be $1,700 per ton.

Malaysia and South Vietnam account for almost 75 percent of the secondary quality imports, with Hong Kong at 20 percent and Taiwan the rest. Taiwan imports have been constant while Hong Kong has declined. However, Malaysia has grown at an annual rate of about nine percent (for the period 1962 through 1968 using a three-year average at each) and South Vietnam at a rate of about 16 percent per year.

For the plan period, the growth rate for the whole group is projected at six percent per annum. This assumes that Hong Kong and Taiwan remain constant and that Malaysian and particularly South Vietnamese demand will slow down.

Average value per ton will be $900.

The quantity of third-grade imports is questionable as 1968 was an unusual year for Singapore. Prior to that year, import value was above $1,000 per ton and quantity was around 4,000 tons. For the plan period, a constant 10,000 ton figure is used, valued at $500 per ton.

6. Vegetables

Northeast Thailand: Total vegetable consumption (including tomatoes, onions and shallots) in the Northeast in 1970 was 200,000 tons. Over the plan period, vegetable consumption will increase at the rate of

population increase (three percent) plus at an income elasticity rate of .2. With income increases projected at two percent per year, total vegetable consumption will grow at 3.4 percent per year.

For the plan period, an average vegetable value of 2.00 baht/kg. is used. It is recognized that tomato values are often well above this as well as other individual vegetable values. However, given the large fluctuations and large percentage of low-cost vegetables, a 2 baht/kg. average value was used.

Bangkok Market: Per capita consumption of vegetables in metropolitan Bangkok is about 25 kgs. per capita, per year. For the plan purposes, that per capita consumption figure is held constant while population is grown according to the Kasetsart study results. This probably understates total consumption.

Value is three baht per kilo because of markup between producer and Bangkok.

Laos Market: The Laos market is almost impossible to forecast. For plan purposes, a constant 20,000 tons was used, valued at 3 baht/kg.

7. Kenaf

National Market The Thai market is projected to remain constant at 70,000 tons. This figure should fulfill all bag and backing demand over the plan period.

External Market The maximum annual export potential is 250,000 tons. This amount is projected as a constant over the plan period.

The farm price of 2.00 baht/kg. is used for value determination.

8. Groundnuts

Major demand for groundnuts comes from Europe where the meal is used for animal feed. Groundnut usage information in Thailand is lacking, but it should be related to feedlot development.

No market potentials are shown for groundnuts due to the strong competition (Niger, Nigeria, Senegal, Cambia and India) which exists for the European market. These countries also have special trading links with England and the EEC which Thailand lacks.

Before groundnut production can be encouraged, much more market investigation must be carried out.

C. AGRICULTURAL CREDIT

The FAO Indicative World Plan for Agricultural Development to 1975 and 1985, for Asia, made some challenging statements concerning the role of credit in the development of the agricultural sector. It advocated the replacement of privately financed debt with publicly financed lending, and went on to say, "This cannot be done until farmers learn how to use farm credit wisely, and governments learn how to extend it and collect it."1/ It went on further to state that public credit for farmers will be "as important in the agricultural revolution presently beginning in the region as the new high yielding varieties or irrigation."2/

1. Rural Credit in Thailand

Thailand has already made the initial move to make credit available to its farmers through public institutions. One of the recently created agencies is the Bank for Agriculture and Agricultural Cooperatives. This institution has had a rapid growth since its creation, as the data in Table C-1 demonstrates, which covers the last four years of its operations. The number of loans made in 1968 represented an increase of 158.5 percent, over 1967, loans in 1969 increased 92.5 percent over 1969, while loans for 1970 were 10.1 percent above 1969. In 1970, 53,633 individual loans were made through all BAAC branches in the Northeast.

1/ Food and Agriculture Organization of the United Nations, Rome, Vol. I, 1968, p. 394.

2/ Ibid., p. 396

The average size of loan increased in each of the first three years, reaching ฿2,855 in 1969 and then declined to ฿1,894 in 1970.

The monies outstanding have also risen rapidly, reaching a total of ฿134,755,000 in 1970. The data does not indicate whether loan periods are lengthening or whether farmers are now more willing to accept government loans.1/

TABLE C-1

Bank for Agriculture and
Agricultural Cooperatives Loan Activities
Northeast Thailand
1967 - 1970

	1967	1968	1969	1970
Number of Loans	9,891	25,598	48,702	53,633
Annual Increase (%)		158.8	90.3	10.1
Average Size Loan (Baht)	2,396	2,588	2,855	1,894
Annual Increase (%)		8.0	10.3	-33.6
Total Loans (000 Baht)	23,692	68,822	109,823	101,604
Annual Increase (%)		190.5	59.6	-7.5
Outstanding Loans (000 Baht)	21,161	56,264	67,103	134,755
Annual Increase (%)		165.9	19.3	100.8

1/ One of the reasons government credit is popular with farmers, according to the FAO, is that "Most farmers consider a government loan as a gift that does not have to be repaid."
Food and Agriculture Organization of the United Nations, Rome, Vol. I, 1968, p. 394.

The latest survey concerning credit in the region was made just before the inauguration of the BAAC. In that survey, Peters found that relatives and neighbors were the chief sources of credit with Northeastern farmers; 57 percent of those who had borrowed reported doing so from these sources. The next largest source was the local merchant who supplied 32.4 percent of the loans. Only 10.8 percent was obtained from institutional sources (government agencies, cooperatives, banks, etc.).1/

The first study of agricultural credit, made on a nationwide sampling basis, was one conducted by Kasetsart University in 1965. At that time, it was stated "Today government loans account for no more than five percent of the agricultural credit market in Thailand."2/

In its survey of seven agricultural villages in Khon Kaen during the 1969 crop season, the NEDB found that 60.6 percent of the farmers had borrowed no money from any source during that year. Whether they may have wanted to borrow and were unable to do so, the data does not reveal. Of those who did borrow money, 58 percent borrowed from friends, neighbors and relatives; 33.8 percent from merchants, traders and money lenders; 14.7 percent from institutional sources (cooperatives, banks, etc.); and 3.5 percent from "other"sources.

In a sample survey of the Northeast, made in 1965,the Kasetsart University found somewhat similar information concerning source of borrowing by farmers. That study reported 50 percent borrowed from relatives, 12.1 percent from neighbors, 30.5 percent from commercial sources, (local stores, landlords, money lenders, and crop buyers) and only 7.6 percent from government credit cooperatives.3/

The NEDB survey made during the last farm season reveals trends very similar to those found several years earlier by Peters. In other words, there has been no significant change in farmers' borrowing habits in recent years.

1/ Charle W. Peters, Agricultural Credit and Marketing in Northeast Thailand, USOM, Bangkok, August 1966, Table 1, p. 15.

2/ Agricultural Credit in Thailand, Theory, Data, Policy, Pantum Thiayamondol, Virach Arromdee, Millard F. Long, Faculty of Economics and Business Administration, June 1965, p. 58.

3/ Ibid., Table 18, p. 37

Private banks have recently entered the farm loan field also, and Table C-2 shows the extent of their operations in the several branches which the Bangkok Bank and the Bank of Ayuthya have in the Northeast. Farm Loans made by the two banks have been very similar in amount to those made by the BAAC, with the same tendency to increase in size. They are now averaging about ฿2,700 per loan. 1/

TABLE C-2

Bangkok Bank and Bank of Ayuthya Agricultural Credit
Northeast Thailand
1967 - 1970

	1967	1968	1969	1970*
Number of Loans	1,210	4,813	5,208	3,215
Annual Increase (%)		297.7	8.2	-
Average Size Loan (Baht)	1,677	2,175	2,766	2,766
Annual Increase (%)		29.7	27.2	-
Total Loans (000 Baht)	2,510	7,040	10,250	8,893
Annual Increase (%)		180.5	45.6	-
Outstanding Loans	3,985	6,215	5,205	9,551
Annual Increase (%)		55.9	-16.2	-

* Bangkok Bank, only, incomplete year.

1/ The Kasetsart study states, "The Bangkok Bank's venture into supervised agricultural credit is less than one year old. Thus far, the amount lent has not been large--7.9 million baht, of which 7.1 million baht has been in the form of individual loans to large farmers." Ibid., p. 50.

Table C-3 gives a recapitulation of loans made by the BAAC in 1967-1970 through seven of its branches in the Northeast, classified by size of farmer making the loan. It will be seen there is a preponderance of loans in the 15-29.9 and 30-44.4 rai intervals, ranging in the first case, from 24 percent of all loans in 1970, to 33.5 percent in 1969. The range is from 26.2 percent to 33.3 percent in the larger interval. The incidence of both size groups in the general farm population is 31.2 and 13.8 percent, respectively, based on tabulations of farm size as reported by the Agricultural Census of 1963. These tabulations would indicate there is disposition to loan to the larger farmers; over half of the loans were made to farmers with units 30 rai or larger, yet they account for only 24.1 percent of the farmers. Because they do own, however, 54.7 percent of the land in farms, this may indicate their greater need for loans and, thus, justify the banking procedures.

The distribution varies from branch to branch, representing the greater agricultural productivity of one changwad over another. That so small a percentage of farmers in the smaller intervals were among the borrowers may reflect their greater inability to qualify. As it is shown in the section concerning Land Tenure, only a small portion of the small farmers have legal title to the lands which they supposedly "own" and, therefore, find it difficult to meet the collateral requirements of banks in their loan procedures.

Table C-4 attempts to explore the question of farm size and amount of loan obtained. Clearly, as farm size increases, so does the size of the loan. Farm units under 6 rai average ฿2,000 in loans, and loan size increases in accordance with increased acreage. The largest loans were made to the largest farms--an average of ฿4,245 is granted to those having 45 or more rai in their units. Loans totalling 11,739 were made by six branch offices for the period 1967-1970 in the amount of ฿3,579 each.

The earlier Kasetsart University study found that size of farm and operation also influenced credit needs: the larger the operation, the greater was the need for credit. Nationally, it reported that among farmers cultivating only 5-to-10 rai, 54 percent required credit. The percentage rose to 72.49 with farmers who cultivated 20-to-50 rai and still higher, to 90.85 percent for those having more than 50 rai in their enterprises.1/

1/ Op. cit., Table 4, p. 24.

TABLE C-3

Bank for Agriculture and Agricultural Cooperative
Loan Activities by Size of Holding Seven Branches,
Northeast Thailand
1967 - 1970

Rai	Number of Loans 1967 Number	1967 Percent	1968 Number	1968 Percent	1969 Number	1969 Percent	1970* Number	1970* Percent
- 6	102	2.1	199	1.5	526	2.0	183	0.6
6 - 14.9	833	17.5	1,722	13.0	3,268	13.8	2,902	9.2
15 - 29.9	1,380	28.9	3,776	28.5	8,597	33.5	7,560	24.1
30 - 44.4	1,251	26.2	4,412	33.3	7,200	28.1	9,958	31.7
45 +	1,205	25.2	3,136	23.7	6,048	23.6	10,836	34.5
TOTAL	4,771	100.0	13,245	100.0	25,639	100.0	31,439	100.0

* January - August, 1970.

NOTE: According to the Agricultural Census of 1963, the percentage distribution of farms in the Northeast by number and by area of land in farms, was:

Rai	Number of Holdings	Area of Holdings
- 6	14.8%	2.0%
6 - 14.9	29.9%	13.4%
15 - 29.9	31.2%	29.9%
30 - 44.9	13.8%	22.9%
45 +	10.3%	31.8%
	100.0	100.0

In addition to farm credit through banking institutions, the government has long made loans available to farmers in the Northeast through other specialized programs. These programs have taken many forms, but mainly the approach has been through government-organized, government-sponsored and government-managed "cooperatives". They have assumed many farm-land cooperatives, land improvement associations, self-help associations village credit cooperatives, production credit cooperatives, etc. They are now administered out of the several departments of the Ministry of Interior or the Ministry of National Development--originally the Ministry of Cooperatives--and have access to the Bank for Agriculture and Agricultural Cooperatives for financing. USOM was especially active in the organization of the production credit cooperatives, when it had become apparent by the late 1950's that the numerous village credit societies were not effectively accomplishing their purpose.

TABLE C-4

Bank for Agriculture and Agricultural Cooperatives
Average Loan Amount, by Size of Farm, 6 Branch Offices
Northeast.Thailand
1967 - 1970

Farm Size (Rai)	Amount Loans (Baht)	Number of Loans	Average (Baht)
Under 6	206,000	103	2,000
6 - 14.9	2,530,000	910	2,780
15 - 29.9	15,510,000	4,541	3,415
30 - 44.9	14,098,000	3,907	3,608
45 +	9,670,000	2,278	4,245
TOTAL	42,014,000	11,739	3,579

As of 1970, some of the largest of these specialized programs had outstanding loans of the following order: Agricultural Cooperatives of the Ministry of National Development, ฿101,056,069; Amphur Farmers' Groups of the Accelerated Rural Development, ฿15,850,378[1/]; Land cooperatives of the Ministry of National Development, ฿3,904,426; and the Department of Welfare, Ministry of Interior, ฿2,618,135. This congeries of credit and cooperative programs--only some of which have been named--continues with little attempt being made to assess its usefulness.[2/]

Consonant with the endeavor to lead the Northeasterner out of his traditional, primitive farm enterprise to a more modern, market-oriented enterprise, all of the equally primitive "cooperative" and "self help" as much of their outstanding credit as possible, and phase out the efforts into more modernized rural banking programs.

2. Supervised Credit

In order for a development program to succeed, greater financing is needed at the smaller level of farms, those in the 6 to 14.9 and 15 to 29.9 rai group, which are now underrepresented in the credit programs. At this level, more is needed than just credit--the basic ingredient of the loan needs to be instruction, which means that supervised credit is needed at the small farm level if "farmers are to learn how to use farm credit wisely" as stated in the FAO Indicative World Plan. With BAAC branches now operative in all of the provinces that agency is prepared to take on a broader role in the development program. The recommended programs in this plan for the diversification of the monocultural rice pattern with a diversified crop program will need credit to become operative. Fertilizers, insecticides, improved seeds, water pumps, spraying equipment and hired labor will make up the package of inputs that every farm plan will require.

Considering the nature of the program that will be necessary, mainly a supervised credit effort, the BAAC will need both increased staff of rural loan supervisors and increased

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1/ Amount is for 1969; the 1970 figure is not yet available.

2/ Except for A Study of the ARD Program by DTEC, October 1969, and the Thailand Agricultural Cooperatives: An Evaluation with Recommendations for Improvement by USOM, February 1968, evaluative studies of the programs are not available. The two cited criticize the programs studies and make valuable suggestions for their improvement.

capital. The first requirement may be much more difficult to obtain than the second, and with that in mind, neither the rate of growth which was obtained in the years 1967 to 1968, nor that of 1969 to 1970, should be accepted as reasonable for the future growth of the credit program. If staff requirements can be increased at a rate of 20 percent per year, which is a liberal estimate, this would suggest approximately ฿20 million annual increase in loans. While that appears to be small in baht, in terms of borrowers, it would mean 10,000 new notes added to the Bank's loan pouch yearly. For the pouch to remain solvent, each of the loans will require a farm plan that will result from an on-the-farm evaluation of the loan request and a proposed production program that has been projected so as to enable to farmer to liquidate the debt in the specified time. Until the time comes that farmers' associations and cooperatives are trained to help in the supervisory tasks, each 100 of the above 10,000 new supervised loans will require one additional farm loan supervisor to be employed by the BAAC yearly. Supervised credit is costly to administer, but there is no reasonable alternative in an economy when the majority of its 1,345,000 farmers have no previous experience in a developmental loan endeavor.1/

Other developing countries have learned that some farmers are too poor to benefit from a loan program even when the borrowers are closely supervised. The reason may be that they lack education or incentive and, in reality, are rural residents with no more interest in farming than to provide themselves and their families with minimal existence. Their needs qualify them for public welfare assistance and not agricultural credit.2/

If a loan program were aimed at middle income farmers, the size of the universe in the Region can be estimated from their distribution in the 1963 Census of Agriculture: 79.4

1/ "Supervision" as used here, connotes much more than fiscal revision and collection in the day-to-day normal banking operation. The counselling, teaching and demonstration will only bear fruit after an effective borrower-supervisory rapport has become established.

2/ A. T. Mosher, Case Study of the Agricultural Program of A.C.A.R. in Brazil, Washington, D.C., National Planning Association, Dec. 1955.

percent of all rice farm were from 6 to 45 rai in size and they accounted for 70.9 percent of the acreage in rice. While no rule can be inflexible, supervised loans should be concentrated at these farm size levels.

Loan practices vary from changwad to changwad, within the same institution, but in general, loans have averaged ฿500 to ฿700 for fertilizer, although some branches loan ฿1,000 to ฿1,500. Little is borrowed for seed--฿25 or even less--unless it be a vegetable growing area. In a changwad like Loei, with heavy pestilence to control in its cotton fields, no loans will be taken for fertilizer, but ฿400 to ฿700 was frequently borrowed for pesticides. Cotton seed needs brought loans of ฿25 to ฿75 per client. Loans were used for the purchase of machinery, almost exclusively hand machinery, and for hired labor. As Table C-1 indicates, loan amounts have been increasing, and will be at the average level of ฿2,750-฿3,000 in coming years.

The total farm credit need of the region can only be indirectly understood. The outstanding loans of the banking institutions herein listed were 140 million baht in 1970, and adding to this the 124 million baht of the other governmental programs, yields a total of 264 million. This is but a fraction of the 1,818 million baht which the Kasetsart University study estimated the total farmers' indebtedness to have been in 1965, basing its calculations on the 1,398 baht it had found as the average farmer's debt. 1/

Allowing for inflation, current farm indebtedness might be as high as 2,500 million baht. It is doubtful that public institutions can assume this amount. The process of private money lending will continue its way, and until public credit becomes available in greater quantity, private money will have to do the major share of the job. Development, however, will come but slowly from a continuation of the local money lender-borrower relationship because that is geared to a continuation of the patterns of traditional farming.

1/ Op. cit., Table 3, page 20.

D. AGRICULTURAL RESEARCH AND EXPERIMENTATION

1. Administrative Organization

In the NEED/PAG Paper, Institutionalization of Agricultural Development and the NEED/PAG Staff Memorandum #30, the role of research in agricultural development was discussed. The emphasis was on the need to integrate research efforts within the Ministry of Agriculture. These efforts are now widely dispersed within that ministry and, in some instances, they are not coordinated with one another. As a result, much of the high quality analytical work that is being done is lost because there is no synthesis or integration of results. Such synthesis cannot come about unless the atomistic, fragmented efforts are first brought together.

The need to eliminate duplicating separate research administrations is of long standing. To accomplish this unification, a policy decision at the highest level is required. Until such a decision is made and implemented, scientific manpower and capital will be wasted and developmental research knowledge will not be available for the farmer.

The following discussion concerns the relationship of research to the specific production problems now facing the agricultural sector in the Northeast.

The wide publicity given the "Green Revolution" with its "miracle rice" and "Mexican wheat" has resulted in the general feeling that agricultural research is now well in hand and the principles of the science of plant breeding have all been established. Two assumptions are imbedded in this trend of thought that are false and dangerous.

The breakthroughs which led to the breeding of corn hybrids and higher producing rice and wheat came only after long years of extremely costly, multidisciplinary research that was conducted in many experiement stations in many countries. The results were so unusual and unpredictable and there is no assurance their duplication is an automatic process.

Then, even though the first transplanting of the borrowed high producing varieties may yield more satisfactory results than local varieties, sustained experimentation will be needed to guarantee a continuance of that productivity against the debilitating effect of the competitive ecological adjustment and accommodation that will take place. Indigenous diseases and pests will attack the exogenous plant. The plant breeder was able to borrow when he introduced the new varieties, but the plant pathologist will have to discover the solutions to the competitive disease and pest battle. Such discoveries will only come from sustained research.

The basic agricultural research structure in Thailand is sound. It is comprised of a strong central institutional organization at the national level, supporting research organizations at the regional level and demonstration and localized testing stations in the changwads. However, to make the structure effective in practice, administrative and technical revisions are needed.

Only now,in the second five-year period of the University of Kentucky project at the Northeast Agricultural Center, does it appear that the role of that Center and its relationship to the central research departments within the Ministry of Agriculture, will at last be defined.1/ The intervening years spent in waiting for the projected idea to become an administratively functional program have held back the realization of research results that might have contributed toward agricultural development.

How effective the regional-national linkage will be depends upon the collaboration of the involved parties. The long-standing fragmentation of programs within the Ministry has become institutionalized. Departments that were not signatories to the regional plan originally will now lend it their collaboration but reluctantly. Only firm administration at the ministerial level will facilitate the adoption of the guidelines of the agreement for the Center to achieve its functional potential as an instrument for regional agricultural development.

2. Technical Organization

The technical decisions are of more importance to agricultural development within the region than the administrative. The first of these will spell out the working relationship between the central stations and the regional. Theoretically, the latter should concentrate on adaptive research on products and projects of national scope, in which the fundamental guidelines have been determined and agreed upon, while it reserves basic research to commodities and problems that are peculiar to the region. In practice, the division of labor will vary, but so far, the fundamental decisions to determine priorities in projects and their necessary budgetary and personnel needs have not been made.

1/ Annual Report University of Kentucky Team, Northeast Agricultural Center, Tha Phra, June 30, 1970, p.4.

On an operational level, scientific investigation in the regional and changwad verification stations should proceed along two principal lines. One will be applied research and the other, protective. The nature of the Third Plan, with its emphasis on diversification, will require this twofold program. None of the recommended crops are new ones to the region, but their planting is being recommended on an expanded scale, and in some cases, new environmental conditions. Some will be planted for the first time in many soil areas during the dry season in irrigation systems, others will be given heavier applications of fertilizer, and in some cases, improved seed varieties will be proposed.

Any one, or any combination, of the three changed practices will require adaptive trials to find the right mix of factors to produce maximum yields and to give the plants the necessary protection against their propensity to pathological development. Research will have to be tailored to specific problems in specific localities: "When and how to irrigate, when to plant, the optimum plant population, when and how to fertilize, and which pest-control practices will not adversely affect the forms of life, upsetting the ecological balance."1/

The meaning of this should be clear. Annual research programs will have to cease being the theoretic creations of the scientist, closeted in his laboratory, as has been the case. Rather, through integration of extension and research, the agricultural agent will act as both the harbinger of the new technology to the farm and the carrier of the farmer's problems back for study by the research scientist.2/

For the first time in their lives, farmers in the Northeast will try year-round working of their lands as they become involved in double cropping programs under irrigation. Other than the few hundred rai that are part of the irrigation demonstration farm at Huey Sithon, in which a handful of agronomists are now getting their first introductory training in irrigated agriculture, there is no body of knowledge of double cropping in all

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1/ Lester R. Brown, Seeds of Change, Overseas Development Council, Washington, D.C., 1970, p. 53.

2/ This dual role of the change agent will come when an integration of extension and research takes place, and for that to happen will require a violent wrench with tradition because the agent of one branch of the Ministry has not been accustomed to speaking with his counterpart in other branches. See Institutionalization of Agricultural Development, op. cit., for discussion of the problem.

the Northeast. Here they are making the first attempt to experiment with the methods and techniques of double cropping, crop rotation, restructuring of soils through green fertilization and composts, and techniques to overcome the "ecological imbalance which their innovations have introduced." 1/

What will be learned in the Ubon sandy soils series at Huey Sithon cannot be automatically transferred to any other neighboring province; adaptive facilities will have to be on hand to lead in the trials.

Every additional rai of land that will be made available through irrigation will increase the hazards of arousing hitherto unknown indigenous pests and stimulating diseases. In the mere fact of making green crops grow in concentrated plots surrounded by relatively unlimited expanses of dormant lands, the insects that would normally lie dormant in all these lands will flock to the irrigated plots. Thus, there will be ushered in what are known as the "biological dynamics of crop disease-host plant relationships." 2/

The protective research facilities of the plant pathologist and entemologist will have to be multiplied manifold as irrigation spreads in order that serious endemic losses will be forestalled.

When disease will strike and where, cannot be foretold. But that it will strike and strike suddenly and forcibly, is a certainty. This has been the experience with every new crop and every new technology all over the world because such innovations disturb ecological balances. Thailand will not be any exception to the rule.

It has been aptly said that "While man breeds new wheats (or rice, kenaf or maize),nature breeds new rusts, and occasionally she spawns virulent ones that can attack varieties that had been resistant to those previously prevalent." 3/

Thus far, there has been no discussion of plant hazards in the publicity given diversification, double cropping and irrigation.

1/ Taken from Albert H. Moseman, Building Agricultural Research Systems in the Developing Nations, Agricultural Development Council, New York, 1970, p. 97.

2/ Ibid., p. 97

3/ E. G. Stackman, et. al., Campaigns Against Hunger, Cambridge Belknap Press, 1967, p. 76, quoted in Brown, op. cit., p. 54.

It seems to have been assumed that increasing productivity is the only problem. Protection has been overlooked, and it must not be or severe problems will occur.

Traditional agriculture hasn't required modern research facilities to maintain desired levels of productivity. The Thai peasant has the ability to allocate his limited resources efficiently to help nature meet his needs. Modern agriculture, on the other hand, has achieved its high productive capacities by a campaign against nature, by manipulation of the biochemical composition and processes in the plant's germ plasm. Artificial behavior has been introduced, to bring about high productivity levels, but these will not be maintained without continuous research to guard against the occurrence of unpredictable events in the newly-created environmental-genetic sequences.

Plant breeding and plant protection have no end points if modern agriculture is to continue.

3. Research and Development

The recommendation that there be created an integrated, unified agricultural research administration was made so that the ministerial research scientists can throw their full weight into the development programs that are now being planned. The constraints of the present compartmentalized system do not allow their effective participation as team workers in the programs. The day of the separate crop approach has to give way to a multi-disciplinary approach. While there will continue to be specialized farms devoted exclusively to rice, rubber, casava, sugar cane, maize and other major crops--even on a larger scale than now--the emphasis in future agricultural development will primarily be on transforming the monocultural system that is now so dominant. Three research ingredients, now largely missing or misdirected in their implementation, will be required in the process. These are:

a. Multidisciplinary Research

Mellor stated the need for interdisciplinary research by recalling, "To attain that delicate adjustment between plant and environment which will insure maximum productiveness, increased collaboration and cooperation must be affected between the various agricultural units. For, although the research scientists must specialize, agriculture,itself, is not specialized and (scientists) must all join forces for successful

solution of this fundamental problem of adoptation of plants to environment." 1/

When the assertion is made that isolated research projects that are designed to probe into the interaction of the Mendelian gane complex, or that are concerned with insect and disease control, or with agricultural chemistry, have contributed but marginally to agricultural progress, this is not a criticism of the scientists in the Ministry of Agriculture. The potentials of their contribution have been held back by administrators whose professional training has prepared them to act only in the narrow crop approach to development; they are not trained to administer integrated research programs.

It has been amply demonstrated that a combination of environmental factors are responsible for the response to efforts at increasing crop yields. No one factor can be considered in isolation; rather, a combination of factors must be considered which calls for a team approach when projects are designed.

To decentralize research effort and to bring the branch stations into productive union with the regional center, the more than one hundred single-purpose rice stations, upland crop stations, forage crop centers, livestock proving grounds and similar fragmented programs have to give way to multiple purpose, regionally adaptive interdisciplinary programs.

This includes research and demonstration in the techniques of irrigation, because the majority of the farms will continue to be heavily concerned with non-irrigated agriculture while only a minor portion of their areas will fall into the new irrigation systems now being developed. For farmers to be able to apply the proper principles of resource allocation if one system is to economically supplement the other, such principles will have to be developed at experiment stations that are designed for the purpose. While these principles are fully researchable, the fact is that the necessary stations are not yet in existence.

1/ John W. Mellor, Economics of Agricultural Development, Cornell University Press, Ithaca, N. Y., 1966, p. 270, Quoting the eminent research agricultural scientist of the Onterio Research Foundation, Dr. Tennyson B. Jarvis.

b. The farm unit as the objective.

After all has been said concerning agricultural development, there is a tendency to forget that any development that may take place, will do so on specific pieces of land, called farms, each one being the property of a particular farmer and operated by him and his family.

Agricultural development will mean change, perhaps in the size of the farm, most certainly in its organization. It is hard to visualize the introduction of double cropping without, in one way or other, affecting the farm. Shifting cultivation and undue scattering of fields are both practices that most certainly will have to be modified because the added load of work that intensive labor practices will require will be taken from that formerly expanded in spreading the labor force to cover all areas. Participation in irrigation associations will call for more careful farm cadastrals and measurement, land consolidation, and perhaps land redistribution and exchange new farm-to-market roads and many other organizational changes.

Every innovation that will be introduced into the system will alter that system to some extent. Land that would otherwise not be used at all or that will require a substitute use and/or allocation of labor, will be involved in the introduction of every new factor, in every new practice. The farm, as a unit, will determine whether the recommended innovations can be easily attempted or whether major restructuring of the enterprise will be required. The answer to this question will heavily influence the decision to adopt or refuse to adopt suggested innovations. The fertilizers, insecticides, seeds and tools will have to be both available precisely when needed, and priced so that their adoption will be profitable. All of these considerations require that the planning of change will have to be done within the framework of the farm unit.

c. Economic Analysis

When national targets are determined according to the potential exportability or local demand of particular crops, two considerations are fundamental: their technical feasibility and economic profitability. Restructuring of scientific research administration and implementation has been outlined to meet the first of the conditions. More, however, than technical feasibility is required: "the sound course is always to try to expand whatever agricultural commodities farmers can produce most profitably." 1/ Economic analysis is the third ingredient for productive multidisciplinary research.

1/ A.T. Mosher, Creating a Progressive Rural Structure, Agricultural Development Council, New York, 1969, p.56. Italics in original.

The farm unit approach to development is where the economist is needed and in a region where the emphasis is upon greater productivity of the land and more efficient allocation of the family labor force, the branch of economics known as farm management, is expecially important. While increasing use of economic analysis is being made in development programs, its purpose and usefulness have not been discovered by agricultural scientists in the design of their research projects.

While some obvious cost factors have been incorporated in recent demonstration trials in rice and have been gathered in statistical surveys in some other crops, input studies are still lacking. Likewise, studies of opportunity costs of land, labor, fertilizer, and irrigation water, the principal inputs in modernized agriculture, have not yet appeared.

Agriculture is not a static industry. The very process of converting a monocultural subsistence economy to a commercially-oriented one will cause the relative economic advantage of new commodity to change from year to year as farm technology makes its impact. Haphazard innovation is not the procedure. The introduction of watermelons, for example, into the Northeast brought handsome rewards to the first innovators, but the extremely limited local markets were soon over-supplied. Broiler production was an outstanding economic success in the first two years of its introduction in the Saraphi Community Development project, but increased competition from larger specialized operators made small farm broiler production uneconomic.

A commodity high on the priority list because of current export demand--maize, for example- can quickly alter its relative position, as every country dependent on cereal exports for its foreign exchange earnings has experienced. Barring governmental subsidy, no commodity can be assured a continuing favorable market, but with farm management research on input costs per unit of production proceeding cheek by jowl with agro-biological production programs, adjustments could more quickly be made in the commodity concerned than is now the case. 1/

In his argument for a progressive rural structure, Mosher states that no element is more important for its attainment than rural roads;2/ as productivity rises, roads increase in importance. Nowhere is this more true than in the Northeast,

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1/ A case could be made in the present dilemma concerning rice. Had farm management analysis been proceeding in the cereal in proportion to the expenditure for research in its production by the Rice Department, some factual data could supplant the emotional arguments that are now so dominant. On these data,appropriate economies of production costs could have been realized.

2/ A.T. Mosher, Creating a Progressive Rural Structure, op. cit., p. 115.

an area given over almost wholly to extensive rice culture. In the traditional system, when rice is the only crop, its marketing is not urgent. If the ox cart cannot make more than one trip to market from dawn to dark, with its few bags of paddy, that is of no importance. On the other hand, when double cropping and intensive farming take up the slack of under-employment and when harvests of perishable commodities have to be made in the midst of monsoon seasons, time is of the essence. Trips to town become more frequent and have to be made in a hurry. Farm modernization, therefore, requires planning of more and better all-weather roads, and transportation costs will continue to be of vital importance in the final farmer profit equation.

Modern agriculture is a dynamic enterprise and it needs to be planned for when its early targets are established. Diversification *per se* will not overcome stagnancy of monoculture if its implementors are not continuously alerted to the changing demands of technology, prices and markets.

The nature of the economic research assignment contains the essentials for its organization. Some of the issues or problems go far beyond the line fences of individual farms; they are macro-economic in character. As such, the conceptualization and design of their research study is the responsibility of the central staff in responsible agencies. However, it is hard to imagine any problem whose reverberations do not have local overtones, so that somewhere in the process, the farm unit will be involved.

Accepting the proposition that economic analysis is incorporated into the integrated administration of multidisciplinary research at the ministerial level[1/], its functioning at the regional and sub-station levels will be micro-economic in essence.[2/] Also, in an economy that is subsistence in

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1/ Mindful of the need for local staff to be brought into the implementation of macro models to give them the necessary substance.

2/ The Five-Year Plan of the Northeast Agricultural Center contains a working proposal of research in production (costs and returns of cultural practices in the major crops, cost analysis of irrigated agriculture and of the peasant enterprise, etc.) and in marketing. Concerning project selection, it says, "The economic analysis of a specific "improved practice" should be initiated at the request of primary researchers after it has been found technically feasible. At some level of coordination with the original researcher, the economics staff will either advise, direct or conduct the pertinent analysis." Tha Phra, n.d. However, it should be understood that each discipline will have the privilege of initiating projects for multidisciplinary research to be fully functional.

character, where the majority of the family labor force are females, and in which tradition is to important, all senior staff should have strong minors in rural sociology. Even more specialization will be advisable if basic research and follow-up pilot projects are undertaken in cooperatives, farmer movements, extension methods and home management.

4. Summary

Three basic recommendations are made in agricultural research and experimentation.

1. The existing facility for research and training in the principles and cultural practices of irrigated agriculture in the joint FAO-MOA station that is located at Huey Sithon needs two-fold expansion: in staff and in demonstration area. Sufficient elementary tests have been performed at the experimental farm and started in the 300 hectare demonstration area to warrant expansion. 1/ The station is ideally located to expand adaptive trials to other parts of Kalasin Province, including the Lam Pao irrigation area, and to Mahasarakham where its soils are similar to those of Kalasin and to Roi-et. Varying ecological conditions warrant the recommended expansion and the needed staff additions are envisaged in the project's report on diversification.2/ The present recommendation differs from the existing program and projected future work with its emphasis on increased areas of activity. Since this Kalasin station is the main effort at irrigation demonstration in the region, its scope should be expanded to embrace other areas and soil series.

2. The Northeast Agricultural Center at Tha Phra should be given a much greater scope of activity to allow it to function effectively as the main regional research and experimental center for the Northeast. Its expansion into more effective irrigation enterprises is critical because this is the only station in the vast region that is consecrated to reserach and experimentation in the combined enterprises of dry land and irrigated farming. The natural area of expansion into irrigation should be the Nong Wai irrigation system. The station's existing

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1/ See Progress Report, UNDP/SF Project 546, 28 February, 1971.

2/ NEED/PAG Memorandum, 20 March, 1971.

facilities will permit it to only carry on limited experiments and for these to be demonstrated and adapted, much more ample irrigation facilities will be required. The existing staff was recruited for general farming and livestock experimentation; the rate at which other specialists can be added will be determined by the rate at which the present plan of work can be altered to expand activities in irrigated agriculture.

The irrigation required to take advantage of high-yielding varieties of seed, the amount of water needed and time of its application to maximize fertilizer inputs, have been assumed to be that which the farmer has been using under his rain-fed system. This assumption is totally erroneous. "The type of irrigation which is required..... should be higher in technical quality than that which is necessary when irrigation is carried on simply for protecting against drought in the wet season," and "water management based on the traditional gravity method does not permit the realization of the yield-increasing potential of the new varieties." 1/

The author of the foregoing commentary has long observed irrigation of the two types herein described in his own country--Japan--and since that country's phenomenal progress in agriculture is universally acclaimed, it is interesting to note his comment on the "before" and "after" systems. The first was in the early Meiji era when the irrigation ratio was already as high as at present, but defining "irrigation" in the more primitive gravity connotation. Notwithstanding vigorous efforts to modernize the systems with heavily financed governmental programs, starting in the 1920's, "modern irrigation projects have emerged largely after the Second World War." 2/

Thailand will go through the same steps and whether it will make the transition from gravity operated systems to modern irrigation in the three or four decades which Japan required, will depend on many factors. Not the least of these is that which the consultant has emphasized: a recognition and correct understanding of the

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1/ S. Ishikava, Direction of Technological Change in Agricultural Production in the ECAFE Region during the 1970's., U.N., Department of Economic and Social Affairs, Bangkok, September, 1969, p. 15.

2/ Ibid., p. 16.

problem. For these reasons, high priority should be given in planning for the development of agriculture in the Northeast to the research proposals in controlled irrigation at Tha Prah and Huey Sithon.

3. Three stations, each now understaffed and budgetarily limited, are in the Borabu vicinity. The Ministry of National Development has a forage crop experiment near Borabu that has carried on limited trials in the growing of certain grasses and legumes for pasture and ensilage uses, but now needs animals to carry on feeding trials. The Livestock Department of the Ministry of Agriculture has some of the needed cattle, but is primarily concerned with upgrading native cattle through cross breeding. It buys much of its feed because it has given little attention to its production, and nothing whatsoever is being done in the study of the relationship between feeding and breeding, which could be remedied if it joined hands with the station of the other Ministry. There is also a station under the Department of Agriculture (a dependency of the Ministry of Agriculture) that is trying to improve the dryland enterprise system, but not with the collaboration of the two other stations.

If these three stations should be coordinated or combined, they could aid in the development of major portions of Southern Mahasarakham, Southern Khon Kaen, Buriram, Srisaket and Roi-et.

E. FARMERS ORGANIZATION

Various kinds of farmers' organizations exist in Thailand. Included in these are farmers' associations, amphur farmers' groups, irrigation associations and cooperative societies. Functional duplication does exist as well as various levels of efficiency. The different farmer organizations are often formed by different government agencies.

Farmer groups and associations created by agencies of the government are often more responsive to the government agencies than to the farmers needs. This often results in lack of farmer interest in the organization.

Farmers are easily brought together for group action because their basic social institution, the family, is also their greatest occupational resource and they have long known that its effective group functioning makes their farm unit an economically viable enterprise. Therefore, farmers' associations can be easily organized if they exhibit two fundamental, necessary

characteristics: that they are grass-roots organizations and that they are farming locality oriented. The first requisite will give farmers a voice in their organization and administration, and the second will assure that it serves an area with which the farmer feels himself identified because it is a "community" within which he can both market his produce and buy the off-farm facilitites he needs for his enterprise.

The following are the principal farmers' organizations that were reported operative in the Northeast region during 1970.

Land Improvement Cooperatives: This is one among many specialized programs of credit administered through the Ministry of National Development. It emphasizes irrigation, fertilizer and soil improvement programs.

As of 1968, there were reported 73 active cooperatives in the 15 changwads, having 8909 member farmers, each operating a unit of 24 rai.

Irrigation Associations: These are organized to help farmers utilize water from recently constructed dams and tanks. With financial assistance from USOM, Water Users' Groups or Irrigation Associations were started in the Northeast in 1963, and expanded to other regions in 1968. As of June 30, 1970, "In the Northeast Region there are 64 Irrigation Associations with 19,462 family memberships, over an area of 831,643 rai."1/ RID has supervision of the associations. Other similar groups had already been organized by another department in the same ministry (Land Cooperatives), by the Department of Local Administration, and by the Rice Department of the Ministry of Agriculture. Notwithstanding the proposal to "give instruction and training and demonstration programs to the water users who are lacking technical know-how"2/, the project planned has not materialized.

Peoples' Irrigation Associations: These are organized by the Department of Local Administration within the Ministry of Interior. They were started in 1965. The objectives of the Peoples' Associations are a repetition of those found in the other organizations: get water from presently unused dame, weirs

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1/ Irrigation Association, Mimeo, 19 p.4. Another report by NEDB gives 74 associations operative in the same year, having 22,071 member families and covering 904,795 rai.

2/ Ibid., p. 3.

and canals to the farmers' fields, improve land use, introduce improved seed varieties, promote crop rotation and diversification, help in the securing of farm credit, raise farm levels of living, etc. As of 1970, 18 associations were reported in the Northeast in ten of its changwads. The report indicates 77,973 "members" or population; (converted to mean families, their number would be 12,000) who operated 33.6 rai of land per family.

Amphur Farmers' Groups were a creation of the Accelerated Rural Development Office, with help from USOM, started operations in 1966. The proposal was to bring farmers' organizations from outlying villages into a district (amphur) centered association with the amphurs being allocated ฿150,000 for the first year's operations and ฿100,000 for the second, AFGS have had a considerable advantage over all other rural organizations that have had to depend upon voluntary leadership for administration and assessment and collection of individual due for their financial support. The proposal envisaged the construction of an organizational headquarters and general commodity warehouses, but most of the groups failed in the latter respect, other than providing temporary fertilizer and rice storage facilities.1/ As of 1970, 25 AFG's were organized in nine Northeastern changwads with a reported total membership of 43,360 farm families.

Farmers' Associations: Two special interest groups also operate in the region; they were originally organized by the Ministry of Agriculture; one was exclusively an organization of rice growers while the other was for other crops, but including rice as well. With the creation of the Agricultural Extension Department in October, 1968, the separate groups have become the responsibility of this department and have taken the name of Farmers' Associations. In general, amphur agricultural officers are responsible for the ground work which stimulates and initiates the creation of the groups and the changwad superiors are responsible for final accrediting and functioning of the groups.

Having previously evaluated the associations in a working paper presented 10 February, 1970, there is no need to repeat that evaluation here.2/ There are, however, supporting data in another evaluation made of the associations by staff of the Extension Department itself. The report recognizes the responsibility of the Extension Department in the creation of the

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1/ DTEC, Mimeo, n.d.

2/ The Agricultural Extension Service as an Adult Educational Institution, NEED/PAG Working Paper No. 30.

groups and technical guidance which it is supposed to provide, and finds the latter woefully lacking because of the lack of training on the part of extension agents in group organization, group functioning and the general principals of voluntary leadership.

As a rule, amphur agricultural officers have had no training in the social sciences, in the elements of public administration or in the problems of marketing, transportation or even in the fundamentals of crop rotation, agricultural economics or farm management. Their professional preparation, if any, is limited to the traditional production of rice growing, which is a much as the farmer himself has so the agent is not capable of leading the way in the organization or functioning of group activities. Where a successful association was found in the evaluative study, the key to the group's success lay in the influence of a school teacher, a farmer or merchant who had seen and heard about associations elsewhere and had given his time and money to the creation of a group in his community. In concluding its analysis, the report said, "It can be said that most of the amphur government officials fail to lead the group effectively despite the fact that some of these officials are leaders of high calibre..... Past experience indicates that not all changwad officers likewise are capable of effectively advising these groups due to lack of understanding as to what the ideal group should be."1/

The combined efforts of the amphur and changwad officers were unable to stimulate enough interest among farmers in the need for group organizations so that, as a rule, three or more mubans had to be canvassed to find 20 or 25 members to form an association, notwithstanding that each muban has an average of 100 farm families. This has made for small, weak associations, representing no more than nine percent of the farmers in the village. Consequently, the groups have no bargaining power with buyers of rice nor in representing members in the purchase of inputs. As of 1970, public statistics show 2983 farmers' associations in the 15 changwads, with a combined membership of 113,910 which would allow 38 members per organization.

The total number of farmer organizations (of all kinds) in the Northeast in 1970 was roughly 7000 with a total membership of 325,000. The quality and effectiveness of these organizations varies considerably, thus prohibiting any generalizations.

1/ Thanya Viengklang, The Preliminary Survey for the Study of Farmer-Groups in the Northeast, Mimeo 16, February, 1970, p. 23.

It is true, however, that many exist only on paper and are not functional.

Because of the organizational overlap, it is recommended here that all "education, training and advisory work" with farmers should be made the sole responsibility of the Agricultural Extension Department, Ministry of Agriculture. The transferral of such functions to Extension should be on a schedule that will be consonant with that agency's ability (quantity and quality-wise) to absorb such functions.

Having an eventual goal, the grouping of federated associations on the amphur and changwad level, the Third Plan period should aim at no more than federation at the tambol level. The average tambol is a collection of 10 mubans, each with 100 farm families. 1/ This is a base large enough to allow viable tambol organizations to be formed with existing muban assocations becoming sub-units of the tambol. Until the associations have become successfully functional, their activities should be limited to being strictly extension-type associations, acting as vehicles through which training and advice is channeled by the amphur officer. Once this point has been perfected and association officers have been trained, the associations can branch out to serve as the marketing organization for farm products and for purchasing and distributing farm supplies and consumption goods to members. The final role they might adopt is to function as credit organizations for receiving deposits of savings and making loans to members. In other words, they will eventually be multi-purpose groups, but acting as such only after they have proven experience.

Other services essential to agricultural development, such as those performed by the Royal Irrigation Department, Land Development Department and Bank for Agriculture and Agricultural Cooperatives, should be administered by these same agencies but, at the same time, restricted to functions which they perform. The broad assumption on which most of their specialized associations were originally brought into being--"to raise farmers' levels of living by teaching them new agricultural techniques"--should be disavowed and to the extent they are needed to administer and regulate the agencies' programs, their group functioning structured accordingly.

1/ There are approximately 1300 tambols in the region.

Once these policies have been adopted and put into practice, many of the surplus useless groups and organizations will have been eliminated. For the Agricultural Extension Department to assume the full responsibility of the creation and administration of Farmers' Associations, so that they will function as the vehicles of change, the existing staff of the agency will need to be both upgraded in training and increased in numbers. Two proposals were spelled out in detail in a previous paper, so they will need only to be mentioned again. 1/

1. Post Graduate Training for Agricultural Agents. It was recommended the combined facilities of the Northeast Research Center and the Northeast Extension Training Center, both at Tha Phra, can be utilized for a one-year course for 50 amphur agricultural officers, in which modern techniques of agricultural production will be emphasized, including farm management, farmer organizations, marketing problems and extension methods. To amplify existing facilities, to buy needed machinery and equipment, and to provide needed staff, a five-year budget of ฿4,965,000 of local funds was suggested and a sum of U.S. $638,000 foreign exchange for needed purchases. The training center would be administered by the Agricultural Extension Department, Ministry of Agriculture, with assistance and participation of the Research and Experiment Station Department of the same ministry.

2. Bearing in mind that the Agricultural Vocational Schools of the kingdom will concentrate on the training and education of field level personnel to serve as amphur agricultural officers, supervised credit agents, irrigation program specialists and the many other related agricultural services and that the Universities and Agricultural Colleges will prepare senior level personnel for employment in Bangkok and the changwad offices, a program for practical assistant agents was recommended. This would recruit farm youth having a basic primary education and in a non-structured training course of one year's duration, who would be taught the basic elements of improved agricultural operations. It was suggested that such a school might utilize the facilities of an existing experiment

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1/ NEED/PAG Progress Report, Paper No. 2, Institutionalization of Agricultural Development, 4 December, 1970.

station in the region, or it might be worked in conjunction with the FAO-Ministry of Agriculture demonstration farm at Huey Sithon, Kalasin Province. A budget of ฿10,639,000 of local money and U.S. $1,364,000 foreign exchange for the five-year period was suggested. It was visualized that three or four animateurs could be trained for each amphur of the region in the five-year period.

Eventually, these assistant agents would become employees of the tambol Farmers' Associations. It will be through them that amphur agricultural officers will promote their annual educational programs with one notable change from current practices. Since the muban units will elect their officers who, in turn, will serve on the tambol boards, each "association will make up its own program"--a program that will be in line with the national production policies by crops as it will be formulated and announced by the government.

F. SOILS AND LAND USE

1. Soils

Any statement on soil resources and land capability of the Northeast has to start with Pendleton's reconnaissance survey which, in many respects, is the most informative study yet made of either the land base or soils in the Korat Plateau, as he called the region.1/ His report clearly defined the natural constraints of the Northeast region.

Comparing his observations with those he made in other regions, Pendleton concluded that the Korat Plateau was the most infertile in the kingdom. The major portion of the Northeast falls within three broad soil groups. These are:

a. Korat sandy loan series, "one of the most extensive.... most infertile soil groups in the kingdom." While this soil group is not confined to the Northeast, that is where it is found most abundantly. The soil has weathered from sandstone and the natural vegetation is an open, savanna-like forest, much of which is left standing in the paddies for its annual contribution to the organically deficient sand loan.

1/ R. L. Pendleton, Thailand, Aspects of Landscape and Life, America Geographical Society, New York, 1962, p. 71 ff.

b. It combines with Korat at lower levels of depression where the plant nutrients that have been washed down from the higher slopes can accumulate. As a consequence, they make the most productive paddy sites within the two series. In general, both Korat and Roi-et types are extremely infertile and lack plant nutrients because of their origin which is from the silica sands.

c. Kula Ronghai silt loams which are prevalent in central Korat and north of the Mun River. They are flat, treeless, swampy plains or savannas (called thung in the region).

Editing and publishing Pendleton's studies in 1964, Sarat Montrakun says:

> "The soils are, as a whole, very poor, high in quartz and silt, but contain little else....(they) contain little unweathered minerals that could release plant nutrient substances." 1/

The plateau is a saucer-like land formation that is tilted toward the Southeast. It is bordered on the east and north by the Mekhong River and the mountains of Laos; the Phetchabun and Dong Phrayayen ranges separate it from the rest of the kingdom on the west, and the Sankamphaeng and Dong Rek scarps from Cambodia. In land area, it measures approximately 170,000 square kilometers,2/ and one of its chief determining factors for agriculture is its generally low relief; this impedes the speed with which heavy rain waters can run off and, thus, large areas of the low-lands, with their accumulation of plant nutrients, become unsuitable for rice cultivation because of long and periodic flooding.

1/ Agriculture and Soils of Thailand, Department of Rice, Ministry of Agriculture, Bangkok, 1964, p. 94.

2/ The Changwat-Amphoe Statistical Directory, NSO, gives the total for the 15 changwats as 170, 294.

Following the classification system of Dudal and Moormann, the "great soil groups" that are dominant in the Northeast Plateau are: the Low-Humic Gley soils and the Gray Podzolic soils, with important areas of Alluvial and Red Yellow Podzolic soils.1/ This is the major soil resource of the Southern and Central parts of the region. While the same groups are also found in the Northern part, the Red-Yellow Podzolic soils are the most dominant. Moormann and Dual2/ document how the amount and quality of water, and the important physical and chemical soil properties, such as their drainage and permeability, texture, structure, fertility and susceptibility to salinity, all taken together, determine the suitableness of paddy soils and their varying yields.

It is an extremely complicated matter to determine the correlation between soil conditions and soil yields when both soil and water are so intimately interrelated.3/ It is for these reasons that seasonal shortages or irregularities of rainfall bring such variations in annual yields on the same lands. In periods of short rainfall, the yields will quickly suffer on the light,textured soils, whereas they may turn out satisfactorily on the clayey soils. On the other hand, in excessively wet years, the poorer,light textured soils will produce more heavily than the better and richer bottomland, so that the inherrent qualities of a soil will show varying capacities depending on the timing and amount of rainfall in its area. It may, therefore, be no accident that the average, small farmer has two or more plots of differing characteristics. He knows he cannot influence or control the amount and timing of the rains, but he can control his use of the water.

The mineralogical and chemical composition of a soil determines its inherent fertility, and whenever the fertility level is being corrected with an application of chemical fertilizers,

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1/ R. Dual and F. R. Moormann, "Major Soils of Southeast Asia" The Journal of Tropical Geography, 18:54-80, University of Malaysia, Kuala Lumpur, 1964, as quoted in Soil Survey Report No. 48, Department of Land Development, Ministry of National Development, Bangkok, June 1966.

2/ F. R. Moormann and R. Dudal, Characteristics of Soils on Which Paddy is Grown in Relation to their Capability Classification. Soil Survey Report, No. 32, Department of Land Development, Ministry of National Development, Bangkok, March 1965.

3/ Ibid., p. 1.

"soils with low inherent fertility call for more care than the ones having adequate reserves of plant nutrients".

Terracing, benching and surface drainage are irrigation techniques that can be practiced by the individual farmer, provided he understands the appropriate management practices. In any government or cooperative sponsored irrigation system, the silt carrying function (a fertilizing additive in itself) of irrigation water must be understood and managed because yields even on similar soils may be a function of their distance from the impounded water.

The oxygen generating process of even slow moving water which is important to combat the accumulation of toxic substances,as happens in stagnant water, is well known in rice production. While some farmers have learned this through experience, although they may not know the chemical change involved, most of them only think of the weed-repelling affect of water innundation.

Present cultivation techniques result in poorly prepared land which leads to weed growth and poor aeration that is so vital to seed germination and plant growth. The structure of the soil below the plow layer is important from the standpoint of drainage and permeability, and a combination of improper plowing and excess innundation will produce an unfavorable tilth. The drainage problem needs to be investigated more fully.

Soil and water, whether the source of the latter be through controlled irrigation of impounded waters or rain-fed, when properly combined and managed, will lead to profitable yields. Proper soils management is essential and should be taught by the extension service.

It is the force of folk knowledge--tradition--that has brought the Thai farmer this far as a principle world rice producer. The professional should now help him make the transition into a new competitive era.

2. Land Use

Soil surveys and classifications become useful to the adminis trator and planner when they can be used to preduct the suitability of any given land for agricultural use, and here the concern is threefold: The suitability of the soils for rice paddies, upland crops or pasture. The Land Development Department is now doing land capability classifications, using the inherent soil characteristics as the "building stones for

this capability classification."1/ Two classifications systems were set up, one for rice and another for upland crops. The former is broken into five classes and the latter into eight. Each, in turn, is subdivided according to terrain, susceptibility to flooding, moisture, drainage, etc.

Class UI soils possess the necessary characteristics to make them well suited for upland crops. In general, they are "deep, well drained, permeable and nearly level." 2/ Class UII have slight hazards or limitations, but they are amenable to good management and will yield profitably therefrom. Class UIII are more hazardous, while Class IV are poorly suited for farming and offer only limited possibilities for a few crops. Classes V and VI are unsuited for upland crop cultivation under presently known management practices.

Paddy soils follow the same general classificatory system. The PI are excellent, having few limitations. PII have only slight hazards for rice growing and are considered well suited, and PIII are classified only "fair", while PIV and PV are not suited for paddy farming.

Taking the first six changwad maps which the Land Development Department has prepared from information from the classificatory process, the aerial tabulations made from these maps give useful information for agricultural planning in the respective changwats. Table F-1 summarizes land classification in each of six changwats. Of the six states, Nakornphamom, Roi-et and Ubon have the highest percentages of their land areas classified as being good for rice; the percentages being 9.9, 8.7 and 8.8, respectively. In the "fair" class, or PIII, the resources are more uniform, ranging from 19.6 percent in Kalasin to 34.5 percent in Mahasarakham. Considering all three classes, none of the six provinces is fortunate enough to have at least 40 percent of its land classed as good or fair for rice growing and, since the bulk of the farms are rice farms, this suggests the handicaps under which they must operate.

1/ D. L. Gallup, Srilak Kashemsania and Avudh Pimpand, Soil Survey Interpretation Handbook for Northeast Thailand, Parts I and II, Nos. 59 and 60, Ministry of National Development, Bangkok, July 1967.

2/ Ibid., p. 4.

Table F-1

Soil Capability Classes, 6 Changwats
Northeast, Thailand

Changwat	Surveyed Classified Km^2	PI	PII	PIII	PIV	PV	
PADDY LANDS							
Nakornphanom	1,146	-	113	322	181	530	
Percent Classified			9.9	28.1	16.1	46.2	
Roi-Et	7,202	105	533	2,196	2,313	2,066	
Percent Classified		1.5	7.2	30.5	32.1	28.7	
Sakolnakorn	3,171		6	788	900	1,472	
Percent Classified			0.2	24.9	28.4	46.6	
Ubon	3,270	53	237	975	1,678	327	
Percent Classified		1.5	7.2	29.8	51.3	10.0	
Kalasin	7,651*		137	1,498	179	5,431	
Percent Classified			1.8	19.6	2.3	71.0	
Mahasarakham	5,761		273	1,983	666	2,786	
Percent Classified			4.7	34.5	11.6	48.5	
Totals	28,201*	158	1,288	7,762	5,917	12,612	
Percent Classified		0.6	4.6	28.0	21.3	45.5	
UPLAND CROP CLASSES		UI	UII	UIII	UIV	UV	UVI
Nakornphanom	1,146	32	452	352	58	252	
Percent Classified		2.8	39.5	30.8	5.1	22.0	
Roi-et	7,196	76	3,620	2,644	793	40	23
Percent Classified		1.1	50.3	36.8	11.1	0.6	0.4
Sakolnakorn	3,171	-	1,194	602	24	952	399
Percent Classified			37.7	19.0	0.8	30.1	12.6
Ubon	3,098	18	731	1,980	56	273	40
Percent Classified		0.6	23.6	64.0	1.8	8.9	1.3
Kalasin	7,651		18	5,772	308	85	994
Percent Classified			0.2	75.4	4.0	1.1	13.0
Mahasarakham	5,761		63	3,770	1,077	8	765
Percent Classified			1.1	65.4	19.2	0.1	13.3
Totals	28,023	126	6,078	15,120	2,316	1,610	2,221
Percent Classified		0.5	22.1	55.0	8.4	5.9	8.1

* Slight differences in totals are caused b some categories contain two or more classes. These, however, are significant in total area.

There was great variation in the percentages of land area classified totally unsuitable for rice or Class V. The percentage reached 71 in Kalasin; it was in the 40's in Nakornphanom, Sakolnakorn and Mahasarakham, and got to a low of 28.7 percent in Roi-et and 10.0 in Ubon.

Considering the six provinces as a group, only 5.2 percent of their classified area falls into Class II or better, which are the preferred soils, while another 28.0 percent falls into UIII. Because of this unfavorable balance, the Northeast is a poor producer of rice when compared to other regions.

The upland crop area has a higher percentage of better quality land. Of the three changwads completely classified (Roi-et, Kalasin and Mahasarakham), Roi-et has 50.3 percent of its land area classified in the UII class and 1.1 percent in UI. In other words, over half its land is considered good for upland crop cultivation. Neither Kalasin nor Mahasarakham have more than traces in this favorable position. The former has 75.4 percent in Class III, and the latter, 65.4 percent, which is a "fair" category. The remainder is poor and useless land for agriculture.

The other three provinces--Nakornphanom, Sakolnakorn and Ubon--were quite similarly endowed with Class UII or Class UI, having 42.3, 37.7 and 24.2 percent, respectively, in these classes. The highest percentages of wasteland were found in Sakolnakorn, Kalasin and Mahasarakham.

Because the criteria for classification are broader and may be less intense than was required for paddy classification, the results may be biased. However, a much higher portion of land fell into Class UII or better (22.6 percent) than was the case for rice land. Further, if to the 22.6 percent is added that in Class UIII, 55.0 percent, this makes more than three-fourths of the land considered to be fair or better for upland crops compared to only one-third for rice similarly classified. These comparisons favor a strategy of more diversification for the Northeast, as well as setting aside the unusually large portion classified unsuitable for recreational and forestry industries.

When this land capability classification becomes available for the changwads, the provincial planning agencies can then utilize the information to combine land capability classification with actual land use and, thus, provide farm type maps for their provinces. It may be that disproportionate numbers of farmers will be found trying to cultivate the poorer paddy and upland crops land, while the better classed lands are still available. It is not very probable that this will prove

to be the case, but the true status will not be know until the capability classification, which is a theoretic suggestion of land use, is verified against its actual use.

3. Land Zoning

Finally, with the help of the foregoing classifications, it will be possible to check the trend in land use as it was first observed in the making of the Agricultural Census in 1963. At that time, 24.8 percent of the 106.4 million rai in the Northeast Plateau, was classified as farmland, 39.9 percent as forest and grazing land, while the balance remained unclassified. The number of farms has continued to increase in the post-census years at a rate estimated at approximately 1.5 percent compounded per year. If this rate should continue unabated, the Korat Plateau will have 1,396,000 farms in 1972, having increased from 1,221,000 in 1963, and projecting this trend another five years, the region will then have 1,482,000 farms. Assuming the same average size of unit as that which was obtained in 1963, 21.6 rai, 30,154,000 rai will be in farmland in 1972, and 32,011,000 in 1976. In other words, 28.3 percent of the total land area will be in farms in 1972 and 30.1 in 1976, causing the forest lands to have diminished to 34.6 percent of the total in the latter year, whereas they accounted for 39.9 percent in 1963.

While the above land expansion estimates are trend line projections, they follow logically from the information that is already at hand concerning land capability and the earlier reconaissance survey material gathered by Pendleton and his successors. The majority of the remaining forested and unclassified lands lie along the eastern border with Laos which area is extensively covered by the quartzitic and silicious sandstone hills and in the western fringe that is dominated by the Phetchabun Mountains and Dong Phrayayen. It is inconceivable that other than in the limited valley floors can suitable farmlands be found. so it should be clear that a land policy in the public interest will try to curb this unlimited expansion which is rapidly leading to the wanton destruction of the country's diminishing forest reserve. In other words, land zoning legislation is recommended to limit expansion. Unwise expansion into lands that are becoming increasingly marginal for agricultural use, not only runs counter to the kingdom's efforts at land conservation, but will lead to the establishment of village settlements in isolated areas that will disproportionately increase social infrastructure overhead. A wise zoning policy will restrict the development of these remaining unsettled areas to their only economic use: planned forestry cutting and recreation.

Insofar as the preliminary tabulations of land capability are representative of the region as a whole, the data bear out the general statement that the Northeast Plateau is not a productive region for the growing of rice, while at the same time,

giving support to the idea that its natural resources should be employed to diversify production into other crops and the development of pasture lands for livestock grazing. The recent soil analyses indicate that 37.7 million rais (35.5 percent) of the 106 million that were in farms when ennumerated by the Agricultural Census of 1936, were made up of the poorest of the great soil groups so poor they are not recommended for cropping. This includes such series as Numpong, Phon Pi Sai, Sakon, Tha Uthen and some of the Korat series.1/ Most of these series have been temporarily cultivated under the swidden system (kaingin) and then abandoned, but many years are required before forest regeneration can restore the original fertility and structure of the soils so they submit to the force of erosion and do not even make forest lands.

G. LAND TENURE

Land Tenure refers to the legal or contractual and customary arrangement whereby farmers have rights to the occupancy and use of the lands which make up their farm enterprises. The agricultural Census of 1963 reported 90.8 percent of the 1,221,000 farm holdings in the Northeast to be operated by their owners. In other words, there was no problem of landless tenancy and absentee ownership.

However, the land tenure situation is complicated by the various kinds of land titles which exist. The three classes of land ownership are:

1. A full owner with title deed to his land is in the highest category, chanod tidin is the Thai expression. This corresponds to simple ownership.

2. A partial owner possessing only preliminary title to his land or right of occupancy and use that is issued by the district officer. This is called an expolitation testimonial or sor khorl and nor sor 3. This testimonial carries rights of permanent occupancy, inheritability and transferability. But the latter is encased in many cumberson restrictions and banks are reluctant to accept such titles as collateral.

3. An occupancy right or reserve license,known as bai chong or tra chong, issued by the district officer. This carries no security of tenure, is valid for three years'

1/ Ministry of National Development, Thailand Development Report, Vol. III, No. 2, March 1968.

occupancy, although it can be extended. The English expression would be "squatter" possessing public approval for his occupancy.

Dr. Chaiyong Chuchart estimates that of the total land under cultivation, 27 million acres, title deeds have been issued to about six million acres, exploitation titles to about 4.5 million acres and reserve licenses to about one million acres. 1/

To move up the tenancy ladder from a status of exploitation testimonial to full ownership with title deed, the law requires that the area under consideration must be cadastrally surveyed. Thus far, cadastral surveys have been limited primarily to the Central Region, and it is estimated that less than five percent of the land has been surveyed.

That the Northeast may suffer from the lack of cadastral surveys is borne out by data of the Manpower Utilization Survey. That study found 92.7 percent of the farmers in seven villages full owners and another 3.1 percent part owners because part of their cultivated lands were rented from others. However, when the families were questioned concerning their land ownership title status, another story came out. When classified into the three groups of ownership mentioned earlier, 20.3 percent were holders of chanod tidin; 76.3 percent were sor khor 1 and nor sor 3; 3.3 percent of the 473 farmers were bai chong or tra chong, as it is more commonly known in Khon Kaen.

Lack of clear titles is generally the rule in new settlement areas, and the problem has been accentuated by the building of dams, reservoirs, canals and highways which have caused the affected families to move or to relocate their paddies; the slowness of cadastral surveys,coupled with the disruptive effect of public works, makes the problem of land titles unusually serious in the region. When land is required as collateral for bank loans, only a small percentage of the region's farmers can hope to obtain institutional credit; when in need, the others have to seek loans from private money lenders and pay higher interest rates, as a result.

By custom, size of holding and distribution of land has come into tenurial discussions. These factors were reported by the Agricultural Census of 1963, as is shown in Table G-1.

1/ Chaiyong Chuchart, "The Prospects of Land Reform in Thailand," Economic Journal, II Year, Book I, January-April, 1969, Thammasart Economic Association, P. 142.

TABLE G-1

Number and Area of Farm Holdings
Northeast Thailand
1963

Size in Rai	Number of Holdings	Percent	Area in Rai	Percent
Under 6	180,622	14.9	529,334	2.0
6 - 14.9	363,656	29.8	3,545,497	13.4
15 - 29.9	380,339	31.2	7,928,246	29.9
30 - 49.9	196,172	16.0	7,282,002	27.7
50 and over	99,997	8.9	7,134,018	27.0
TOTAL	1,220,786	100.0	26,419,099	100.0

Source: Census of Agriculture, 1963, NSO, Bangkok, Table 1.

That 14.9 percent of the holdings are smaller than six rai in size, and another 29.8 percent under fifteen rai, constitutes a land problem that cannot be overlooked. This high percentage of small farm holdings is a major factor contributing to the low average per farm income in the Northeast.

VI. LIVESTOCK DEVELOPMENT PROGRAM

FOREWARD

This paper represents the summation of the work done by Dr. Wilfredo De Rafols during the period May - July 1971.

LIVESTOCK DEVELOPMENT PROGRAM

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VI. LIVESTOCK DEVELOPMENT PROGRAM

NORTHEAST THAILAND

Summary

The purpose of this report is to suggest a program for improving and increasing the contribution that the cattle sector in Northeast Thailand can make to the region's economy. At the present time, cattle in the Northeast are below average in size and yield small amounts of low quality meat. To examine whether this situation can be ameliorated, NEED/PAG's agrobusiness specialist made a three month investigation of the livestock sector.

This analysis of livestock may be divided into six basic elements:

1. Pasture Development
2. Cattle Breeding
3. Crop Development
4. Feed Lots
5. Slaughterhouse
6. Feed Mills

The above represent the key areas requiring capital expenditures. The result of such a cattle development program should be a substantial increase in the quality and quantity of meat from the Northeast. However, this cannot be achieved without changes in existing practices or introduction of new facilities and procedures which at a minimum will require 4-5 years before results can be observed.

Pasture

Presently, cattle graze at random on land which is not being used for crop production. This means that livestock feed primarily on rice stubble.

A more efficient system for grazing would involve the development of land strictly as pastures such as have been demonstrated at Borabu or as part of a crop rotation/land restoration program as proposed for Mancha Khiri.

It is estimated that it would cost 500 baht per rai to develop pasture land and that 2.5 to 3.0 rai would be required to support each head of cattle. A minimum of about one year is required to convert existing land into pasture.

Cattle Breeding

The second step in a cattle development program involves a breeding program to improve the physical quality of livestock. Imported bulls, artificial insemination, and cross breeding with local stock are involved in this phase. The major goal of this program would be to increase the average size of cattle from 350 kg to 400 - 420. Such a program would take about 3½ years and involve at least three imported bulls. It is assumed that initially these bulls would be cross bred through artificial insemination with local cattle, but after approximately three years they could be cross-bred with the resultant improved breed of local cattle.

Crop Development

To ensure that sufficient quantity of low cost feed would be available, it is recommended that a maize and sorghum program be developed adjacent to a feed lot operation. The development cost for either crop would be about 1,200 baht per rai. To feed a continuous feed lot operation of 2,000 head every five months therefore would require 7,500 rai. The yield per rai is estimate to be 640 kg. which would result in a per kilo cost of 0.58 baht, assuming two crops per year. Silage with a yield of 4.8 tons/rai would result at 7 stang/kg.

This program could be developed in one or two seasons.

Feed Lots

The purpose of a feed lot operation is to effectively for feed cattle during a five month period in order to significantly increase their weight and the quality of their meat. A 2,000 head feedlot appears to be the best size for an initial operatio in Northeast Thailand. The capital cost of a feed lot of this size is estimated to be 2.7 million baht. Assuming 90 percent utilization of capacity (1,800 head each five months) 4,380 head of cattle per year could be channeled through a single feed lot. The operating cost per head of such an operation is estimated to be 1,074.40 baht.

Construction of a feed lot is estimated to take one year. Therefore, the optimum timing for start of construction would depend on the development of the pasture, and breeding and crop development programs since feed lot operations from existing types of local cattle would not be efficient. These programs are assumed to take 3½ years. Therefore, construction of a feed lot could begin 2½ years after the first phase of an integrated cattle development program was implemented.

Slaughterhouse

It is recommended that modern slaughterhouses be constructed in the Northeast in order to reduce the transport costs involved in hauling live cattle to Bangkok. Modern slaughterhouses also have the advantage of lower cost of operations - assuming their full capacity is utilized - and better utilization of by-products.

Slaughterhouses with capacity for 20,000 to 40,000 head per year are deemed the smallest practical for the region. The capital cost of a slaughterhouse for 40,000 head per year would be 13 million baht and their operating cost per head is estimated to be 150.9 baht. One year would be required for construction. However, since the type of slaughterhouse envisioned has capacity greater than that necessary to support the initial phases of a cattle improvement program, the timing of its construction is not critical.

Feed Mills

The final element of an integrated cattle development program involves the construction of feed mills. These are required to mix feed for the feed lot operations. Usually, one feed mill is associated with three feed lot operations. Therefore, a feed mill having minimum capacity of 24,000 tons per year would handle 13,000 head in feed lot operations. The cost of a feed mill of this size would be 9 million baht with one year required for its construction.

Conclusion

Table I gives the cost and time phasing of the required investments for an integrated livestock development program involving the elements mentioned above. Based on these figures, it appears that the rate of return for a cattle development program would be around 19 percent.

TABLE I

COSTS, TIME PHASING, AND PROFITS IN A TEN YEAR PERIOD

	0	1	2	3	4	5	Totals
INVESTMENT:							
Pastures:	16,500,000	13,200,000	7,700,000	6,600,000	11,880,000	14,520,000	69,300,000
CATTLE:							
Bulls @ 20,000/head	60,000				60,000		120,000
11,000 Cows @ 1,500	16,500,000						16,500,000
Crop Land			7,800,000		7,800,000		15,600,000
Equipment			5,725,200		5,725,200		11,450,400
Feedlots			2,753,700		2,753,700		5,507,400
Feed Mill				9,040,500			9,040,500
Slaughterhouse			13,241,200				13,241,200
SUBTOTALS	33,060,000	13,200,000	36,120,100	15,640,500	28,218,900	14,520,000	140,759,500
PROFIT							
From Export:							
Feedlot Liveweight @ 3211.6 B/head				14,066,808	14,066,808	14,066,808	42,200,424
Feed Mill				2,145,840	2,145,840	2,145,840	6,437,520
Selling cows after replace old ones @ 3500 B/head							
TOTAL				16,212,648	16,212,648	16,212,684	48,637,944
From Feedlot Domestic MKT @ 2804 B/head				12,337,600	12,337,600	12,337,600	37,012,800
Feed Mill				2,145,840	2,145,840	2,145,840	6,437,520
Slaughterhouse profit @ 58.7 B/head				2,348,000	2,348,000	2,348,000	7,044,000
Selling cows after replace old ones @ 3500 B/head							
TOTAL				16,831,440	16,831,440	16,831,440	50,494,320

TABLE I (CONT'D.)

COSTS, TIME PHASING, AND PROFITS IN A TEN YEAR PERIOD

	6	7	8	9	10	Total
INVESTMENT:						
Pastures:	17,160,000	21,912,000	4,752,000	5,808,000	7,287,000	56,919,000
CATTLE:						
Bulls @ 20,000 /head		60,000				60,000
11,000 Cows @ 1500						
Crop Land	7,800,000	7,800,000	7,800,000	7,800,000	7,800,000	39,000,000
Equipment	5,725,200	5,725,200	5,725,000	5,725,200	5,725,000	28,626,000
Feed Lots	2,753,700	2,753,700	2,753,700	2,753,700	2,753,700	13,768,500
Feed Mill						
Slaughterhouse						
SUBTOTALS	33,438,900	38,250,900	21,030,900	22,086,900	23,565,900	138,373,500
PROFIT						
From Export:						
FeedLot, Liveweight @ 3211.6 B/head	19,783,456	25,435,872	31,088,288	39,001,670	49,176,019	164,485,305
Feed Mill	2,145,840	2,145,840	4,282,080	4,282,080	4,282,080	17,137,920
Selling cows after replace old ones @ 3500 B/head			53,592,000	120,764,000	189,483,000	363,839,000
TOTAL	21,929,296	27,581,712	88,962,368	164,047,750	242,941,099	545,462,225
From Feedlot Domestic MKT @ 2304 B/head	17,272,640	22,207,680	27,142,720	34,051,776	42,934,848	142,609,664
Feed Mill	2,145,840	2,145,840	4,282,080	4,282,080	4,282,080	17,137,920
Slaughterhouse profit @ 58.7 B/head	2,348,000	2,348,000	2,348,000	2,348,000	2,348,000	11,740,000
Selling cows after replace old ones's @ 35000 B/head			53,592,000	120,764,000	189,483,000	363,839,000
TOTAL	21,766,480	26,701,520	87,364,800	161,445,856	239,047,928	536,326,584

A. FEEDLOTS

1. Introduction

The purpose of this report is to analyze the feasibility of improved methods of production and processing of livestock in Northeast Thailand. This analysis considers the type and cost of improved breeds of cattle, their requirements for pasture land, a 2,000 head cattle feedlot operation and the production of feed grains. However, a complete market analysis is not presented here. The reason for this is that the market situation has been studied in the NEED Third Five Year Plan, in the Mancha Khiri report, in the ADB Compac report, in the Manderstam report and in other reports.

The general conclusion of all the market research that has been carried out is that over the Third Five Year Plan period most demand for Thai meat will have to come from local consumption. Few export sales of processed meat can be expected - the Japanese market will be extremely difficult to penetrate due to the disease problems of Thai cattle. Therefore, the major market influences over the plan period will be Thai consumption and Thai meat prices. Export market potential will exist, but Third Plan Period will see Thai meat standards raising to international specifications (especially Japanese standards) and costs being reduced to make Thai meat competitive (especially with Australia).

2. Cattle

Thai native cattle differ considerably in type, but are rather uniform in their small size and low muscular growth potential; these characteristics seem to be similar to the N-Dama Africans. The fertility rate is 60-70 percent, and the first parturition occurs at 3.5 years. These cattle seem to have an inborn resistance to foot and mouth disease. The mature bulls have an average weight of 300 kgs while the female weigh 220 kgs.

An intensive program carried on by the Livestock Department is taking place in the Northeast Region to improve native cattle by crossing it with Brahaman bulls.1/ About 50 purebreds and crossbreds are supplied annually to private farmers at 3,000 baht each, plus 120 bahts per month of age. The bulls are used to serve native cows. The charges vary between 50 baht and 150 baht. The crossbreds are larger and can be sold at higher prices.

A survey on calving done at Khon Kaen University shows the rates are about 60 percent with crossbreeds of Brahaman and native cattle with good pastures of stylosanthes base, the weaning percentage could be increased from 60 to 80 percent in a five year program and cattle mortality would decrease from 5 percent to 2 percent.

1/ Mancha Khiri Dryland Farming Pilot Project FAO/IBRD Cooperative Program. Rome, December 1970.

The Chokchai Ranch has started a program with Santa Gertrudis breeds, and crossbreds with pure Brahamans and native cattle with the main purpose of producing high quality beef. At present, the ranch has pure breeds: Sta. Gertrudis 512 heads and 40 Brahamans. After six months, both pure breeds sell for 15,000 baht per head with weights of 220-250 kgs. for Santa Gertrudis and 200-220 kgs for the Brahamans.

According to Mr. Chokchai, heifers and steers at his ranch in feedlot operations are gaining an average of 1.2kg. weight per day during the last 6 months of the fattening period starting with a liveweight of 220 kgs at the weaning stage (6 months); at age two they are sold with an average of 600 kgs. at a selling price of 15,000 baht per head. (25 baht per kg.) The conversion factor for concentrates on pure breeds is around 4:1 and for crossbreeds 6:1. The ration is 3-4 kgs. of concentrates plus 15 kg. of roughage or silage.

Based on the above, it appears that the most suitable type of cattle for Northeast Thailand would be St. Gertrudis, Brahamans crossed with native cattle, and in some areas Charolais, Angus and Shorthorn.

3. Pastures

Traditionally cattle are allowed to forage for themselves in the wet season, often in the hills and mountains away from the farming areas. At present, rice, maize, kenaf, cotton, and groundnuts have priority over cattle grazing during the rainy season when these crops are grown. As a result, the grazing areas are substantially restricted and the animals are confined to small grazing areas. Frequently, this amounts to only the little strips between the fields and along the side of the roads. Since no fodder crops are grown, the farmer's animals lose weight during the rainy season. During the dry season animals graze on stubble and a number of farmers feed them with rice straw and rice bran. When kenaf is grown on rice land, no rice stubble is available which results in severe feed shortages.

It will be necessary, therefore, to develop pastures for grazing for improved cattle breeding to be successful in the region. In this regard, extensive research has been conducted at the Borabu Demonstration Farm. This facility consists of 810 rai on which a New Zealand sponsored program is demonstrating the feasibility of developing pastures.

Around the perimeter of the demonstration farm 2,400 rai are distributed among 24 selected farmers to be developed as pasture cattle farms with the provision that not more than 5 rai be used for crops. The staff of the demonstration farm

provided assistance to these farmers when requested. Some of these farms have built up large herds of cattle. A similar scheme can be adopted in areas with the same ecological conditions.

The station has developed grass-legume pastures and recently corn millet and sorghums have been included in the program. Also, trials for fertilizer responses are being planned with peanuts, cassava, cotton, kenaf, bean and non-bean varieties of leguminous plants. (Mung beans, black gram, soybeans, limas, triobed, ricebean and red mung, amoung the bean varieties and for the non-bean leguminous plants the following ones are on trial: Cowpea, Glycine wightii, Mimosa, Dollichos axillaris, Dolichos lab Pad, Dolichos uniflorus.) Corn for silage was also included in the experimental trials.

Most of the experiments are related to soil fertility tests, with several grasses and legumes. Also, animal grains are recorded for several pasture combinations.

Some of the results are very encouraging i.e., the combination of guinea grass and stylosanthes plus 10 kgs nitrogen per rai gave a yield of 1548 kgs/rai (9675 kg/ha) after 6 months growing period.

Several major soil deficiencies became apparent at the station, with the main one being sulphur, the application of which has resulted in a threefold increase in pasture yield. The Borabu Demonstration Farm program could be extended to other areas of the Northeast Region. There is an estimated 40-50 million rai unsuitable for farming but suitable for pasture development in the Northeast Region.

Therefore, the potential area for pasture and cattle raising is vast and the future role of cattle a most promising one.

The total costs for establishing grass pastures in new land would be:1/

	Baht/rai	
Clearing first - complete	300	(no trees remain)
Clearing first - partial	150	(big trees remain)
Clearing low shrub	80	
Plowing	60	
Seed bed preparations	12	
Planting material/seed at an approx. rate of 1 kg/rai	75	
Planting	20	
Fertilizer (average)	75	
Total	242	
Plus average clearing	150	
Total	392	
or 2350 baht/hectare ($118)		

1/ Cattle and Buffalo Project - Compac Program, January, 197

TABLE I

RESULTS OF PASTURE PRODUCTIVITY MEASUREMENTS AT BORABU

1970

Pasture	Treatment	Growth Period in months	Dry Matter Yield kg. per Ha.
Comparison 1			
Guinea grass alone	Basal dressing of sulphur	5	3,270
Guinea and perennial stylo	Basal dressing of sulphur	5	7,850
Comparison 2			
Guinea and perennial stylo	Basal dressing of sulphur	4	6,250
Guinea and perennial stylo	plus 30 kg. P/hectare	4	6,230
Comparison 3			
Coastal Bermuda and Annual Stylo	Nil	4	5,430
" "	60 kg. S/ha	4	7,260
" "	60 kg. S/ha plus 90 kg. P/hectare	4	6,230
Comparison 4			
Coastal Bermuda and Annual Stylo	Basal dressing of P and S	4	6,070
" "	ditto + 240 kg. K/hectare	4	5,630
" "	ditto + 480 kg. K/hectare	4	8,550
" "	ditto + 2,400 kg. K/hectare	4	5,110
" "	ditto + 4,800 kg. of lime/hectare	4	4,910
" "	ditto + 480 kg. K/hectare + 2,400 kg. of lime/hectare	4	7,200
" "	ditto + 480 kg. K/ha + 4,800 kg. of lime/ha	4	7,110
Comparison 5			
Coastal Bermuda and Annual Stylo	Basal dressing of P, S, and K	4	8,510
" "	ditto + trace elements except Borax	4	8,680
" "	ditto + trace elements except Copper	4	8,390
" "	ditto + trace elements except Zinc	4	7,250
" "	ditto + trace elements except Molybdenum	4	8,760
" "	ditto + trace elements except Manganese	4	9,850
" "	ditto + trace elements except Magnesium	4	9,510

Source: Kancha Khiri Report, FAO/IBRD. December 1970. Rome

In conclusion, it appears that the best program to follow in developing pastures in the Northeast would be planting a mixture of quince grass and Stylosanthes with some nitrogen and sulphur fertilizer.

4. Feedlot Operations

At present, only cattle in limited numbers would be available for feedlot. However, the local cattle is not suitable for such operations. Therefore, an intensive breeding program should be started with St. Gertrudis cattle or crossings between local cattle and purebred Brahamans. In the future, the Mancha Khiri Project as well as the Chokchai Ranch may be able to supply farmers with good cattle breeds for beef production. These new breeds of feeding cattle would then be kept by the farmers for approximately one year, after which they could be sold to the feedlot operators. The minimum time, therefore, for providing a steady flow of cattle for feedlot operations would be 18 months from the start of an intensive breeding program.

The most important aspect of a feedlot operation, other than having an adequate supply of suitable cattle, is feed grains. To operate efficiently, if feed is not grown, it should be bought at the lowest market price during the year. However, the price of the main grains produced in Thailand fluctuate considerably as show in Table II.

In addition to price fluctuation, the market cost in Thailand of these grains is relatively high. It is essential, therefore, that the feedlot operation grow its own grains.

The feedlot should be installed in the corn belt area. According to the ecological conditions of the area, corn, sorghum, soybeans and other leguminous crops can grow well. Due to the rainfall distribution in some locations, two crops could be obtained. The primary ingredients of the concentrate formula would be corn or sorghum. If prices were too high, broken rice could be used as a grain substitute.

High yields of corn and sorghum have been obtained at the experimental farm at Suwan (National Corn and Sorghum Program, Cooperating the Ministry of Agriculture, Kasetsart University and the Rockefeller Foundation.) These results were as follows:

Table II

Average Wholesale Prices (Bangkok)

in Baht per Kg

	Maize			Sorghum			White rice bran		
	1968	1969	1970	1968	1969	1970	1968	1969	1970
Jan	0.982	1.147	1.137	0.971	1.020	1.096	0.862	0.852	1.195
Feb	0.918	1.130	1.208	0.979	1.025	1.125	0.847	0.848	0.790
March	1.008	1.160	1.197	0.983	1.058	1.144	0.993	0.913	0.845
April	1.058	1.113	1.248	1.013	1.050	1.142	1.778	0.913	0.850
May	1.058	1.205	1.296	1.013	1.025	1.171	1.115	0.950	0.870
June	1.035	1.316	1.241	0.975	1.098	1.138	1.120	0.921	0.892
July	0.985	1.114	1.204	0.892	1.017	1.029	1.152	0.977	0.962
Aug	0.915	0.981	1.213	0.775	0.958	1.054	1.227	1.176	0.946
Sept	0.851	0.958	1.257	0.779	0.846	1.178	1.118	1.163	0.837
Oct	0.842	0.974	1.295	0.792	0.908	1.158	1.046	1.127	0.999
Nov.	0.941	1.072	1.236	0.879	1.004	1.108	1.177	1.336	1.055
Dec	1.053	1.093	1.201	0.998	1.054	1.046	1.089	1.224	0.956

Source: Commercial Intelligence Department

Corn Yield Trials at Farm Suwan 1969

Variety	Grain Yield Kg/Ha	Height of Plant in cms
Cupurico	5957	266
Cupurico x flint Comp (F) CI	5897	271
Veracruz 181 - Antigua Gr 2 x Cuba GvF	5575	264
Cuba Gr. 1 x Cuba 40 (F) CI	5467	269
Guatemala (PB_3) S_1	5412	271
Veracruz 181 - Antigua Gr. 2. PCI	5302	253
Puerto Rico Gr. 1 (S) CI	5276	243
Guatemala PB5	5061	276

Source: Thailand National Corn and Sorghum Program. Annual Reporting Session January 15-16, 1970, Bangkok, Thailand

For sorghums at the same station, the Early Hegari varieties introduced in Thailand by USAID in the late 1940's, offer yields between 4,000 and 5,000 Kgs per hectare.

The late Hegari variety or TSP 750 also offers a good yield potential specially during the off season under irrigation, when it may yield 5,000-6,000 kgs per hectare. Some lines of open - pollinated varieties gave experimental yield of 4,000-5,000 kgs. per hectare.

The corn silage yields could vary between 25 and 30 tons per hectare. The government is taking action for an intensive program for soybean production, to improve yields and expand to new areas. Several experiment stations are working on variety improvement and adaptation of foreign varieties. At present, a multiplication program of varieties SJI for rainy season and SJ2 for dry season, are giving good results. The original varieties from Taiwan were yielding 200-250 kgs per rai.

Seed multiplication with irrigation gave 300-400 kg per rai and 20-21 percent oil content, according to Dr. Arwooth. It is expected that in the near future with good varieties and technology yields more than 2,000 kg per hectare can be reached.

A model unit farming area of 300 hectares has been assumed in order to estimate the cost of feed grain production. Several of these units will be combined to obtain the necessary amounts of feed for a 2,000 head feedlot operation.

The necessary hectares to grow the grains and silage for such a feedlot operation would be:

	Yield/hectare	Necessary hectares
Silage	30 tons	373
Corn	4 tons	1199
Soybean	2 tons	423

Therefore, a total of 1,200 hectares is necessary consisting of four units of 300 hectares, each with a double cropping pattern. Some hectares would be available for mung beans or other leguminous plants that can be used as a protein rich hay.

On the basis of the yields mentioned above, some calculations have been made to obtain the cost of grain and silage on mechanized farming operations. (See Table IV, V, VI.) Assuming that one or two crops are harvested per year in the same field, the following figures were obtained:

	Assumed Yield/Ha	1 Crop per year Baht/Kg	2 Crops per year Baht/Kg
Maize	4000 kg	0.85	0.58
Soybeans	2000	1.60	1.07
Maize Silage	30 tons	0.104	0.073

These costs can only be reached when a high productivity (high yield per hectare) is achieved. With traditional agriculture these high yields are very hard if not impossible to obtain. Therefore, mechanized agriculture is required for a feedlot operation to be feasible.

An approximate investment of 13 million baht would be necessary to buy the land plus the equipment for such an operation.

A. Feedlot Location

The location of a commercial feedlot in a certain area requires careful analysis of the advantages and disadvantages of alternative sites. The main criteria that should be considered are:

I. Supply of cattle from breeding areas.
II. Nearness to a feed grain production area.
III. Proximity of a feed mill plant in case one is not included in the feedlot.
IV. Proximity to a trading center or a slaughterhouse.
V. Adequate transportation facilities.
VI. Availability of labor force, technical services (veterinary, nutritionist, animal husbandry adviser, etc.), power, water, sewage and other facilities which are essential for a feedlot operation.

It must be emphasized that weather conditions (drought years) in some areas have a definite effect on the cattle industry, causing much instability both in the size of the breeding herd and the supply of cattle for the feedlot.

B. Size of Operation

Commercial feedlot vary in sizes ranging from a hundred to several thousand head.

According to the economies of scale studies in other countries, where feedlots are used continuously during the year, approximately 75 percent of the costs savings per kg. of gain liveweight associated with scale are reached with a 2000 head feedlot, with practically none achieved in feedlot exceeding 5000 head.1/

There are advantages, however, which accrue to feedlots of a larger capacity. One advantage is that a large feedlot is able to employ high quality management, which is considered essential for an efficient operation.

The more uniform the utilization is during the year, the more efficient and economical the operation will be.

Much emphasis has to be placed on an educational program to get farmers to supply cattle to the feedlot on a year round basis rather than seasonally. As farmers can be supplied with good breeds, perhaps by a specialized breeding ranch like Chokchai ranch, a timing schedule should be organized in order to supply young heifers and steers for fattening at the feedlot at certain periods of the year. Substantial savings could be reached with good management and organization.

1/ Beef Cattle Feedlots in Oregon, Special Report No. 170. Agricultural Experiment Station - Oregon State University and U.S. Department of Agriculture. Washington D.C. March, 1964.

The following assumptions have been made for calculating the cost of feedlot operations:

- young cattle (steers) will be transported from breeding areas, located in Mancha Khiri, Chokchai ranch and other areas.

- soybeans, sorghum, and maize (grain and forage) will be grown in the area.

- a conversion ratio of 8.5:1 would be reached in the near future.

- feeder steers from selected breeds can start at 250 kgs and be slaughtered or sold at 436 kgs. after 150 days in the feedlot area with an average daily gain of 1.24 kg. Losses from death are included in this figure.

Feeding of the steers is the most important item of this operation. Other costs might vary according to location and management of each feedlot. The nonfeed costs include investment costs, labor and management costs, clerical and office expenses, death losses, licenses and taxes.

Considering that in the future several of these operations will take place, economies of scale will effect the price structure considerably.

One of the main investments will be in mechanized equipment to prepare the feed rations and systems for distribution. If several of these feedlot operations will take place in the future in a rather close area, a general feedmill should be installed. Therefore, the fixed capital cost per feedlot could be reduced.

Some of the facilities required for a feedlot operation can be summarized as follows:

A. PENS

1. Feedpens
2. Sorting and handling pens
3. Hospital pens

B. ALLEYS

1. Drive alleys
2. Feed alleys
3. Sorting and working alleys

C. FEED PROCESSING

1. Milling
2. Mixing
3. Storage of different feeds
4. Distribution equipment for feed

D. OTHER FACILITIES

1. Watering facility
2. Sheds (cattle working area and hospital (one))
3. Scales
4. Loading zone
5. Squeeze chute
6. Spraying system for pesticides
7. Fence enclosing the entire lot

E. MANAGEMENT

1. Offices
2. Housing
3. Workshop and equipment storage

Since it rains heavily for several months, good drainage is required. The pens should be as dry as possible. This can be accomplished by mounding with wood chips, straw, sand, gravel or similar materials. Also, simple sheds with bamboo and palm leaves or any other construction type can be provided. In every specific case the proper alternative should be chosen. The drainage should be designed in such a way that excess water could be carried out of the pens and away from the entire lot. In some cases, it would be cheaper to mound in one section of the pen rather than depending upon drainage entirely. Slopes of 3 percent to 5 percent are recommended.

The pen layout will depend on the feeding methods used, the loafing space adopted and bunk space per animal, land availability, livestock handling facilities, etc.

For feed distribution purposes, pens will be arranged so groups of animals of the same size, weight, and age will be together. An example of this distribution can be seen in the enclosed figure. Pens for 50, 100, 200 and sometimes 500 head of cattle are used in some large feedlot operations.

Space about the loafing also varies. It is generally recommended to have 16 to 21 m^2 for each animal. In areas where the land costs are low, even larger areas would be advisable. The two factors determining the size of the loafing space per animal are the cost of land and the pens' construction costs.

Feed bunk or manger space per head also varies. An average 40 cms per head is recommended. If large amounts of roughage are distributed, which will be the case in the project area at some periods of the feeding season, larger manger space is necessary. As an example, in the pens with an age group that should receive more roughage, the head bunk space should be 45 cms, but in pens where more grain and concentrates are distributed, 37 to 38 cms would be sufficient. For calculation purposes, an average of 40 cms will be adopted.

For a 2,000 head feedlot model, 6 hectares of land are needed and approximately 2,000 to 3,000 m of fencing for the general lot and pen spaces. About forty gates would be necessary as well as corrals or spaces where the animals can be worked and sorted with dimensions of 55 x 30 mts. The hospital area would require 20 x 30 mts. Six hectares will be for feedlots only. Facilities for storage space, preparation rooms for milling and mixing feed, silos and housing, are also necessary. Therefore, 10 hectares of land is required.

Water supply is necessary, although the water can be pumped from rivers or wells in the area. It is assumed that the water table might be very close to surface in some areas and wells yield pure water.

Facilities are necessary for feed processing and storage for a two month supply of concentrates. Mills, (roller, hammer or other types) would be required for processing some feed grains as well as special mixers for ingredients used in small quantities like trace minerals and vitamins and molasses.

The overall processing plant, with all the necessary machinery is estimated to cost 1,300,000 baht (US $65,000). This includes storage for about 800 tons of grains and other concentrates. The useful life of the processing plant is 10 years.

It is assumed that an average 10.5 kgs of feed per day per head will be consumed. Therefore, 21 tons of feed would be handled everyday. It is not likely that the feedlot will always be filled to capacity. If it is assumed that it would be filled to 90 percent of its capacity, then 18.9 tons would be handled. The feedmill would have to operate from four to five hours a day.

If proper sanitary conditions are established, e.g. weekly pesticide sprays with Gammatix or another pesticide, clean water supply, etc., the death rate should not be more than 1 percent. (The average daily gain of 1.24 kgs assumed includes the death rate and sick animals.)

Assuming that 90 percent of the feedlot capacity will be used, 1,800 heads will be fed in 150 days or 4,380 heads per year for a turnover of 2.43. This will be an average for several years operation. Since only 3,600 head will be finished in the first year, it has been assumed that an average gain of 186 kgs/head will be produced in 150 days of feeding. In future years, an average of 4,380 head will be fed per year yielding a total gain of 814,680 kgs.

C. Formulas

To operate a feedlot system efficiently, it is necessary to develop a low cost feed formula. This requires mixing ingredients that contain the necessary carbohydrates, proteins, vitamins and minerals that cattle require for fattening. Although there are many "formulas", the general approach used in this model are discussed below.

a.) Grains

In Thailand these generally consist of maize, sorghum and white rice bean. However, since prices of these grains vary greatly throughout the year (see Table II), they must be bought during the low price period and stored.

b.) Proteins

Protein feeds are also available at the Thai market. Oilseed cakes are the most important ones, followed by copra cake, soybean cake, groundnut cake and cottonseed cake. Table III shows the price of protein ingredients found in Thailand.

TABLE III

Average Yearly Prices for Protein Ingredients

(in Baht per Kg)

	1967	1968	1969	1970
Copra cake	2.177	2.250	2.250	-
Soybean cake	1.840	2.070	2.169	2.250
Groundnut cake	2.002	2.096	2.069	2.105
Cotton seed	-	-	1.300	1.363

Source: Commercial Intelligence Department

c.) Vitamins & Minerals

Vitamins and minerals are used in the formula since they may be procured locally. However, they are a minor item.

In order to have a figure for calculating the cost of the operations, the three following formulas are from Morrison II[1/] adjusted to the main foodstuffs that will be available in the area.

Formulas for Daily Beef Fattening Rations in Kgs

	A	B	C
Corn silage or sorghum silage	9	11.25	13.50
Corn or sorghum grain, ground	5.85	6.30	6.30
Soybean meal	0.7-0.8	0.23	0.67
Soybean or cowpea hay	-	1.80	-
Limestone	0.045	-	0.045

Soybean meal and ground sorghum grain, or corn are considered supplements. Also, rice bran could be used in formulations. The pre-mix formulation that contains vitamins, minerals, antibiotics, etc. is mixed with the supplement. The amount of pre-mix used varies according to the formulation adopted. An average concentrate pre-mix is assumed; it will be mixed with the supplement, in approximately one kg per ton of supplement.

The average formula adopted for the sake of calculations costs, assuming that the daily average intake is 10.53 kg per head of concentrate feed will be:

Corn silage	7	Kgs
Corn grain	3	"
Soybean meal	0.53	"
	10.53	Kgs

If corn and silage are produced on the farm, the estimated values per kg of silage are 0.104 baht/kg and per kg. of corn 0.84 baht/kg. Soybean meal, produced on the farm would cost about 1.60 baht/kg. See Tables IV, V, and VI. If not available, any protein equivalent amount of copra cake or groundnut cake could be used.

Current prices in the Bangkok market for the two products in May 1971 are for groundnut cake 2.20 baht/kg. Prices for copra cake 1.10 baht/kg.

1/ Feeds and Feeding. Frank B. Morrison. The Morrison Publishing Co., Ithaca, New York 1957.

An estimated price for soybean cake of 2.10 would be acceptable in the area. Therefore, the proposed formula would have an estimated cost of:

Corn or sorghum for silage 7 kg x 0.104 ฿/kg	= 0.73	Baht
Corn or sorghum ground grains 3 kg x 0.85 ฿/kg	= 2.55	"
Soybean meal or cakes 0.53 kg x 1.60 ฿/kg	= 0.85	Baht
Price for 10.53 kg	= 4.13	
Price per kg	= 0.392	Baht

List of Raw Materials Available in Thailand

for a Livestock Feeding Program

(Prices in May 1971)

	Price Baht/Kg		Price Baht/Kg
Groundnut cake	2.20	Grude bran	0.24
India cake	2.15	Fresh water fish	1.80
Yellow bean cake	2.50	Africa fish	5.75
Black bean cake	2.30	Shrimp shell	1.10
Black bean	2.30	Kratin powder	1.10
Soybean	2.50	Bones	1.10
Corn	1.50	Oyster shell	0.33
Broken rice	0.75	Ground limestones	0.18
Broken cargo rice	0.73	Calcium	2.10
Broken glutinous	0.70	Dry yeast	2.00
Paddy	0.77	Coconut cake	1.10
Glutinous paddy	0.75	Flour	0.75
Rice bran	0.45	Crab shell	1.00
White bran	0.50	Fish oil	3.00
Molasses	0.30	Powder milk	10.00

D. Manure Production

The feedlot operation can supply a certain amount of manure that should be distributed in the nearby fields since most agricultural soils in rainy tropical countries are severely leached out of some mineral compounds. The essential compounds, nitrogen, phosphorus and potassium, as well as organic matter can reach very low levels that evidently are responsible in most cases for very low yield crops. Manure can replace such elements and supply most of the organic materials in a depleted soil.

In a feedlot operation, some 7-8 tons per head of cattle per year can be produced.

The average composition of manure obtained in feedlots, according to Morrison (1957), has the following composition per ton:

Water	78%
Nitrogen	6.6 Kgs
Phosphorus	1.9
Potassium	9.2

plus several other trade elements and growth factors. To have an estimate of the value of manure, since the prices in the area could not be found, a rough calculation was made taking into consideration the average international price of nitrogen 3.59 baht/kg., phosphorus 4.0 baht/kg., and potassium 2.43 baht/kg. The value of manure should then be 53.64 baht/ton. Therefore, in the feedlot operation, with 4,380 steers per year, 8 tons of manure per head would result in a profit of 1,879,896 baht or $90,380.

5. Investment, Operational Costs and Returns

a. Fixed capital

The estimated investment cost is presented in Table VII. This investment assumes that the land purchased has already been cleared. An average price of the land of 1,000 baht per rai has been considered.

The construction requirements for the feedlot have been specified in paragraph 6. Since wood is available at reasonable prices in most places of the corn belt area, wood construction will have preference except poles for fencing and feed bunks that should be built of concrete. An average life of 25 years for buildings and construction has been adopted for depreciation purposes.

Equipment includes scales, water pump, tractor and loader, feeding equipment, manure handling equipment, and a pick-up truck that will also be used by the manager. The larger investments in equipment is for milling machines, mixers, pelleting, loading chutes, etc. The average life in equipment has been calculated at 7 years. When cattle are sold, a reinvestment in another new herd of 1,800 heads would be made. Annual turnover would be 2.43. Interest of 12 percent has been used as it is the current one prevailing at the Banks in Thailand.

b. Operational Costs

The calculated costs included in Table VIII, IX and X are based upon the model specifications already outlined and the present operational climate in Thailand. The costs and prices, except where indicated otherwise, are those which now prevail in Thailand.

The operational costs have been segregated into their fixed and variable components. Uncertainties exist with respect to prices of several critical factors concerning the feedlot operation. As explained above, the purchase of feed at reasonable prices is very important. Therefore, the main ingredients should be produced by the same organization that owns the feedlot. (Grains and silage.) With such a scheme, a consistency in feed prices would be assured.

Operating costs for such a venture have also been included in order to know the prices of such feed ingredients as grains and silage.

c. Salaries and Wages

Salaries and wages amounting to a total of 623,040 baht annually cover the services of the following personnel at the rates indicated in the Tables VIII, IX and X: a manager, an accountant-assistant manager, animal husbandry technician, veterinarian (4 months only), a clerk, a storekeeper, a mechanic, a tractor driver, 2 pick-up drivers, and 2 guards during the night, an equipment operator for the feed mill, a feeder, foreman and 12 laborers.

d. Utilities and Supplies

Power either bought or installed would be necessary for the feed mill equipment. Also, fuel would be necessary for operating the tractor and trucks. For utilities (electricity and fuel), an approximate figure of 43,000 baht per year has been assumed on the basis of past experience with other feedlot operations of the same size.

Supplies include vaccines and pre-mixes with vitamins, minerals, antibiotics and antiparasites, as well as molasses, fish meal, and other protein concentrates. Miscellaneous items of 20% will cover all other expenses like roughage (hay, rice straw, corn stover etc.).

e. Feed Costs and Price Structure

As can be seen in Tables IV, V and VI, cost calculations for growing crops have been included.

The costs for maize, soybeans and maize silage per one or two crops would be:

	Yield	1 crop	2 crops
Maize for silage	30 Tons	0.104 ฿/Kg	0.073 ฿/Kg
Maize for grain	4 "	0.85 "	0.58 "
Soybeans	2 Tons	1.60 ฿/Kg	1.07 ฿/Kg

In the inputs, fertilizers as well as pesticides and herbicides have been overestimated, considering that future world market prices will increase. Also taxes, licenses and insurance will be only 50% of the total cost per this item where two crops are considered.

f. Fixed Operational Cost

The total amount would be 1,105,414 baht, and per day 3,028.53 baht. Therefore, the fixed cost per 150 days would be 454,279. Since 1,800 head are fed in 150 days, the fixed cost per head would be 252.37 baht.

g. Variable Operational Cost

The total amount would be 2,962,216 baht of which 266,040 baht are wages, utilities and supplies and 2,696,176 baht for feed costs (one crop prices). The feed cost for two crop prices is: 1,829,548 baht. The per day costs are:

Wages, utilities and supplies:	728.88 Baht
Feed cost (one crop prices)	7386.78 "
Feed cost (two crop prices)	5012.46 Baht

Since 1,800 heads are fed in 150 days, the wages, utilities and supplies would be: 60.74 baht per head fed in 150 days.

The feed cost (one crop prices)	:	615.56 baht per head fed
The feed cost (two crop prices)	:	418.91 baht per head fed

Total variable cost per head fed:

For one crop prices	:	676.30 Baht
For two crop prices	:	479.65 Baht

To these amounts, the cattle ownership of 1,500 baht/head should be added.

h. Total Operational Costs

The total operational costs per year including cattle ownership would be 10,637,630 baht (one crop price). The total operational cost per head fed would be:

	With one Crop price	With two Crop prices
Total fixed costs	252.37	252.37
Variable costs:		
Wages, Utilities and supplies	60.74	60.74
Feed Costs	615.56	418.91
Cattle ownership	1500.00	1500.00
Total operational costs	2428.67	2232.00
Six months working capital interest (12%)	145.72	133.92
Total operating costs per head	2574.40	2365.95

i. Returns

Meat cattle prices at the Bangkok market are set by Municipal regulations at 12 baht/kg. although prevailing illegal slaughtering might have lower prices. Most of the cattle slaughtered are old animals with very poor quality meat.

It is expected that higher prices could be obtained from cattle from feedlot operations, since premium quality meat could be sold.

The Hong Kong market imports about 200,000 heads of cattle per year. The average live weight price is U.S.$ 0.7 per kg. or 14.56 ฿/kg. Charges for handling and shipment from Bangkok seaport to Hong Kong are U.S.$ 27 per head or 562 baht per head. The average transportation cost from a distance of 160 kms to Bangkok is approximately 67 baht per head or with an assumed 436 kgs. liveweight animals 0.15 ฿/kg.

1. Export Market

	Feed Price A	Feed Price B
Cost per head	2574.40	2365.95
At selling price Hong Kong Market @14.56 per kg. (Av. 436 Kg/head)	6348.00	6348.00
Less shipment cost @US$27 per head	562.00	562.00
Less transportation cost from Ranch to Bangkok seaport	67.00	67.00
Total selling price	5719.00	5719.00
Gross profit	3144.60	3353.05
Benefit cost ratio	1.22	1.42

The 14.56 baht price was the average wholesale price at the Hong Kong Market for 1970. More recent quotations showed a rising price of 18.56 baht/kg liveweight for unfattened animals. Therefore, the total selling price would be 8,092.16.

Less transportation and shipment costs of 7,463.16,

	Feed Price A	Feed Price B
Cost per head	2574.40 Baht	2365.95 Baht
Selling price	7463.16 "	7463.16 "
Gross profit	4888.76 Baht	5097.20 Baht
Benefit cost ratio	1.90	2.15

2. At Bangkok Market

	Feed Price A	Feed Price B
Cost per head	2574.40 Baht	2365.95 Baht
Selling price @ 12 baht per kg liveweight at ranch gate	5232.00 "	5232.00 "
Gross profit	2657.6 Baht	2866.05 Baht
Benefit cost ratio	1.03	1.21

See in Table XI and in the graph the benefit-cost ratio variations where selling prices and feed cost varies.

To the returns, manure as a marketable by-product should be added. According to paragraph D, the theoretical calculated value of the manure produced by the feedlot, considering nitrogen, phosphorus and potassium, are evaluated at international prices of 1,879,896 baht or 429 baht per head.

Table IV

MAIZE - FULLY MECHANIZED COST PER HECTARE FOR 300 HECTARE ESTIMATED YIELD 4000 KGS/HA

Operation	Hours labor per Hectare	Cost of labor at 6 Bht per hour	Fuel and repairs	Materials	Costs	Totals
ltural costs						
owing	1.23	7.38	25			32.38
rtilizing	0.62	3.72	9	110 kg N. Fertilizer	211	223.72
tavating	2.27	13.62	27			40.62
anting and fertilize	1.25	7.5	28	25 kg seed at at 4 R/Kg	100	135.50
				46 Kg Fert. N and P	87	87.00
ltivating	1.66	9.96	19			28.96
st control	0.50	3.00	6	1.5 kg Aldrin	200	209.00
ed control	0.50	3.00	6	1.1 kg 2.4 -D	44	53.00
tal cultural costs		48.18	120		642	810.18
rvesting costs						
mbine	1.33	7.98	41			48.98
uling	3.36	20.16	24			44.16
ying	0.75	4.50	68			72.50
tal harvesting costs		32.64	133			165.64
tal operation costs						975.82
sh overhead						
iscellaneous 5% total						48.79
xes, license, insurance 20%						195.16
tal cash overhead						243.95
tal cash cost						1219.77
nagement, 5% of 4000 kgs at 0.85 baht/kg.						170.00
tal cost						1389.77

Investment	Per hectare	Annual cost	
		Depreciation	Interest 12%
nd	6250		750
uipment	4771	681	572
tals	11021	681	1322

	1 Crop/year	2 Crops/year
tal cash cost	1219.77	2439.54
epreciation plus interest 12%	2003.00	2003.00
nagement	170.00	232.00
tal cost	3392.77	4674.54
stimated yield/hectare	4000 Kgs	8000 Kgs
rice baht per kg.	0.85	0.58

Table V

SOYBEANS – FULLY MECHANIZED COST PER HECTARE FOR 300 HECTARES ESTIMATED YIELD 2000 KGS/HECTARES

Operation	Hours Labor per hectare	Cost of Labor at 6 baht per hour	Fuel and Repairs	Materials	Costs	Total
Cultural costs						
Plowing	1.23	7.38	25			32.38
Fertilizing	0.62	3.72	9	50 kg NPK @ 3฿	150	162.72
Rotavating	2.27	13.62	27			40.62
Inocculation	2.00	12.00		1 kg inocculum	110	122.00
Planting	1.25	7.50	28	30 kg of Seed @ 4 baht	120	155.50
Cultivating	1.66	9.96	19			28.96
Pest control	0.50	3.00	6	1 kg pesticide	150.80	114.80
Weed control	0.50	3.00	6	1,1 kg 2,4 - D	44.00	53.00
Total cultural costs		60.18	120		529.80	709.98
Harvesting costs						
Combine	1.53	9.18	54.53			63.71
Hauling	1.68	10.08	12.22			22.30
Drying	0.38	2.28	34.44			36.72
Total harvesting costs		21.54	101.19			122.73
Total operation costs						832.71
Cash overhead						
Miscellaneous 5% total						41.63
Taxes, license, insurance 20%						166.54
Total cash overhead						208.17
Total cash cost						1040.88
Management, 5% of 2000 kgs at 1.60 baht/kg						160
Total cost						1200.88

Investment	Per Hectare	Annual cost	
		Depreciation	Interest 12%
Land	6250		750
Equipment	4771	681	572
Totals	11021	681	1322

	1 Crop/year	2 Crops/year
Total cash cost	1040.88	2081.76
Depreciation and interest 12%	2003.00	2003.00
Management	160.00	215.00
Total cost	3203.88	4299.76
Estimated yield kgs/hectare	2000	4000
Price Baht per Kg.	1.60	1.07

Table VI

AIZE FOR SILAGE, COST PER HECTARE FOR 300 HECTARES, ESTIMATED YIELD 30 TONS

Operation	Hours labor per Hectare	Cost of labor at 6 [illegible] per hour	Fuel and repair	Materials	Costs	Totals
Cultural costs						
Plowing	1.23	7.38	25			32.38
Fertilizing	0.62	3.72	9	110 kg N Fertilizer	211	223.72
Rotavating	2.27	13.62	27			40.62
Planting and fertilize	1.25	7.5	28	25 kg seed at 4 baht/kg	100	135.50
				46 kg Fst NP	87	87.00
Cultivating	1.66	9.96	19			28.96
Pest control	0.50	3.00	6	1.5 kg pesticide	200	209.00
Weed control	0.50	3.00	6	1.1 kg 2.4.D.	44	53.00
Total cultural costs		48.18	120		642	810.18
Harvesting costs						
Harvester, choper	1.33	7.98	23			30.98
Hauling	6.50	39.00	48			87.00
To silo (Loading)	2.50	15.00	13			28.00
Total harvesting costs		61.98	84			145.98
Cash Overhead						
Miscellaneous 5% total						47.80
Taxes license insurance 20%						191.23
Total cash overhead						239.03
Total cash cost						1195.19
Management, 5% of 30 tons @ 104 baht/ton						156.00
Total cost						1351.19

Investment	Per Hectare	Annual Cost	
		Depreciation	Interest 12%
Land	6250		750
Equipment (7 year)	3878	554	465
Totals	10128	554	1215

	1 Crop/year	2 Crops/year
Depreciation plus interest	1769.00	1769.00
Total cash cost	1195.19	2390.38
Management	156.00	219.00
Total cost	3120.19	4378.38
Estimated Yield per hectare	30 tons	60 tons
Price per kg.	0.104	0.073

Table VII

TOTAL INVESTMENT FOR A FEEDLOT OPERATION FOR 2000 HEAD

(Operating at 90% capacity or 1800 head)

		Fixed Capital Costs	Baht	Total Baht
A		Cost of Land		
	1	10 hectares of Cleared land @ 6250 baht	62,500	
	2	Title clearance 1% of above	625	
		Subtotal A		63,125
B		Buildings and Construction		
	1	Grading and filling	12,000	
	2	Housing and Offices	160,000	
	3	Silos for grains (800 Tons)	385,000	
	4	Silage Trenches (2000 Tons)	30,000	
	5	Warehouse and milling (25 x 50 ms)	200,000	
	6	Feed bunks and other concrete	210,000	
	7	Feedlot fence	80,000	
	8	Working corrals	43,000	
	9	Hospital area	25,000	
	10	Water storage tank (10 x 16 x 2)	48,000	
	11	Pump house	18,000	
	12	Piping 2000 ms @ 30 baht/m.	60,000	
	13	Miscellaneous facilities 10% of above	127,100	
		Subtotal B		1,398,100
C		Equipment		
	1	Scales	100,000	
	2	Mills, Mixers, Pelleting, Loading chutes, etc.	500,000	
	3	Waterpump	15,000	
	4	Tractor and loader	180,000	
	5	Feeding equipment	200,000	
	6	Manure handling equipment	100,000	
	7	Pickup truck	80,000	
	8	Miscellaneous equipment 10% of above	117,500	
		Subtotal C		1,292,500
		Total Capital Feedlot Requirements		2,753,725
D		Depreciation and Interest		
		Depreciation:		
		Buildings 25 years	55,924	
		Equipment AV: 7 years	184,643	
		Interest Capital 12%	330,447	

Table VIII

Fixed Feedlot Operating Costs Per Year

	Fixed Costs	Baht	Total Baht
A	Salaries		
1	General Manager	360,000	
2	Animal husbandry technitian @ 2500 Bht/month	30,000	
3	Veterinarian 4 month/year @ 6000 Bht/month	24,000	
4	Accountant @ 2000 Bht/month	24,000	
5	Storekeeper @ 1200 Bht/month	14,400	
6	Mechanic @ 1000 Bht/month	12,000	
7	2 Guards @ 500 Bht/month	12,000	
8	1 Tractor driver @ 1200 Bht/month	14,400	
9	Clerk @ 1000 Bht/month	12,000	
10	2 Pickup drivers @ 900 Bht/month	21,600	
	Subtotal Salaries		524,400
B	Utilities and Supplies		
1	Telephone, Mail, Office Supplies, etc.	10,000	
	Subtotal B		10,000
C	Depreciation and Interest		
	Depreciation:		
	Buildings : 25 years	55,924	
	Equipment : 7 years	184,643	
	Interest capital 12%	330,447	
	Subtotal C		571,014
	Total Fixed Costs		1,105,414

Table IX

Variable Feedlot Operating Costs Per Year

2		Variable Costs	Baht	Total Baht
A		Wages		
	1	12 Laborers @ 360 baht/month	51,840	
	2	1 Foreman @ 1,000 baht/month	12,000	
	3	1 Equipment operator @ 900 baht/month	10,800	
	4	1 Feeder @ 2,000 baht/month	24,000	
		Subtotal A		98,640
B		Utilities		
	1	Electricity, Fuel, etc.	43,000	
		Subtotal B		43,000
C		Supplies		
	1	Vaccines, Medicines, etc.	42,000	
	2	800 Kgs Pre-mix (Vitamines, minerals)	65,000	
	3	Miscellaneous 20% of above	17,400	
		Subtotal C		124,400
		Total wages, utilities and supplies		266,040
D		Feed		
	1	Average feed cost 6,898 Tons @ 392 ฿/ton	2,696,176	
		Subtotal D		2,696,176
		Total Variable Costs		2,962,216
E		Cattle Ownership		
		4,380 heads @ 1,500	6,570,000	
		Total variable costs		9,532,216
		Total fixed costs		1,105,414
		Total operating costs		10,637,630
		Cost per head (4,380 heads)		2,428.68
		Six month interest (12%) working capital		145.72
		Total costs		2,574.40
		At selling price Hongkong market 14.56 ฿/Kg	6,348	
		Less shipment cost @ 27 US$/head (562 ฿/head)	562	
		Total selling price	5,786	
		Gross profit	3,211.60	
		Benefit cost ratio	1.24	
		At selling price Bangkok market 12 ฿/kg	5,232	
		Gross profit	2,804	
		Benefit cost ratio	1.03	

Table X

Feedlot Variable Costs
With Two Crops

Variable Costs Considering a Two Cropping Pattern for Feed Production	Baht	Total Baht
Wages, Utilities and Supplies	266,040	
Feed Average feed cost @ 266 ฿/Ton, 6898 Ton	1,834,868	
Cattle Ownership 4,380 heads @ 1,500 ฿/head	6,570,000	
Total variable costs		8,670,908
Total fixed costs		1,105,414
Total operating costs		9,776,322
Cost per head (4,380 head per year)		2,232.03
Six month interest (12%) working capital		133.92
Total cost per head		2,365.95
At selling price Hongkong market @ 14.56 ฿/Kg (Average weight 436 Kgs/head)		6,348.00
Less shipment cost @ US$ 27/head		562
Less transportation cost from Ranch to Bangkok		67
Total selling price		5,719
Gross profit		3,353.05
Benefit cost ratio		1.42

Table XI

BENEFIT COST RATIO AT DIFFERENT
Selling Prices and Feed Costs

Selling price per kg liveweight in Baht:	8	10	12	14	16	18	20
Benefit Cost Ratio with Feed Cost at 392 Baht/Ton							
Cost per head	2574.4	2574.4	2574.4	2574.4	2574.4	2574.4	2574.4
Selling price per head (436 kg)	3488	4360	5232	6104	6976	7848	8720
Gross profit	913.6	1785.6	2657.6	3529.6	4401.6	5273.6	6145.6
Benefit cost ratio	0.35	0.69	1.03	1.37	1.71	2.05	2.39
Benefit Cost Ratio with Feed Cost at 266 Baht/Ton							
Cost per head	2366	2366	2366	2366	2366	2366	2366
Selling price per head (436 Kg)	3488	4360	5232	6104	6979	7848	8720
Gross profit	1122	1994	2866	3738	4613	5482	6354
Benefit cost ratio	0.47	0.84	1.21	1.58	1.95	2.32	2.69
Benefit Cost Ratio with Feed Cost(1) at 752 Baht/Ton							
Cost per head	2745	2745	2745	2745	2745	2745	2745
Selling price per head (436 Kg)	3488	4360	5232	6104	6979	7848	8720
Gross profit	743	1615	2487	3359	4234	5103	5975
Benefit cost ratio	0.27	0.58	0.91	1.22	1.54	1.86	2.18

(1) With feed market prices per kg. at: Silage 0.30 Baht, Corn 1.50 Baht and Soybean 2.50 Baht using the formula for calculation proposes silage 7 kg, corn 3 kg and soybean 0.53 kg.

B. FEED MILL

1. Introduction

For a rational livestock development in the Northeast Region where pastures are very scarce, feed mills can play a very important role.

The establishment of a feed mill should encourage economic development in the area by providing an expanded outlet for locally produced grain and allowing maximum development of a future soybean expansion program by providing the proposed local soybean processing industry a market for its main by-product, soybean cake.

With the establishment of such a plant, development of cattle feedlots and hogs and poultry farms will be encouraged.

The nutritional balance that can be obtained with feed formulation plays an important role in livestock development in many areas of the world and processed feeds have been proven to be well worth their costs.

It is the purpose of this study to determine the economic parameters for the feasibility of a proposed feed mill manufacturing plant. This simulated model could be applied in the future to several areas in the Northeast where cattle development schemes look most promising.

In the design of the feedlot operation already included in this report a small feed mill was included. If several feedlots can be established in a certain area, a feed mill could be substituted for the equipment that a feedlot should have thus offering substantial savings per feedlot.

A feed mill could operate more efficiently if a different formula could be supplied for hogs and poultry farms where benefit margins are larger than for cattle, due to their higher conversion ratio.

For the present simulated model, the Korat area has been chosen since it is located in the corn belt area, has livestock available, and has good transportation facilities to Bangkok.

2. Potential Livestock Availability in the Korat Area

A minimum processing tonnage would be required to install a feed mill plant. According to economies of scale, it would be advisable to build a feed mill with a minimum economic operating capacity of 10 tons/hours.

As can be seen in Table I, the totals for 1970 show there are sufficient livestock in the area to support a demand for the production of a feed mill plant, even assuming that only 10% of animals are using formula feed.

TABLE XII

The Estimated Minimum Average Demand for Formula Feed in Korat

Type of Livestock	Number in 1970	Rate of feeding kg/head/year	Total T
Cattle	248,175	200	49,6
Swine	127,538	900	114,7
Poultry (i)	1,953,360	15	29,2
		Total	193,7

(i) Broiler fattening Av. 3 kg for every 10 weeks.

The following assumptions are considered:

a. Cattle : Only 10% of the above figures are steers that should be fed during a three month period when pastures or roughage are not available in the area. Therefore, the expected consumption is 4,963 tons.

b. Swine : For fattening purposes a conservative figure of 10% has been assumed. The total consumption would be 11,478 tons.

c. Poultry : Although in the Korat area the growth rate is declining in recent years, farmers with proper training and support could start installing several poultry farms, since this type of operation has been successful in oth countries. Due to the high conversion ratio of poultry (2.5:1) it would be the cheapest meat that a large sector of the local popula tion could consume, and would supply the necessary protein supplement in their diet. Assuming a 10% figure would be 2,929 tons.

It should be pointed out that the neighboring changwats can also offer good possibilities for marketing formula feed. The demand for future years will depend upon the expansion in livestock in the area and changes in feeding practices such as increased reliance upon processed feed for livestock.

3. Plant Description and Requirement

a. Plant Size

The total expected demand would be 19.317 tons (say 20,000 tons). Assuming a 10 ton/hour processing capacity, an 8 hour shift, and 300 working days per year, the total plant capacity would be 24,000 tons per year. Therefore, the plant can start with an 83.3% capacity.

b. Plant Location

The city of Korat has all the necessary utilities, labor and communications required for building such a facility.

c. Type of Operation

In the feed mill industry there are a great variety of formulations that can be processed to specific livestock requirements. The feed can be prepared in different forms, i.e., mashed, pelleted, granulated, blocks, bagged or bulk.

Several models are designed according to specific requirements. In this analysis, a general model has been assumed considering that pelleting will be the main type of operation performed and that all the processed feed will be bagged.

d. Equipment Required

The equipment necessary to perform the following operations are:

(i) Receiving Equipment: - Includes conveyors, bucket elevators, cleaning, weighing and other equipment for handling incoming ingredients from the receiving point to the storage bins.

(ii) Grinding Equipment: - Includes conveyors to move grain from storage to the hammermills, and pneumatic conveyors for moving the ground material to the work bins. Distributor turnheads and conveyors located on the bin floor direct and convey the material into the proper work bins.

(iii) Mixing Equipment: - Consists of feeder conveyors, hoppers, horizontal mixers and weighing and mixing control devices.

(iv) Pelleting Equipment: - Two pellet mills, with pellet coolers, crumblers, graders, conveyors and other miscellaneous equipment for such operations.

(v) Boiler: - Most of the steam used is for pelleting purposes. A 60 HP boiler has been assumed. The boiler is high pressure in order to obtain the maximum amount of steam with the correct amount of moisture.

(vi) Miscellaneous Equipment: - Air compressor, remote motor controls for the entire mill, automatic devices, panel control, etc.

e. Buildings

A warehouse for a two month production storage capacity is required. Also, storage bins for grains, office and laboratory building. The plant for equipment will use a gravity flow method, and should be three floors (6 x 18 x 25 mt high. The plant building should be designed to provide for future expansion. Finished products storage has also been included. The first and second floors would include the heaviest equipment, hammer mills and pelleting equipment. The mixing panel board, the scale hopper, the scale and the packing equipment will also be located on the second floor. Above the second floor would be the working bin area. Below each of the work bins is a conveyor to carry material from the bin hopper to the hopper scale above the mixer.

f. Labor

The labor is classed as production, maintenance, and supervisory. Most of the mill labor force would be used in transporting bags; loading and unloading. Handling equipment and maintenance would require 17 specialized personnel. The total labor required has been specified in Tables XIV and XV.

g. Utilities

Includes water, feed and electricity. Electricity cost for the area has been estimated at 0.42 baht/Kwh. The total installed power for a 10 ton/hour capacity is 500 HP. The amount of water estimated is 8,000 m^3.

The requirement for the boiler has been estimated at 141,960 liters per year.

h. Raw Materials

Grains will be used in large amounts especially corn, sorghum and broken rice. Also, protein cakes and meals from soybean, groundnuts, cotton seed and copra cake are necessary ingredients available in the market. The only available protein concentrate meal is fish meal. When a proper slaughterhouse is installed in the area, low cost by-products from this industry like meat meal, blood meal, bones, tallow etc. could be utilized.

Vitamins and minerals can be obtained in the local market. A price list of materials available has been included in the feedlot operations report.

i. Formulas and Analysis

Formulas will be prepared according to market needs and prices of the available raw materials.

The composition of raw materials should be carefully analyzed in a plant laboratory according to standard specifications. The processed feed mill carries a guaranteed analysis of its composition in the product nutritional value.

4. Investment, Operational Costs and Returns

The feed mill industry operates on a very low return basis. More benefits are obtained when the plant operates at full capacity for 22 hours per day (2 hour stop for cleaning equipment and repairs). The present plant has been calculated on a 10 ton/hour basis, or 80 tons per 8 hours shift. The maximum capacity would be 220 tons per day. With a well organized sales network, it can be assumed that in a period of 3 years the plant could reach its maximum capacity.

a. Land, Buildings, and Equipment

For land acquisition an average price of 60,000 baht per hectare has been estimated. One hectare of land is sufficient for this plant.

The building and construction requirements, will be the one adopted for any industrial building. The equipment usually is installed in a metal frame structure, but for the rest of the buildings and warehouse, a concrete structure with brick walls or any other type of similar local construction materials is adequate. The total estimated cost for the buildings is 4,114,000 baht. In the office building a small laboratory will be included.

An average life of 25 years for depreciation purposes has been adopted for the buildings.

The equipment is a standard type for a mill of this capacity and can be supplied by any specialized manufacturer. The total equipment cost, including transportation costs, amount to 3,848,645 baht. The equipment installation cost is estimated to be 577,296 baht.

For raw material transportation as well as for delivery of processed feeds to customers, one pick-up truck plus three 10 ton trucks are considered necessary; their total cost would be 440,000 baht.

The toal fixed capital cost equals 9,040,541 baht as shown in Table XIII.

Table XIII

CAPITAL FEED MILL COSTS
(Capacity: 10 Tm/hour - 8 hours Shift)

		Fixed Capital	Bahts	Total Baht
A		LAND		
	1	1 Hectare of land @ 60,000 baht/Ha	60,000	
	2	Land title	600	
		Subtotal A		60,600
B		BUILDING AND CONSTRUCTION		
	1	Grading and filling @ 10 baht/m^2	100,000	
	2	Building, 600 m^2 @ 2,500 baht/m^2	1,500,000	
	3	Warehouse 1200 m^2 @ 1,200 baht/m^2	1,440,000	
	4	Office, 200 m^2 @ 2,500 baht/m^2	500,000	
	5	Electric system and plumbing	200,000	
	6	Miscellaneous, 10% of above	374,000	
		Subtotal B		4,114,000
C		EQUIPMENT		
	1	Receiving	655,200	
	2	Processing	155,610	
	3	Mixing	1,056,510	
	4	Pelleting	693,420	
	5	Packing	163,800	
	6	Warehousing	191,100	
	7	Miscellaneous 10% of above	291,564	
	8	Transportation costs (ocean freight, crating, insurance, etc.) 20% of above	641,441	
		Subtotal C		3,848,645
D		EQUIPMENT INSTALLATION COST		
	1	15% of total Equipment cost	577,296	
		Subtotal D		577,296
C		TRANSPORTATION EQUIPMENT		
	1	Pick-up-truck	80,000	
	2	Three 10 ton trucks	360,000	
		Subtotal C		440,000
		Total Fixed Capital		9,040,541

b. Operational Costs

The salaries and wages are based on those which now prevail in Thailand. The costs have been calculated according to standard methods applied to feed mills in Thailand as well as in other countries. A full costing approach has been used which includes depreciation, interest charge (12%), as well as the usual labor, utilities and supplies.

(i) Salaries and Wages:- Managerial and administration salaries, plus labor amount to a total of 1,266,200.

(ii) Utilities and Supplies:- The fixed utilities and supplies, electricity, mail, office supplies, etc. will correspond to administration, light and overhead expenses which have an estimated cost of 180,000 baht. The cost of utilities and supplies are 655,368 baht. Therefore, the total for fixed and variable costs is 835,368 baht.

(iii) Maintenance and repairs:- The feed mill needs an adequate supply of spare parts having an estimated cost of 540,000 baht.

(iv) Depreciation and Interest:- A straight line depreciation less a 10% for scrap value has been adopted. Buildings have an assumed life of 25 years and equipment 10 years. For transportation equipment a 6 year life is used.

The total annual depreciation amounts to 557,885 baht. The annual interest (12%) is 1,084,864 baht.

(v) Total Fixed and Variable Operational Cost:- These total 4,522,290 baht as shown in Tables XIV and XV. Assuming that a plant processes 24,000 tons per year, the total operating cost is 188.43 baht per ton. If the plant works with two shifts, with a total production of 48,000 ton per year, then the costs would be 139.27 baht per ton.

TABLE XIV

FIXED FEED MILL OPERATING COSTS PER YEAR

1		Fixed Costs	Bahts	Total Baht
A		SALARIES		
	1	Plant Manager	96,000	
	2	Plant Superintendent	60,000	
	3	Sales Manager	50,000	
	4	Office Manager	45,000	
	5	Bookeeper	36,000	
	6	5 Clerks @ 24,000 Baht/year	120,000	
	7	Livestock Nutritionist	72,000	
	8	Lab. Technician	48,000	
	9	Watchman (2) @ 6,000 Baht/year	12,000	
		Subtotal A		539,000
B		UTILITIES AND SUPPLIES		
	1	Electricity, Telephone, mail office Supplies, etc.	180,000	
		Subtotal B		180,000
C		DEPRECIATION AND INTEREST		
		Depreciation: (less 10% scrap value)		
	1	Buildings: 25 years	148,104	
	2	Equipment: 10 years	343,781	
	3	Transportation equipment: 6 years	66,000	
	4	Interest Capital 12%	1,084,864	
		Subtotal C		1,642,749
D		MISCELLANEOUS		
	1	Start-up expenses	80,000	
	2	Insurance (estimate)	81,000	
	3	Maintenance 2% Equipment	76,973	
		Subtotal D		237,973
		Total Fixed Costs		2,599,722

Table XV

Variable Feed Mill Operating Costs Per Year

2		Variable Costs	Bahts	Total Baht
A		WAGES		
	1	2 Foremen @ 2,000 Baht/months	48,000	
	2	2 Mechanics @ 1,500 Baht/month	36,000	
	3	2 Assist Mechanics @ 900 baht/month	21,600	
	4	10 Specialized Labor @ 700 baht/month	84,000	
	5	80 Laborers @ 500 Baht/month	480,000	
	6	Four truck drivers @ 1,200 Baht	57,600	
		Subtotal A		727,200
B		UTILITIES		
	1	Fuel (Fuel oil for Boiler @ 80 stang lits	113,568	
	2	Electricity @ 0.42 Baht/kwh	373,800	
	3	Water 8,000 M^3	8,000	
		Subtotal B		495,368
C		SUPPLIES		
	1	Lubricants, Bookeeping Supplies etc.	60,000	
	2	Miscellaneous	100,000	
		Subtotal C		160,000
D		MAINTENANCE AND REPAIR		
	1	Maintenance and equipment repair	540,000	
		Subtotal D		540,000
		TOTAL VARIABLE COSTS		1,922,568
		TOTAL FIXED COSTS		2,599,722
		TOTAL OPERATIONAL COSTS		4,522,290
		Total cost per ton (24,000 tons/year)		188.43
		Total cost per ton with 2 shifts (48,000 tons/year)		134.27

(vi) Formula Costs:- Formulas for livestock feeding vary according to livestock, age of animals, and production purposes (meat, milk, eggs). They also, may vary according to different types of breeds. Since the feed mill will be constructed mainly for cattle feeding, a general formula has been used for calculation purposes. This sample formulation has an ingredient cost of "range protein" feed carrying a minimum crude protein of 20%. The cost of this sample formula based on a wholesale price at Bangkok, May 1971 is:

Ingredients	Kgs/Ton of Feed	Price/Ton	Cost Baht in Formulation
Maize	500 Kg.	1,500	750
Groundnut cake	250 "	2,200	550
Soybean meal	2 "	2,500	5
Rice Middlings	22 "	700	15.4
Rice Bran	13 "	450	5.85
Oyster shell	2 "	330	0.66
Molasses	10 "	300	3.00
Premix (Vitamins, trace mineral antibiotics)	4 "	1,200	4.80
Cottonseed meal	67 "	1,300	87.1
Coconut cake	100 "	1,100	110.0
Shrimp shell	30 "	1,100	33.0
Total	1000 Kg.		1,564.81

The total cost of ingredients (average) is 24,000 tons x 1564.81 = 37,555,440 Bht.

(vii) Total Operating Cost Plus Raw Materials:-

Cost of raw materials	= 37,555,440	Baht
Operating Cost	= 4,522,290	Baht
Total Cost	42,077,730	Baht
Total Cost per tons (24,000 tons)	1,753.23	Baht

(viii) Working Capital:- Except for some grains, that it is suggested be bought when the market price is the lowest (harvesting season), the rest of the materials can be purchased as needed. Two months working capital, therefore, has been assumed.

Summary of Cost

Total cost	42,077,730	Baht
Interest 12%	5,049,327	"
Two months working capital interest	841,554	"
Per ton working capital and interest	35.06	"

(ix) Returns Per Ton of Feed Processed:-

Income:

Total cost plus interest on working capital (per ton)	1,788.29	Baht
Assuming 5% mark-up per ton	89.41	"
Selling price (per ton)	1,877.70	"
Total Income (14,000 ton)	45,064,800	Baht

Expenses:

Total Operating Costs	42,918,960	"

Return:

Net return	2,145,840	"

Return on Investment:

Fixed capital investment	9,040,541	"
Plus interest working capital	841,554	"
Total capital investment	9,882,095	"

The total return on investment is 21.7%

C. SLAUGHTERHOUSES IN THE NORTHEAST REGION

1. Introduction

According to the last figures published by the Ministry of Agriculture in 1965, the existing livestock population in Thailand was 5,287,000 cattle and 7,160,000 buffaloes, which included 2,337,000 cattle and 3,549,000 buffaloes in the Northeast Region. This gave the Northeast the largest regional percentage of cattle (44.2%) and buffaloes (49.5%).

Estimates concerning cattle and buffaloes slaughtered are shown in Table XVI. NEED-PAG estimates that 76,000 head of cattle and buffaloes will be slaughtered in the Northeast, and 379,000 head of cattle and buffalo in the whole kingdom during 1972. The proposed Third Five Year Plan recommends a program for increasing animal production for slaughtering from the 1972 figures to 180,000 by 1976.

In most countries, meat production (slaughtering) is taking place in areas close to cattle raising in order to save transport. (A liveweight animal yields roughly a 50% carcass.) Therefore, savings in transportation are equivalent to the reduction in carcasses plus a 5% - 10% shrinkage during transportation of liveweight animals; in addition, other damages occur in transportati of live animals.

Assuming an average liveweight for cattle of 350 kg. with an average price liveweight of 7 baht the total loss from shrinkage would be 245 baht (350 kg x 10% x 7 baht). Using average truck transportation cost of 0.40 baht per ton/km.1/and an average haul of 350 km, the transportation cost per a 350 kg. animal would be 49 baht. (350 km x 0.4 baht x 0.350 tn) Therefore, total of 294 baht (245 + 49) could be saved if meat is transported rather than live cattle. 24.5 baht should be deducted or a total of 269.5 baht would be the total savings per head. These savings will be 1.31 baht per kg. of meat.

1/ NEED-PAG Plan chapter IX page 8. Working paper.

Table XVI

NUMBER OF SLAUGHTERED ANIMALS

Northeast Thailand
1970

Changwat	Cattle	Buffalo	Hog
Chaiyapoom	4,788	511	8,154
Korat	8,551	833	67,613
Burirum	2,461	163	12,993
Srisaket	3,771	219	12,648
Surin	1,887	394	13,413
Ubol	9,710	629	20,680
	31,108	2,749	135,501
Kalasin	2,297	150	3,046
Khon Kean	6,958	1,225	18,776
Nakorn Panom	4,617	690	11,793
Roi-et	4,883	490	11,793
Mahasarakam	2,276	192	2,678
Loei	1,592	798	5,082
Nong-Khai	3,865	781	10,853
Sakol Nakorn	4,430	378	5,302
Udorn	8,310	645	24,428
	39,228	5,369	85,663

Source: Livestock Department 1971.

The existing situation in the Northeast with regard to the successful operation of a slaughterhouse is inadequate due to the following:

(1) No regular supply of suitable livestock for slaughtering are available.

(2) Insufficient demand for the quantities of meat and by-products which the slaughterhouse would produce.

The main objective of this report, therefore, is to analyze the necessary investment operational costs that would be required for future development of a livestock slaughterhouse operation when it could be economically feasible.

a. Slaughterhouses in Thailand

At present, there are two main slaughterhouses in Thailand. The largest one is operated by the Livestock Trading Corporation Ltd., situated at Kluanum Thai in Bangkok with a killing capacity of 40-60 head of cattle per hour and 400 hogs per hour. There is another slaughterhouse at Ban Pong operated by the Preserved Food Organization which is under the auspices of the Minister of Defense. This slaughterhouse has a capacity of 600 hogs/day and 120-150 head/per day of cattle and or buffaloes. According to FAO Report No. TA 2761 (Rome 1970) there are about 70 other private small slaughterhouses, as well as many unregistered slaughter points.

b. Meat Inspection

Except for the largest slaughterhouses, there is no meat inspection. Illegal slaughter operations are occurring in the country. The law concerning meat inspection is the Act for the Control of Animal Slaughter and Sale of Meat B.E. 2502 (1959). This law must be modernized if a livestock and meat production development program is to be implemented.

2. Project Description

In Thailand, there is no industry specializing in beef production. The cattle and buffaloes slaughtered are old animals that are unable to plough. Certain rules and regulations concerning the minimum age for slaughtering vary according to different areas of the country. Also, in order to preserve the stock there is a rule which forbids the slaughtering of females at any age. In some special cases veterinary permission may be given to slaughter animals unable to perform their intended function, such as males unable to work or non-breeding females. However, the beef from such animals is of very poor quality.

The slaughtering rules mentioned above are only one of the factors on which a beef industry depends. It is also necessary to have good beef breeds properly fattened prior to slaughtering. Good pastures plus feedlot operations, with proper sanitary control, are also necessary to produce good quality meat.

If an integrated operation can be performed between a nearby feedlot operation and the slaughterhouse, the price structure can be improved as well as the quality of the beef. As a consequence, demand should increase.

a. Plant Requirements

(i) Cattle Supply:- Efficient and economical operations of a slaughterhouse demands a high degree of continuous operation throughout the year. Traditional methods involved purchasing old cattle, except during the ploughing season, April, May and June, which caused a short supply of cattle and buffalo during these months. Although future operations also would have some seasonability, it should be reduced to a minimum in the proper livestock supply organization and management. Also, slaughtering old animals should be avoided as much as possible. Part of this problem could be overcome through contracts with feedlot operations, and also with selected cattle breeders.

(ii) Plant Location:- The following factors should be considered in order to build the plant with the maximum advantages for efficient operations.

I. Plant Site

Any plant built in the Northeast Region should be installed in an area with good drainage and free from smoke and dust or chemical pollution. The site chosen should have ground for further expansion. Sufficient space for holding and feeding pens should be provided for. Two to four hectares of land outside city limits should be the minimum.

II. Water Supply

The quantity of potable water used by a plant depends on the amount of processing done. If plants do straight slaughtering without meat processing, they can operate with 8.5 liters per kg. of edible meat produced. However, if a plant is processing both an edible and inedible product, the quantity of water consumed runs as high as 25 liters per kg. of meat processed.1/

If condensers are used, large quantities of water will be consumed. An average of 180 to 200 liters per minute per condenser would be used but this does not have to be potable water.

1/ Operational Data of Slaughterhouses, Office of Technical Cooperation and Research. Agency for International Development. Washington D.C. (USA)

III. Sewage Disposal

Sewage disposal presents no problem if a plant can hook up with an adequate municipal system, but in most cases a new plant would not have such facilities.

It is a common practice for slaughterhouses plants to build lagoons or sewage treatment ponds, since the waste from meat processing plants has a high BOD (Biochemical Oxygen Demand) content. The sewage properly treated can be used as fertilizer.

IV. Electric Power

A modern slaughterhouse requires electricity for light and power purposes. The estimated amount can be calculated through the function: (according to Logan and King).2/

$$X = 157,183 + 15.5 \times H$$

Where X are Kwh and H number of heads slaughtered per year.

V. Fuel

The fuel requirements are mainly used for boiler operations, at an estimated consumption rate of 900 Kcal per HP.

The size of boiler can be estimated, accordin to3/the following function:

$$X = 6.98 + 0.102 H$$

X is the total HP required and H the number of heads killed in an 8 hour shift.

VI. Transportation

Transportation conditions would be important for the success of a slaughterhouse plant since livestock would be received at the plant by truck and/or railroad and also meat would be sent to the market by the same means of transportation. Khon Kaen, Korat, and Surin, have excellent transportation facilities with Bangkok and other cities. The railway system can also supply refrigerated cars.

2/ Economies of scale in beef slaughter plants. S.H. Logan a G.A. King - California Agricultural Experiment Station. Giannini Foundation Res. REPT. N.R. 260, University of California, Berkeley. December 1962.

3/ Economies of scale. Op. cit.

VII. Labor Availability

It is assumed that in some areas skilled slaughterhouse workers are virtually nonexistent. A new plant must, therefore, train its own employees to improve the operating efficiency of its workers.

(iii) Site Location:- The requirements for site location coincide with the NEED PAG proposal targets for 1976, which recommend that the new slaughtering facilities should be installed at Khon Kaen, Korat and Surin with the following capacities:

	Khon Kaen	Korat	Surin
Cattle (No. head)	40,000	40,000	20,000
Swine (No. head)	180,000	180,000	90,000
Beef output (Tons)	6,500	6,500	3,250
Pork output (Tons)	12,600	12,600	6,300

(iv) Size of the Plant:- Assuming that the plant will operate during 260 days per[1]/year and 8 hours per day a killing capacity of 20 heads per hour will be sufficient to meet the production targets outlined above.

(v) Labor and Personnel Requirements:- The following personnel will be required.

Salaries:

General Manager	1
Plant Superintendent	1
Sales Manager	1
Office Manager	1
Bookkeeper	1
Clerk	4
Watchmen	2
Livestock Buyer	1
Veterinarian	1
Total	13

Wages:

Slaughtering	17
Chilling and Shipping	8
By products (Rendering, hides, tankage)	6
Mechanic	1
Assistant mechanics	3
Feeding pens and yards	4
Scale	1
Cleaning	2
Total	42

1/ Based on 5 days per week with 2 days for plant cleaning.

b. Operations and Systems for Slaughtering

The slaughtering industry, uses one basic system to perform killing floor operations: the bed type system. This system requires manual performance of most operations. In recent years new systems have been designed using mechanized equipment. These are the so called "on-the-rail" systems. Comparisons between these two basic systems show that the on-the-rail system offers a more efficient operation and economical advantages with substantial savings in labor.

According to the killing rate of 20 head per hour, the most economical system will be the gravity-on-the rail system.

c. Other Operations

(i) Pre-Slaughter Facilities:- The stock should be fasted for 16-24 hours but have drinking facilities in the holding pens. This fasting period reduces the amount of undigested food and faeces in the intestinal tract and improves the keeping quality of the meat. Transportation usually causes nervous excitement and poor bleeding is a result. Therefore keeping the animals in the holding pens for a resting period, will improve the quality of meat.

Holding pen space: Considering that cattle is received every weekday including holidays, a two day holding pen capacity is advisable. An average space of 2.50 m^2 per head is considered necessary.

(ii) Refrigeration Facilities:- Refrigeration is extremely important in a tropical country. The removal of dressed carcasses from the slaughterhouse to the refrigerated chambers should be done as rapidly as possible with the least possible exposure to the slaughterhouse atmosphere, thereby reducing to a minimum the development of microorganisms in the meat.

(iii) By-Products Facilities:- Hides, hoof and horns, bones, meat scraps, blood, tankage, etc. are processed at the plant and the necessary equipment will be included in the budget.

3. Investment, Operational Costs and Returns

In calculating the costs and revenues from a slaughterhouse operation it has been assumed that cattle breed improvement will result in better quality beef. Therefore, prices per head of cattle as well as wholesale prices will be higher than present ones; for calculation purposes, therefore, a liveweight price of 7 baht per kg and a wholesale price of beef of 14 baht per kg. have been assumed.

It should be noted, however, that the key variable for making a slaughterhouse operation viable is that the carcass price is at least double the liveweight price.1/ The sale of by-products will ensure a profit if they amount to more than operating costs.

a. Fixed Capital

(i) Land, Buildings and Equipment:- It is assumed that the plant will be located in the outskirts of one of the cities mentioned in paragraph 8 which have an average land cost of 60,000 baht per hectare.

Construction requirements will be the same as for any industrial building. It is suggested it be a concrete structure with brick walls or any other materials available in the area. The estimated total cost of constructing the slaughter buildings is 5,100,700 baht which equals 1,845 baht per square meter. An average life for the building of 25 years has been adopted for depreciation purposes. Equipment costs are based on the gravity-on-the-rail system.

Equipment for rendering, by-product treatment, refrigeration and a boiler have been included in the budget. The total equipment cost is 4,268,160. A life of 10 years has been assumed on the equipment. Installation charges are estimated to be 640,224 baht.

Other costs to be considered are the design fee 5 percent, interest costs during construction, and provisions for contingencies. These costs are estimated at 1,909,544 baht.

Meat distribution in the area, as well as transportation to the railroad station for sales to Bangkok or export purposes, can be done by four refrigerated trucks. Provision has also been made for a pick-up truck for other services. The total cost for transportation amounts to 1,140,800 baht. Therefore, the total fixed capital is 13,241,228 baht.

Table XVII summarizes these investments.

b. Operational Costs

The salaries, wages and prices, unless indicated otherwise are those which prevail in Thailand. The costs have been calculated according to the operations described in paragraph (i) below.

1/ Note: The ratio of liveweight to carcass of 2:1 is an international accepted figure.

A full costing approach has been used which includes depreciation, interest charges, as well as the usual labor, utilities, and supplies. In the operation costs, the purchasing of cattle for slaughter has not been included. In order to calculate the break-even point the operational costs have been segregated into their fixed and variable components.

(i) Salaries and Wages:- To cover all the slaughtering services, holding pens, refrigeration, by-products handling, maintenance and administration, a total amount of 1,043,600 baht per year is required. (See Tables XVIII and XIX for details.)

Table XVII

Slaughterhouse Fixed Capital Costs

	Fixed Capital	Baht	Total Baht
	Land		
1	3 hectares of land @ 60,000 baht/ha	180,000	
2	Land Title	1,800	
	Subtotal A		181,800
	Buildings and Construction		
1	Grading and filling @ 10baht/m^2	300,000	
2	Stockyards 1,500 m^2 @ 400 baht/m^2	600,000	
3	Building, 730 m^2 @ 2,500 baht/m^2	1,825,000	
4	Refrigeration facilities, 400 m^2 @ 2,750 baht/m^2	1,100,000	
5	Building forhides, 135 m^2 @ 1,200 baht/m^2	162,000	
6	Lagoons - anaerobic and aerobic	250,000	
7	Plumbing, water and sewage	220,000	
8	Electric system	180,000	
9	Miscellaneous, 10% of total	463,700	
	Subtotal B		5,100,700
	Equipment		
1	Slaughtering equipment, gravity on the rail system	1,196,000	
2	Rendering equipment	720,000	
3	Refrigeration equipment	810,000	
4	Boiler, pumps, air compressors, etc.	230,000	
5	Miscellaneous, 20% of above	592,800	
6	Transportation costs (ocean freight, crating, insurance, etc.) 20% of above	711,360	
	Subtotal C		4,268,160
	Equipment Installation Cost		
1	15% total equipment cost	640,224	
	Subtotal D		640,224
	Total A, B, C, D.		10,190,884
	Other Costs		
1	Consulting Engineering fees 5% of A-B-C-D	509,544	
2	Administrative and legal costs during construction (estimate)	900,000	
3	Miscellaneous	500,000	
	Subtotal E		1,909,544
	Transportation Equipment		
1	One pick-up-truck	80,000	
2	Four 10 ton refigerated trucks	1,060,800	
	Subtotal F		1,140,800
	Total Fixed Capital		13,241,228

(ii) Utilities and Supplies:- The fixed utilities and supplies, electricity, office supplies, etc. will correspond to administration, light and overhead expenses, as shown in Tables XVIII and XIX.

Table XVIII

SLAUGHTERHOUSE
Fixed Operating Costs Per Year

		Fixed Costs	Baht	Total Baht
A		Salaries		
	1	Plant Manager	96,000	
	2	Plant superintendent	60,000	
	3	Sales manager	50,000	
	4	Livestock buyer	45,000	
	5	Office Manager	45,000	
	6	Bookkeeper	36,000	
	7	4 clerks @ 24,000 baht	96,000	
	8	2 watchman @ 6,000 baht	12,000	
	9	Veterinarian	60,000	
		Subtotal A		500,000
B		Utilities and Supplies		
	1	Electricity, fuel, telephone, mail, office supplies etc.	200,000	
		Subtotal B		200,000
C		Depreciation and Interest		
	1	Depreciation: (Less 10% scapr value)		
	2	Buildings: 25 years	183,625	
	3	Equipment: 10 years	902,999	
	4	Transp. Equipment: 6 years	171,120	
	5	Interest Capital 12%	1,588,947	
		Subtotal C		2,846,691
D		Miscellaneous		
	1	Start-up expenses	100,000	
	2	Insurance est.	120,000	
	3	Maintenance 2% Equipment	85,363	
		Subtotal D		305,363
		Total Fixed Costs	3,852,054	

Table XIX

SLAUGHTER HOUSE

Variable Operating Costs Per Year

2		Variable Costs	Baht	Total Baht
A		WAGES		
	1	3 Foremen @ 2,200 baht/month	79,200	
	2	17 Laborers for bee kill @ 700 bagt/month	142,800	
	3	8 Laborers for chilling and shipping @ 700 baht/month	67,200	
	4	6 Laborers by-products operation @ 700 B/month	50,400	
	5	4 Laborers for feeding pens and yards @ 500 baht/month	24 000	
	6	1 Laborer for scale @ 700 baht/month	8,400	
	7	1 Mechanic @ 1,000 Baht/month	12,000	
	8	3 Assistant mechanics @ 900 baht/month	32,400	
	9	2 Laborers for cleaning @ 500 baht/month	12,000	
	10	5 truck drivers @ 1,200 baht/month	72,000	
	11	6 Laborers for unspecified jobs @ 600 baht/month	43,200	
		Subtotal A		543,600
B		UTILITIES		
	1	Fuel (Fuel oil for boiler @ 80 stang/liter)	420,000	
	2	Electricity 70,000 KWH/month @ 0.42 baht/KWH	350,000	
	3	Water 30,000 m^3	30,000	
		Subtotal B		800,000
C		SUPPLIES		
	1	7 Kgs of salt per hide @ 0.5 baht/kg. (40,000 heads)	140,000	
	2	Miscellaneous maintenance, repairs, etc.	700,000	
		Subtotal C		840,000
		Total Variable Costs		2,183,600
		Total Fixed Costs		3,852,054
		Total Operational Costs		6,035,654
		Total Operating Costs per head (40,000 heads)		150.89
		Total Operating Costs per Kg. meat (205 kg/head)		.73

The variable cost itemized in Table XIX include the expenses related to slaughtering operations. The fuel for transportation facilities has been included in the miscellaneous items. The total amount for fixed and variable utilities and supplies amounts to 1,340,000 baht.

(iii) Depreciation and Interest:- A straight line depreciation less a 10% scrap value, has been adopted. Buildings are assumed to have a 25 year life. Plant equipment has an average life of 10 years and transportation equipment an average life of 6 years. The total annual depreciation amounts to 2,846,691 baht. Annual interest at 12% is 1,588,947 baht.

(iv) Total Fixed and Variable Operational Costs:- Tables XVIII and XIX show a total of 6,035,654 baht for total fixed and variable costs. Assuming that the plant operates with 40,000 head of cattle per year, the total operating cost per head slaughtered is 150.89 baht. With an average weight per carcass of 205 kg., the operational cost per kg. of beef is 0.73 baht/kg. (No working capital has been included.)

(v) Working Capital:- Assuming a liveweight cost of 7 baht/kg with an average weight per head of 410 kg., the total capital required for the operation is:

Purchasing cattle for slaughtering	114,800,000	Baht
Operating cost	6,035,654	"
Total	120,835,654	"
Interest 12%	14,500,278	"
Two months working capital interest	2,416,713	"
Per head working capital interest	60.41	"

(vi) Returns per head:-

Income:

Carcasses (205 kg) @ 14 baht	2,870	Baht
By-products (See Table XX)	270	"
Total income products	3,140	Baht

Expense:

Purchasing cattle @ 7 baht/kg. liveweight (410 kg)	2,870	Baht
Operating costs	150.89	
Interesting working capital	60.41	
Total expenses	3,081.30	

Net Income:

Net income		58.70
Total capital investment	13,241,228	
Two months working capital interest	2,416,713	
	15,657,941	
Total capital per head		391.44
Return on investment		15%

Table XX

ESTIMATED INCOME FROM BEEF AND BY-PRODUCTS

(Operating Capacity 40,000 Heads of Cattle per Year)

	Yield Per Head Kgs	Totals (40,000 Heads) Kgs	Average Sale Price Baht/Kg	Total Baht
1. Carcass (50% of liveweight)	205.00	8,200,000	14.00	114,800,000
2. Hides	23.5	940,000	3.25	3,055,000
3. Bones (treated)	2.50	100,000	1.10	110,000
4. Meat meal (1)	2.70	108,000	5.20	561,600
5. Blood meal (1)	1.82	72,800	5.00	364,000
6. Edible fat (1)	11.93	477,200	6.00	2,863,200
7. Tallow oil (1)	4.00	160,000	4.50	720,000
8. Frozen glands (1)	0.24	9,600	15.00	144,000
9. Frozen offals (1)	15.09	603,600	4.00	2,414,400
10. Others (1)	2.80	112,000	5.00	560,000
Total				125,592,200
Total by products				10,792,200
Total income per head				3,140
Total by products per head				270

(1) Estimated prices.

VII. ECONOMIC GROWTH AND STRUCTURAL CHANGE IN NORTHEAST THAILAND–SHIFT AND SHARE ANALYSIS

ECONOMIC GROWTH AND STRUCTURAL CHANGE IN NORTHEAST THAILAND SHIFT AND SHARE ANALYSIS

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VII. ECONOMIC GROWTH AND STRUCTURAL CHANGE IN NORTHEAST THAILAND - SHIFT AND SHARE ANALYSIS

by

James A. Chalmers
Richard S. Cowan, Jr.*

1. INTRODUCTION

Over the past decade, the growth experiences of the various regions in Thailand have differed markedly. The Northeast in particular has lagged the Rest of the Kingdom in terms of growth of value-added. The purpose of this paper is to examine the relationship between the growth of the Northeast and the growth of the nation as a whole over the period 1960-1969.

We show how a modified shift and share technique can be used to analyze the changing relationship in the distribution of production between the Northeast and the Rest of the Kingdom. The analysis concludes that the Northeast's relative decline over the past decade is due not so much to its unfavorable mix of industries but to the fact that these industries grow more slowly in the Northeast than elsewhere.

This study also advances, with appropriate caveats, a shift and share projection of GRP for 1976. The formulation is based on exogenous sectoral projections which account for changing demand and supply relationships expected at the national level through 1976. These exogenous projections are coupled with assumptions concerning future market access and the availability of factors of production in the Northeast. The results imply continued divergence in the volume of output between the Northeast and the Rest of the Kingdom over the Third Plan Period.

2. THE SHIFT AND SHARE FRAMEWORK FOR THE ANALYSIS OF REGIONAL GROWTH

The analysis of regional growth in terms of "shares" and "shifts" arose because it was convenient to think about the growth of regions in two parts - a part due to the overall growth of the country (a region's share), and a part which one region

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gains at the expense of another region (a shift). Originally, used as an accounting device to sort out the various factors which contribute to regional growth,1/ it has more recently been extended to predict regional growth. Growing interest in the methodology of regional economics has resulted in several critiques of shift and share analysis.2/ In applying the technique to the growth of Northeast Thailand, we have modified the methodology in response to several of these criticisms.

2.1 The Descriptive Model

The shift and share model is an identity which accounts for the growth of some regional variable, by attributing it to total national growth, total industry growth, and the growth of an industry in a region which can only be explained by that industry's unique competitive position vis-a-vis other industries in the area. These three components are defined as:

(i) The Regional Share (R) is the amount by which value added would have grown in a region if regional production increased at exactly the same rate as national production.

(ii) The Proportionality Shift (or industrial mix effect) is the amount by which the growth of a region's production deviates from the rate of growth of national production due to a high regional concentration of industries which experienced either a typically fast or a typically slow growth. Thus, a region with an above average proportion of industries experiencing rapid growth at the national level will have a positive proportionality shift. A region which has an above average number of slow growth industries at the national level will have a negative proportionality shift.

(iii) The Differential Shift is the result of a given industry growing more rapidly in some regions than in others. If an industry expands more rapidly in one region than it does in another regions possessing the same structure, the region will experience a positive differential shift. If a region does less well on the average than the nation in particular industries it will have a negative differential shift.

1/ Some of the most notable work includes Perloff et. al (1), Ashby (2), Creamer (7), Dunn (3), and Fuchs (9).

2/ Three recent examples are Houston (10), Mac Kay (11), and Brown (5).

The relationship among these components for a single industry in a single region may be expressed mathematically as:

(1) $$S^*_{ij} = S_{ij} + \Delta S^*_{ij}$$

Where:

(1a) $$\Delta S^*_{ij} = S_{ij}\left[(GDP^*/GDP) - 1\right] + S_{ij}\left[(S^*_i/S_i) - (GDP^*/GDP)\right] + S_{ij}\left[(S^*_{ij}/S_{ij}) - (S^*_i/S_i)\right]$$

Where: GDP is Gross Domestic Product at the beginning of the period.

GDP* is Gross Domestic Product at the end of the period.

S_i is value added in the ith industry at the beginning of the period.

S^*_i is value added in the ith industry at the end of the period.

S_{ij} is value added in the ith industry and the jth region at the beginning of the period.

S^*_{ij} is value added of the ith industry and the jth region at the end of the period.

For example, to examine the change in value added in industry i in region j the growth rate of total output would be multiplied by S_{ij} to calculate the regional share effect (R). To calculate the proportionality shift,(*) the divergence between the growth rate of industry i and GDP is multiplied by S_{ij}. The proportionality effect is positive or negative depending on the relative growth rates of GDP and S_i. The third element of change is the competitive or differential effect (D), which depends on the rates of growth of a given industry in different regions. It is a residual in the sense that it is the difference between actual change and that accounted for by (R) and (P). The competitive component is positive if S_{ij} is enjoying faster growth than the same industry in other areas and negative if it is not keeping pace.

The shift and share technique can readily be extended to regional analysis. This is accomplished by summing the components of change over each industry within a region. A positive industry mix component indicates that the region has a preponderance of rapid rather than slow growth industries, and is growing faster than total GDP. The differential effect, when calculated for the region as a whole, indicates whether

the region has competitive advantages over other regions. A positive component means that the performance of the industries with the region is better than other areas possessing the same structure.

Different economic variables are responsible for the different shifts. Industry mix gains or losses are attributable to such factors as the changing demand and supply structure of the industry at the national level, including changing tastes and technology, price and income elasticities, and the capacities of different regions to assimilate rapid and slow growth industries. To understand the competitive component, on the other hand, requires a study of the input-output relationships of specific industries as well as the locational decisions made by private business.

Shift and share analysis is only one way to organize one's thinking about those variables which have influenced regional change. It should not be construed as a technique which purports to explain the changing character of the components. Rather, it is an indicator of where to look for explanations of the growth experience.

2.2 The Projection Model

Lowell Ashby has suggested that the shift and share technique be used for making projection.3/ His formulation is based on exogenous projections of total national and total industry output. This model has the advantage of accounting for changing demand and supply relationships at the national level which have a direct influence on the region.

The enabling assumption is that the differential component for the forecast period will resemble that of the past. Making this assumption, value added for a regional industry for the next period can be written as:

$$(2) \quad S_{ij}^{**} = S_{ij}^{*} + \Delta S_{ij}^{**}$$

$$(2a) \quad \Delta S_{ij}^{**} = S_{ij}^{*} \left[(GDP^{**}/ GDP^{*}) - 1\right] + S_{ij}^{*} \left[(S_i^{**}/S_i^{**}) - (GDP^{**}/GDP^{*})\right] + S_{ij}^{*} \left[(S_{ij}^{**}/S_{ij}^{*}) - (S_i^{**}/S_i^{*})\right]$$

3/ See Ashby (4).

The exogenous projections of GDP^{**} and S_i^{**} yield the expected R and P for the regions industry. To complete the projection the hypothesis is that the competitive or differential component (D) equals that of the previous period. Thus the model becomes:

$$(3) \quad S_{ij}^{**} = S_{ij}^{*} + S_{ij}^{*} (\bar{r}) + S_{ij}^{*} (\bar{r}_i - \bar{r}) + \lambda S_{ij} \left[(S_{ij}^{*}/S_{ij}) - (S_i^{*}/S_i) \right]$$

Where:

$\bar{r}$ is the projected rate of growth of GDP

$\bar{r}_i$ is the projected rate of growth of S_i

λ is a scalar adjustment if the projection period is a different length from the historical period over which the analysis is made.

2.3 Critique and Evaluation

One of the most persistent criticisms of shift and share concerns the length of the time period over which growth is measured. If the time period is great, the shift in output may be improperly classified with respect to the components responsible for change. The problem is critical if the industrial structure of the region relative to the nation is changing rapidly. The fact that a region improves its mix of industries may be hidden if the base against which change is measured is the structure of the region in the beginning (or ending) period. While several possibilities exist for treating the problem of changing structure, nothing short of a multi-point analysis, (i.e. dividing the period up into shorter intervals) has been advanced as a method which "properly" accounts for the impact changing industrial structure has on the transformation process.4/

The advantage of multi-period analysis is obvious; if the region is improving its mix of industries relative to other regions, this fact will be reflected by an upward trend in the proportionality shift. An analysis spanning the period can not reflect this structural change. Likewise, improvement (or lack

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4/ Stillwell (13) has advanced and Ashby (1) clarified the method to measure the extent to which a region has modified its industrial structure. The technique cannot be used for this purpose as it can give contradictory results under a broad range of conditions. See Chalmers (6).

thereof) in the regions competitive position can be estimated by trend in the differential shift over time.

It may be demonstrated that multi-period analysis leads the researcher to different conclusions than an analysis conducted over an entire period.5/ Obviously the empirical reliability and validity of such an analysis far outweighs the extra time spent in calculation. These statements also hold for the projection model. If an assumption is to be made based on structural change over time, not on structure at a point of time. Thus, the descriptive analysis and projections which follow are based on yearly, rather than period analyses.

3. SHIFT AND SHARE ANALYSIS OF NORTHEAST THAILAND: 1960-1969

Based on the shift and share model discussed above, the growth of the Northeast was examined for each of the years from 1960-1969. The annual results are presented in Appendix A, Tables 1-10 and summarized in Table 1.

We see, that the increases in GRP in the Northeast over the period 1960-1969 of ฿8.424 billion could be broken down into a share component of ฿9.698 billion and a shift component of ฿1.274 billion. This negative shift could have occurred for one of two reasons. Either the Northeast has an unfavorable industrial mix, or it suffers from competitive disadvantages, so that, in spite of its industrial mix it does less well than other regions.

Apparently, the relative shift away from the Northeast is not due to an unfavorable mix of industries but rather to an inability of given industries to grow as fast in the Northeast as elsewhere in the nation. While the Northeast experienced a positive proportionality shift of ฿-.034 billion over the decade, indicating slight improvement from its mix of industries, it experienced a differential shift loss of ฿1.308 million to other regions. Thus the mix effect was more than offset by the Northeast's inferior competitive position.

Thus far we have made no reference to the specific sectors which have been responsible for the decline in the Northeast's share of value added. This is easy to do however, since each of the share and shift components discussed above are derived

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5/ A comparison of shift and share results obtained by treating 1960-1969 as a single period as opposed to yearly sub-periods is described in Appendix B.

Table 1

The Regional Pattern in the Growth of Value Added

Northeast vs Rest of the Kingdom

Yearly Summary 1960-1969

(Billion of Baht at Constant 1962 Prices)

Regions	Value Added		Actual Change	Component of Change		Components of Shift	
	1960	1969		Share	Shift	Proportionality Effect	Differential Effect
Northeast	10.045	18.468	8.423	9.698	-1.274	.034	-1.308
Rest of Kingdom	46.024	93.910	47.886	46.611	+1.274	-.034	+1.308
Total	56.069	112.378	56.309	56.309	0	0	0

Source: National Accounts Division, NEDB.

on a sector by sector basis. Table 2, is based on the yearly analysis in Appendix A, shows each sector's share if it had grown over the period 1960-1969 at the same rate as GDP. The share is then subtracted from the actual change to find the shift to or from the region attributable to each industrial sector.

Among the conclusions one may draw from Table 2 are the following:

1. Negative shifts were concentrated in four sectors: Other crops (฿-.866 billion), Paddy (฿-.813 billion), Livestock (฿-.416 billion), and Manufacturing (฿-.232 billion).

2. The reasons for the shifts in these sectors were different. Paddy was the source of a large negative shift primarily because Paddy has an unfavorable differential advantage to the Rest of the Kingdom.

In the Other Crops sector of the Northeast suffered both from negative proportionality and negative differential shifts amounting to more than ฿-.400 million each. The Manufacturing sector is growing slowly in the region because the Northeast is not able to keep up with the growth of Manufacturing elsewhere in the Kingdom. The negative shift in Livestock is entirely due to a negative industrial mix effect of ฿-.513.

3. A few sectors were instrumental in preventing an even more rapid deterioration of the relative position of the Northeast during the 1960's. Key among these were the construction sector with a positive shift of ฿-.578 billion, followed by seven other sectors with positive shifts ranging downward from ฿-.217 to ฿-.016 billion; Wholesale and Retail Trade, Services, Quarrying, Electric and Water, Transportation and Communication, and Cassava.

The conclusions from the analysis are straightforward. Agricultural production is the main source of the relative shift of economic activity away from the Northeast. Northeast agricultural production is in crops with unfavorable access to inputs or to markets, and these sectors have therefore grown more slowly than elsewhere in the Kingdom. It is likely that agriculture will remain a source of negative shifts for the Northeast in the future. Paddy and Other Crops will continue to be slow growing sectors at the regional level. Further, the large positive differential shift in Construction and allied activities can not be expected to continue. Thus, it appears that the Northeast's position relative to the Rest of the Kingdom will continue to deteriorate even if differential improvement occurs in some sectors.

Table 2

Annual Shift and Share Analysis: Northeast, Thailand

Summary by Sector

(All Values in Billion of Baht at Constant 1962 Prices)

1960-1967

Sector	Value Added		Actual Change	Components of Change		Components of Shift	
	1960	1969		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2.442	3.829	1.387	2.199	-.813	.091	-.904
2. Maize	.110	.122	.012	.051	-.039	.037	-.076
3. Cassava	.014	.050	.036	.020	.016	.003	.013
4. Kenaf	.362	.710	.348	.457	-.110	-.146	.036
5. Other Crops	1.412	1.514	.102	.966	-.866	-.423	-.443
6. Livestock	.953	1.349	.396	.812	-.416	-.513	.097
7. Fisheries	.153	.313	.160	.158	.002	.223	-.221
8. Forestry	.358	.583	.225	.351	-.128	.091	-.219
9. Mining and Quarrying	.017	.246	.229	.066	.163	.091	.072
10. Manufacturing	.717	1.186	.469	.701	-.232	.227	-.459
11. Construction	.412	1.623	1.211	.621	.578	.273	.305
12. Electric and Water	.013	.210	.197	.039	.159	.059	.100
13. Transportation and Communication	.316	.836	.520	.390	.130	-.047	.177
14. Wholesale and Retail Trade	1.271	2.835	1.564	1.347	.217	.132	.085
15. Banking, Insurance and Real Estate	.030	.139	.109	.051	.057	.047	.010
16. Dwellings	.250	.312	.062	.198	-.136	-.111	-.025
17. Public Administration and Defense	.444	.810	.366	.413	-.048	-.044	-.004
18. Services	.771	1.802	1.031	.836	.193	.045	.148
Total	10.045	18.469	8.424	9.698	-1.274	.034	-1.308

Source: National Accounts Division, NEDB.

4. SHIFT AND SHARE AS THE BASIS FOR PROJECTIONS 1976

As performed above shift and share analysis is a purely descriptive device. It focuses attention on differences in the growth experience of regions by categorizing them into proportionality or differential or effects. The growth of the region is broken down into a part due to the growth of various sectors at the national level and a part due to differential shifts to or away from the region. It is the basis for theorizing about regional growth only to be extent that a theory is proposed to explain the sectoral composition of national growth and the deviation experienced by each region.

Yet, as discussed previously, an allocation perspective like shift and share analysis is relatively easy to adapt to make projections as the consequences of regional activity are assessed against the background of expected developments in the national economy.

Let us turn to the projection model discussed in section 2.1. The model advanced by Ashby rests on the assumption of "persistency" in the differential component. Obviously this assumption is valid if stability is observed in the component over time. If an industry's competitive differential is unstable it is unlikely that the model will organize a regional forecast in the proper manner.

Our research shows that the differential component is highly unstable for the majority of industries for the period 1960-69. Thus, Ashby's regularly assumption is infeasible in specifying the differential component for S_{ij} for 1969-1976. Instability in the component may be caused by changing local supply relationships, cyclical activity, weather, etc., any of which may be highly erratic in Northeast Thailand. What is interesting, however, is the trend these changes take. Trend indicates improvement or deterioration in the shift components, calculated against changing bases. To adopt the shift and share analysis for projection purposes, an annual rate of growth calculated from trend in the competitive component for each industry is highly desirable.

Unfortunately, the component calculated on a year to year basis for each industry in the Northeast does not display the trend one could expect. Correlation analysis indicates that variation in the majority of differential components is not closely associated with time.

These tests lead to interesting conclusions. Since there is apparently no correlation between time and the differential effect, the estimation of trend is reducible to a simple yearly average. This appears to be Ashby's formulation of the model, but is not. Our analysis is an average of yearly shift and share

calculations summed over 1960-1969. Ashby's assumptions concerning (D) is relative to initial year industrial structure. Further, the base upon which (D) is projected is the terminal year of the shift and share analysis not the base year.

If one accepts the assumption concerning the differential for each sector one may generate sector industry by sector forecasts of Northeast, Thailand to 1976 "statusquo", i.e. in the absence of further shifts of development activity into the region.

We make the simplest possible assumption, namely, that the differential shift will continue in the future to equal its yearly, average in the past, and combine this with the NEDB's sectoral output projections for the Third Plan, to project GRP and the composition of GRP for the Northeast for 1976. These projections are presented in Table 3.

The striking things about the projections are that the relative position of the Northeast is projected to deteriorate at a more rapid rate over the period 1969-1976 than it did over the period 1960-1969 (a 2% vs 1% yearly growth differential). The Northeast is also expected to grow more slowly than its current rate of growth of 5.7 percent per year.

Table 3

Yearly Compound Growth Rates

Actual 1960-1969 and Expected 1969-1976

Northeast vs Whole Kingdom

Region	Actual 1960-1969	Expected 1969-1976
Northeast	7.0%	4.9%
Whole Kingdom	8.0%	6.9%

Going behind this overall forecast on a sector by sector basis. One gains the following insights from Table 4.

1. The main source of the expected deterioration is the slower national projections in Paddy, Kenaf, Livestock and Construction.

2. The competitive effects of consequence for the period 1969-1976 are necessarily the same as those over the period 1960-69 - big negative shifts in Paddy, Other Crops and Manufacturing, and the positive shift in Construction.

3. The industrial mix effect is so large relative to the competitive effects, that if the national sectoral forecasts are reasonable accurate, it would take a totally unrealistic set of projected competitive effects to conteract the overall picture of continued (add accelerating) widening of the gap between the Northeast and the Rest of the Kingdom.

These projections are based on the national sector forecasts prepared by NEDB and the assumption that competitive relationships among regions will persist in the 1970's as they have in the 1960's. The persistency assumption is liable to two major qualifications. First, the Royal Thai Government is committed to increasing the level of development expenditures in the Northeast in the 1970's relative to the 1960's. The increase may be of the order of magnitude of ฿1 billion a year. The hope is by improving the Northeast's supply of certain factors of production and by increasing their access to markets, the Northeast will be able to enjoy a strengthened competitive position vis-a-vis the other regions of the Kingdom. This will result in larger positive differential shifts in the 1970's than those that characterized the 1960's.6/ The second qualification is that the stimulus which the Northeast received over the past six or seven years from U.S. Military construction can not be expected to continue in the 1970's. Thus, the two most serious qualifications to the persistency assumption are offsetting.

5. CONCLUSIONS

While many tools and techniques are available to study regional growth, shift and share analysis provides insights not

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6/ If the government is able to neutralize the negative differential shift away from the Northeast by its improvement of input-output access, the projected annual rate of growth would only increase from 4.9% to 5.8%.

Table 4

Value Added Projections: Northeast, Thailand

1969 - 1976

(Add Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Expected Change	Components of Change		Components of Shift	
	1969	1976		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	3.829	3.471	-.358	2.267	-2.625	-1.922	-.703
2. Maize	.122	.192	.070	.072	-.002	.057	-.059
3. Cassava	.050	.113	.063	.030	.033	.023	.010
4. Kenaf	.710	.786	.076	.420	-.344	-.372	.028
5. Other Crops	1.514	2.021	.507	.896	-.389	-.044	-.345
6. Livestock	1.349	1.766	.417	.799	-.382	-.457	.075
7. Fisheries	.313	.537	.224	.185	.039	.211	-.172
8. Forestry	.583	.563	-.020	.345	-.365	-.195	.170
9. Mining and Quarrying	.246	.441	.195	.146	.049	-.007	.056
0. Manufacturing	1.186	1.927	.741	.702	.039	.396	-.357
1. Construction	1.623	2.329	.706	.961	-.255	-.492	.237
2. Electric and Water	.210	.736	.526	.124	.402	.324	.078
3. Transportation and Communication	.836	1.451	.615	.495	.120	-.018	.138
4. Wholesale and Retail Trade	2.835	4.758	1.923	1.678	.245	.179	.066
5. Banking, Insurance and Real Estate	.139	.305	.166	.082	.084	.076	.008
6. Dwellings	.312	.372	.060	.185	-.125	-.106	-.019
7. Public Administration and Defense	.810	1.187	.377	.480	-.103	-.100	-.003
8. Services	1.802	2.820	1.018	1.067	-.049	-.164	.115
Total	18.469	25.775	7.306	10.934	-3.628	-2.610	-1.018

gained with other macroeconomic approaches. The purpose of this study was to apply a modified shift and share model to describe economic change in Northeast Thailand relative to the Rest of the Kingdom for the period 1960-1969. We were able to categorize the influence various factors have had on structural change over the past decade.

The results of the analysis testify to the region's inability to grow relatively faster than the Rest of the Kingdom over this period of time. The Northeast has unfavorable input-output access relative to other regions in the nation. The extent to which these conditions persist the future will inhibit rapid growth and development.

Assuming that inertia is a strong force in the transformation process, the growth of the Northeast sector by sector was projected for 1976. Given exogenous forecasts and the persistency assumption a compound rate of growth of 4.9 percent per annum was forecast for the period.

It was hoped that shift and share would not only be a useful way to describe the growth of the Northeast relative to the Rest of the Kingdom over the past ten years, but would provide the basis on which a model of regional growth could be constructed. This second objective was not achieved, yet the very pessimistic implications of the sectoral projections make it even more important that the process of regional growth be understood.

In the meantime, however, development funds have to be allocat plans written, etc. Thus, what implications does the shift and share analysis have for the allocation of public investment? Does it make more sense to invest heavily in sectors that have been enjoying competitive advantages; should investment be concentrated in industries that are expected to grow rapidly at the national level; or should public investment be applied in such a way as to compensate for the slow national growth or competitive disadvantages of certain sectors?

Unfortunately, there is no reason to expect the marginal productivity of public capital to be related to the past contribution of a sector to the share or shifts of activity into, or out of a region. For example, a sector could have sustained a large negative differential shift because of low levels of local demand, shortage of skilled labor, or shortages of capital. If the negative shift is due to either of the first two factors, the productivity of public investment will probably be quite low, while it would be higher if the shift were due to a shortage of capital. Thus, all we can say is that capital ought to be allocated to its highest productivity uses and the shift and share analysis doesn't help us identify these uses.

A P P E N D I X A

Yearly Shift and Share Analysis: Northeast, Thailand

1960 - 1969

Value Added and the Components of Change

Table A - 1

Shift and Share Analysis: Northeast, Thailand

1960 - 1961

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1960	1961	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2.442	2.459	.017	.128	- .112	- .020	- .092
2. Maize	.110	.054	- .056	.006	- .062	.005	- .067
3. Cassava	.014	.013	- .001	.001	- .002	.005	- .006
4. Kenaf	.362	.452	.090	.019	.071	.081	- .010
5. Other Crops	1.412	1.430	.018	.074	- .056	.006	- .063
6. Livestock	.953	.987	.034	.050	- .016	- .016	-
7. Fisheries	.153	.156	.003	.008	- .005	.012	- .018
8. Forestry	.358	.386	.028	.018	.009	- .016	.025
9. Mining & Quarrying	.017	.018	.001	.001	-	-	-
10. Manufacturing	.717	.882	.165	.038	.127	.030	.097
11. Construction	.412	.426	.014	.022	- .008	- .001	- .006
12. Electric and Water	.013	.017	.004	.001	.003	.004	- .001
13. Transportation & Communication	.316	.379	.063	.016	.046	- .014	.061
14. Wholesale and Retail Trade	1.271	1.383	.112	.067	.044	.022	.022
15. Banking, Insurance and Real Estate	.030	.036	.006	.002	.004	.004	.001
16. Dwellings	.250	.254	.004	.013	- .009	- .006	-.002
17. Public Administation and Defense	.444	.468	.024	.023	.001	- .002	.002
18. Services	.771	.846	.075	.041	.034	.005	.028
Total	10.045	10.646	.601	.530	.071	.101	- .030

Source: National Accounts Division, NEDB.

Table A - 2

Shift and Share Analysis: Northeast, Thailand

1961 - 1962

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1961	1962	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2.4. 9	3,231	.772	.198	.574	.138	.436
2. Maize	.054	.048	-.006	.004	-.010	.002	- .012
3. Cassava	.013	.014	.001	.001	.000	.002	- .002
4. Kenaf	.452	.266	-.186	.036	-.222	-.228	.006
5. Other Crops	1.430	1.211	-.219	.115	-.334	-.170	-..164
6. Livestock	.987	1.048	.061	.080	-.019	-.063	.044
7. Fisheries	.156	.176	.020	.013	.007	.013	- .006
8. Forestry	.386	.443	.057	.031	.026	-.016	.042
9. Mining & Quarrying	.018	.022	.004	.001	.003	-.003	.000
10. Manufacturing	.882	.878	-.004	.071	-.075	-.037	-.112
11. Construction	.426	.474	.048	.034	.014	.026	-.012
12. Electric and Water	.017	.027	.005	.001	.004	.001	.003
13. Transportation and Communication	.379	.448	.069	.031	.038	.004	.034
14. Wholesale and Retail Trade	1.383	1.451	.068	.112	-.044	-.049	-.005
15. Banking, Insurance and Real Estate	.036	.043	.007	.003	.004	.003	.001
16. Dwellings	.254	.257	.003	.020	-.017	-.013	-.004
17. Public Administation and Defense	.468	.488	.020	.038	-.018	-.015	-.003
18. Services	.846	.943	.097	.068	.029	-.009	.038
Total	10.646	11.463	.817	.857	-.040	-.334	.294

Source: National Accounts Division, NEDB.

Table A - 3

Shift and Share Analysis: Northeast, Thailand
1962 - 1963
(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual Change	Components of Change		Components Of Shift	
	1962	1963		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	3.231	3.468	.237	.270	-.033	- .014	- .018
2. Maize	.048	.046	-.002	.004	-.006	.010	- .016
3. Cassava	.014	.021	.007	.001	.006	-..001	.006
4. Kenaf	.266	.406	.140	.022	.118	.118	- .001
5. Other Crops	1.211	1.496	.285	.101	.184	.023	.160
6. Livestock	1.048	1.120	.072	.088	-.016	- .065	.050
7. Fisheries	.176	.168	-.008	.014	-.022	.034	- .058
8. Forestry	.443	.482	.039	.037	.002	- .004	.006
9. Mining and Quarrying	.022	.028	.006	.002	.004	-	.004
10. Manufacturing	.878	.908	.03	.073	-.043	.009	- .052
11. Construction	.474	.571	.097	.040	.057	.01	.047
12. Electric and Water	.022	.024	.002	.002	-	- .001	.002
13. Transportation & Communication	.448	.450	.002	.037	-.035	- .022	- .014
14. Wholesale and Retail Trade	1.451	1.572	.121	.121	-	.023	- .023
15. Banking, Insurance and Real Estate	.043	.048	.005	.004	.002	-	.001
16. Dwellings	.257	.264	.007	.021	-.014	- .014	-
17. Public Administation and Defense	.488	.532	.044	.041	.003	.006	- .002
18. Services	.943	1.011	.068	.078	-.011	- .016	.006
Total	11.463	12.615	1.152	.958	.194	.096	.098

Source: National Accounts Division, NEDB.

Table 4 - 4

Shift and Share Analysis: Northeast, Thailand

1963 - 1964

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual Change	Components of Change		Components of Shift	
	1963	1964		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	3.468	3.186	-.282	.229	- .511	- .381	- .130
2. Maize	.046	.045	-.001	.003	- .004	.002	- .006
3. Cassava	.021	.023	.002	.001	.001	- .001	.002
4. Kenaf	.406	.579	.173	.026	.146	.129	.016
5. Other Crops	1.496	1.227	-.269	.098	- .368	- .062	- .306
6. Livestock	1.120	1.079	-.041	.074	- .115	- .044	- .072
7. Fisheries	.168	.189	.021	.011	.010	.025	- .015
8. Forestry	.482	.513	.031	.032	- .001	- .002	.002
9. Mining and Quarrying	.028	.052	.024	.002	.022	.010	.012
10. Manufacturing	.908	.882	-.026	.060	- .086	.018	- .104
11. Construction	.571	.741	.170	.038	.132	.047	.085
12. Electric and Water	.024	.031	.007	.002	.006	.004	.001
13. Transportation and Communication	.450	.477	.027	.030	-.002	.022	- .024
14. Wholesale and Retail Trade	1.572	1.669	.097	.104	-.006	.071	- .078
15. Banking, Insurance and Real Estate	.048	.054	.006	.003	.002	.004	- .001
16. Dwellings	.264	.272	.008	.017	-.009	- .009	-
17. Public Administation and Defense	.532	.547	.015	.035	-.020	- .020	-
18. Services	1.011	1.066	.055	.066	-.012	.008	- .019
Total	12.615	12.632	.017	.833	-.816	- .180	- .636

Source: National Accounts Division, NEDB.

Table A-5

Shift and Share Analysis: Northeast, Thailand

1964 - 1965

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1964	1965	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	3.186	2.852	-.334	.250	-.584	- .374	- .210
2. Maize	.045	.053	.008	.004	.004	.003	.002
3. Cassava	.023	.038	.015	.002	.013	- .003	.016
4. Kenaf	.579	.992	.413	.046	.368	.352	.015
5. Other Crops	1.227	1.272	.045	.096	-.051	- .039	-.012
6. Livestock	1.079	1.085	.006	.084	-.078	- .054	- .024
7. Fisheries	.189	.256	.067	.014	.052	.006	.046
8. Forestry	.513	.521	.008	.040	-.032	.015	- .048
9. Mining and Quarrying	.052	.082	.030	.004	.026	.012	.014
10. Manufacturing	.882	1.040	.158	.069	.088	.071	.017
11. Construction	.741	.942	.201	.058	.142	.024	.119
12. Electric and Water	.031	.041	.010	.002	.008	.006	.002
13. Transportation & Communication	.477	.554	.077	.037	.040	- .014	.054
14. Wholesale and Retail Trade	1.669	1.816	.147	.131	.016	- .031	.046
15. Banking, Insurance and Real Estate	.054	.065	.011	.004	.006	.004	.003
16. Dwellings	.272	.279	.007	.021	-.014	- .012	- .001
17. Public Administation and Defense	.547	.591	.044	.042	.001	-	.001
18. Services	1.066	1.169	.103	.084	.019	.028	- .009
Total	12.632	13.648	1.016	.992	.024	- .006	.030

Source: National Accounts Division, NEDB.

Table A - 6

Shift and Share Analysis: Northeast, Thailand

1965 - 1966

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1965	1966	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2,852	4.026	1.174	,348	,826	.273	.553
2. Maize	.053	.085	.032	.007	.025	-	.025
3. Cassava	.038	.029	- .009	.005	-.014	.006	- .020
4. Kenaf	.992	1.233	.241	.121	.120	.106	.014
5. Other Crops	1.272	1.317	.045	.155	-.110	.035	- .145
6. Livestock	1.085	1.207	.122	.132	-.010	- .078	.068
7. Fisheries	.256	.276	.020	.031	-.011	.010	- .021
8. Forestry	.521	.500	- .021	.064	-.085	,104	- .189
9. Mining and Quarrying	.082	.134	.052	.010	.042	.006	.036
10. Manufacturing	1.040	1.017	- .023	.127	-.150	- .006	- .144
11. Construction	.942	1.131	.189	.115	.074	.088	- .014
12. Electric and Water	.041	.062	.029	.005	.016	.008	.008
13. Transportation and Communication	.554	.616	.062	.068	-.006	- .028	.022
14. Wholesale and Retail Trade	1.816	2.225	.409	.222	.187	- .036	.223
15. Banking, Insurance and Real Estate	.065	.083	.018	.008	.010	.007	.003
16. Dwellings	.279	.287	.008	.034	-.026	- .023	- .003
17. Public Administation and Defense	.591	.591	.000	.072	-.072	- .058	- .014
18. Services	1.169	10.171	.183	.143	.040	- .027	.067
Total	13.648	16.171	2.523	1.667	.856	.387	.469

Source: National Accounts Division, NEDB.

Table A - 7

Shift and Share Analysis: Northeast, Thailand

1966 - 1967

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual Change	Components of Change		Components of Shift	
	1966	1967		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	4.026	2.490	-1.536	.222	-1.758	.468	- 2.226
2. Maize	.065	.088	.003	.005	- .002	.002	- .004
3. Cassava	.029	.035	.006	.002	.004	-.003	.007
4. Kenaf	1.233	.940	- .293	.068	- .361	-.349	- .012
5. Other Crops	1.317	1.332	.015	.073	- .058	-.093	.035
6. Livestock	1.207	1.247	.040	.067	- .027	-.027	-
7. Fisheries	.276	.268	- .008	.015	- .023	.018	- .041
8. Forestry	.500	.518	.018	.028	- .010	.012	- .022
9. Mining and Quarrying	.134	.198	.064	.007	.057	.033	.024
10. Manufacturing	1.017	1.141	.124	.056	.068	.044	.024
11. Construction	1.131	1.373	.242	.062	.160	.152	.028
12. Electric and Water	.062	.091	.029	.003	.026	.010	.016
13. Transportation & Communication	.616	.702	.086	.034	.052	.018	.034
14. Wholesale and Retail Trade	2.225	2.498	.273	.123	.150	.152	- .002
15. Banking, Insurance and Real Estate	.083	.106	.023	.005	.018	.010	.008
16. Dwellings	.287	.295	.008	.016	- .008	-.004	- .004
17. Public Administation and Defense	.591	.647	.056	.033	.023	.015	.008
18. Services	1.352	1.394	.042	.075	- .033	.061	- .094
Total	16.171	15.363	- .808	.893	-1.701	.519	- 2.220

Source: National Accounts Division, NEDB.

Table A - 8

Shift and Share Analysis: Northeast, Thailand

1967 - 1968

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1967	1968	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2.490	3.455	.965	.224	.741	.052	.689
2. Maize	.088	.103	.015	.008	.007	-.003	.010
3. Cassava	.035	.047	.012	.003	.009	-.003	.012
4. Kenaf	.940	.363	-.577	.085	-.662	-.651	- .011
5. Other Crops	1.332	1.411	.079	.120	-.041	-.059	.018
6. Livestock	1.247	1.309	.062	.112	-.050	-.075	.025
7. Fisheries	.268	.290	.022	.024	-.002	.048	- .050
8. Forestry	.518	.572	.054	.047	.007	.018	- .011
9. Mining and Quarrying	.198	.219	.021	.018	.003	.007	- .004
10. Manufacturing	1.141	1.095	-.046	.103	-.147	.012	- .159
11. Construction	1.373	1.455	.082	.124	-.042	-.001	- .041
12. Electric and Water	.091	.161	.070	.008	.062	.011	.051
13. Transportation and Communication	.702	.779	.077	.063	.014	-.027	.041
14. Wholesale and Retail Trade	2.498	2.537	.039	.225	-.186	-.009	- .177
15. Banking, Insurance and Real Estate	.106	.122	.016	.010	.006	.008	- .002
16. Dwellings	.295	.304	.009	.027	-.018	-.015	- .003
17. Public Administation and Defense	.647	.743	.096	.058	.038	.032	.006
18. Services	1.394	1.636	.242	.125	.117	.029	.088
Total	15.363	16.601	1.238	1.364	-.146	-.626	.480

Source: National Accounts Division, NEDB.

Table A - 9

Shift and Share Analysis: Northeast, Thailand

1968 - 1969

(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual Change	Components of Change		Components of Shift	
	1968	1969		Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	3.455	3.829	.374	.330	.044	- .051	.096
2. Maize	.103	.122	.019	.010	.009	.016	- .006
3. Cassava	.047	.050	.003	.004	-.001	.001	- .002
4. Kenaf	.363	.710	.347	.034	.312	.296	.016
5. Other Crops	1.411	1.514	.103	.134	-.032	- .064	.032
6. Livestock	1.309	1.349	.040	.125	-.085	- .091	.006
7. Fisheries	.290	.313	.023	.028	-.004	.057	- .062
8. Forestry	.572	.583	.011	.054	-.044	-..020	- .024
9. Mining and Quarrying	.219	.246	.027	.021	.006	.020	- .014
10. Manufacturing	1.096	1.186	.091	.104	-.014	.012	- .026
11. Construction	1.455	1.623	.168	.138	.029	- .072	.101
12. Electric and Water	.161	.210	.049	.015	.034	.016	.016
13. Transportation and Communication	.779	.836	.057	.074	-.017	.014	-.031
14. Wholesale and Retail Trade	2.537	2.835	.298	.242	.056	- .011	.067
15. Banking, Insurance and Real Estate	.122	.139	.017	.012	.005	.007	- .002
16. Dwellings	.304	.312	.008	.029	-.021	- .015	- .006
17. Public Administation and Defense	.743	.810	.067	.071	-.004	- .002	- .001
18. Services	1.636	1.802	.166	.156	.010	- .034	.044
Total	16.601	18.469	1.868	1.584	.284	.077	.206

Source: National Accounts Division, NEDP.

Table A - 10

Annual Shift and Share Analysis: Northeast, Thailand
Summary by Year 1960 - 1969
(All Values in Billion of Baht at Constant 1962 Prices)

Years	Value Added		Actual Change	Components of Change		Components of Shift	
				Share	Shift	Proportionality Effect	Differential Effect
1960 - 1961	10.045	10.646	.601	.530	.071	.101	- .030
1961 - 1962	10.646	11.463	.817	.857	-.040	-.334	.294
1962 - 1963	11.463	12.615	1.152	.958	.194	.096	.098
1963 - 1964	12.615	12.632	.017	.833	-.816	-.180	- .636
1964 - 1965	12.632	13.648	1.016	.992	.024	-.006	.030
1965 - 1966	13.648	16.171	2.523	1.667	.856	.387	.469
1966 - 1967	16.171	15.363	-.808	.893	-1.701	.519	-2.220
1967 - 1968	15.363	16.601	1.238	1.384	- .146	-.626	.480
1968 - 1969	16.601	18.269	1.668	1.584	.284	.077	.206
Total			8.424	9.698	-1.274	.034	-1.308

APPENDIX B

Shift and Share Analysis: Northeast, Thailand

1960 - 1969

A Comparison of Results Under Different Analytical Bases

Table B-1 presents a shift and share analysis using 1960 as the base for computation of the components of change. Table B-2 contrasts the results of the annual shift and share analysis (multi-period) with those obtained by using the initial year.

The results testify to the importance structural change can be in the growth process. Without accounting for this change one may obtain completely different results. By not including structural change in the analysis we would conclude that slow growth in the Northeast over the decade was attributable to a poor mix of industries, while on the contrary, the reason for slow growth was an unfavorable competitive advantage vis-a-vis other regions.

We might add that the use of any base year for the calculation of change may lead to improper conclusions. A possible exception is an average base which does not use extreme points, (beginning or ending period) but the average of the two. Such a base may more closely approximate the same results for R, P, and D elements over a period between two points that would be attained by a multi-period analysis. It should not, however, be construed as a substitute for the more rigorous yearly approach.

Table B - 1

Shift and Share Analysis: Northeast; Thailand
1960 - 1969 a/
(All Values in Billion of Baht at Constant 1962 Prices)

Sector	Value Added		Actual	Components of Change		Components of Shift	
	1960	1969	Change	Share	Shift	Proportionality Effect	Differential Effect
1. Paddy	2.442	3.829	1.387	2.452	-1.066	-1.410	.344
2. Maize	.110	.122	.012	.110	- .098	.135	-.234
3. Cassava	.014	.050	.036	.014	.022	- .004	.026
4. Kenaf	.362	.710	.348	.364	- .016	- .038	.023
5. Other Crops	1.412	1.514	.102	1.418	-1.316	- .799	-.516
6. Livestock	.953	1.349	.396	.957	- .561	- .666	.106
7. Fisheries	.153	.313	.160	.154	.006	.444	-.438
8. Forestry	.358	.583	.225	.360	- .134	- .156	.022
9. Mining & Quarrying	.017	.246	.229	.017	.212	.056	.156
10. Manufacturing	.717	1.186	.469	.720	- .251	.371	-.622
11. Construction	.412	1.623	1.211	.414	.797	.323	.474
12. Electric and Water	.013	.210	.197	.013	.184	.051	.133
13. Transportation & Communication	.316	.836	.520	.317	.202	- .062	.264
14. Wholesale and Retail Trade	1.271	2.835	1.564	1.276	.288	.156	.131
15. Banking, Insurance & Real Estate	.030	.139	.109	.030	.078	.053	.026
16. Dwellings	.250	.312	.062	.251	- .189	- .162	-.027
17. Public Administation and Defense	.444	.810	.366	.446	- .080	- .072	-.008
18. Services	.771	1.802	1.031	.774	.256	.051	.206
Total	10.045	18.469	8.424	10.087	-1.663	-1.730	.066

Source: National Account Division, NESDB

a/ Industrial structive in 1960 is the base for analysis.

Table B-2

Alternative Analytical Results

Multi-period vs Initial Year Analyses

1960 - 1969

(Billion of Baht and Constant 1962 Prices)

Base	Growth (R)	Proportionality (P)	Differential (D)	Total Change
Multi-Period	9.698	.034	-1.308	8.424
Initial Year	10.087	-1.730	.066	8.424

Source: Table 2, and B-1

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