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ASEAN Food Security Reserves

How They Might Have Worked from 1960 to 1977

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KANSAS STATE UNIVERSITY

FOOD & FEED GRAIN INSTITUTE
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ASEAN FOOD SECURITY RESERVES

How They Might Have Worked from 1960 to 1977

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SUMMARY OF SETTING, METHODOLOGY AND FINDINGS

Together the five ASEAN countries consume food grain products equivalent to about 100,000 MT of milled rice each day. Rice provides the dominant portion of the total requirement -- about 89 percent in Indonesia, 75 percent in Malaysia, 70 percent in the Philippines, 57 percent in Singapore and 97 percent in Thailand. Of projected total rice requirements for 1980, Indonesia will need to import 8.6 percent, Malaysia 6.7 percent, and Singapore 100 percent. The Philippines has reached self-sufficiency. Thailand continues to be a major exporter of both rice and corn. All five countries are wholly dependent on imports for milling wheat, and together will import about 2.7 million metric ton in 1980. Malaysia, Singapore and the Philippines remain corn importers, needing a projected total of 950,000 MT in 1980.

Even with imports and exports, total annual grain supplies have deviated widely from food requirements in all five countries. Over the past 18 years, deviations greater than ± 10 percent of total requirements have been common in all five countries -- a degree of instability which could have been avoided by a security reserve. ASEAN is to be congratulated as the first group of nations to implement jointly a rice security reserve program.

The purpose of this analysis is to test the performance and estimated costs of alternative ASEAN food reserve programs had they operated over the period 1960-1977. The alternatives tested include a 2 x 2 matrix, (1) rice only and (2) all food grains by (A) without and (B) with import (export) adjustments. All four include a mix of in-country plus ASEAN regional reserves, and all are capable of achieving stability in annual supplies within the

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targeted ±3 percent of total food requirements in each country. The total size and estimated cost of the reserve program vary from one alternative to another.

The required grain storage capacity for reserve programs to achieve the targeted ±3 percent stability under each alternative is shown in units of 1000 MT milled rice equivalent in Summary Table 1. Without import adjustments

Summary Table 1. Computed Reserve Storage Capacity
(1,000 MT milled rice equivalent)

Alternative → / Location ↓	1. Rice Only		2. All Food Grains	
	A. Historical Trade	B. Adjusted Trade	A. Historical Trade	B. Adjusted Trade
In-Country:	1,434	1,393	1,718	1,671
Indonesia	603	603	690	690
Malaysia	68	68	84	73
Philippines	143	139	173	137
Singapore	43	43	61	61
Thailand	557	540	710	710
Regional:	2,867	1,103	3,411	1,368
Combined:	4,301	2,496	5,129	3,039

Source: Tables 12', 14', 18', 20'.

the required grain storage capacity would have been 4,301,000 MT for rice and 5,129,000 MT for all food grains. With import adjustments the capacities would have been reduced to 2,496,000 MT and 3,039,000 MT, respectively. The major reduction comes in the needed capacity for the regional reserves -- from 2,867,000 MT to 1,013,000 MT for rice reserves, and from 3,411,000 MT to 1,368,000 MT for food grain reserves.[a]

Average annual utilization of the storage capacity for the security reserves would have varied as indicated in Summary Table 2. Under the adjusted trade alternatives the utilization of capacity for the regional reserves would have been nearly twice the rate of that for the historical trade alternatives.

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[a] It should be noted that these estimated capacity requirements are in addition to capacities required for storage from harvest to time of consumption, for normal carryover, and for "pipeline" requirements.

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Summary Table 2. Average Utilization of Reserve Capacity
(Percent)

Alternative → / Location ↓	1. Rice Only		2. All Food Grains	
	A. Historical Trade	B. Adjusted Trade	A. Historical Trade	B. Adjusted Trade
In-Country:	45.4	48.2	45.5	52.2
Indonesia	26.3	26.5	28.7	40.7
Malaysia	54.8	59.8	69.6	67.4
Philippines	79.1	88.8	64.8	75.3
Singapore	46.9	51.6	55.2	55.2
Thailand	63.1	69.8	60.0	63.1
Regional:	34.1	65.0	35.5	59.6

Source: Sections 6-9.

In general, the indicated rate of capacity utilization is somewhat higher for all food grain reserves than for rice reserves alone. The rate of capacity utilization is higher for the Philippines than for the other countries under all alternatives considered.

Based on uniform unit costs for grain storage facilities, inventory costs and annual operating costs, the computed average annual total costs for the alternative food security programs are shown in Summary Table 3.

Summary Table 3. Computed Average Annual Total Costs for Reserves
($ million)

Alternative → / Location ↓	1. Rice Only		2. All Food Grains	
	A. Historical Trade	B. Adjusted Trade 1/	A. Historical Trade	B. Adjusted Trade
In-Country:	79.2	100.6	92.2	117.7
Indonesia	33.5	43.9	39.1	54.8
Malaysia	3.4	3.9	5.0	5.0
Philippines	7.0	9.1	7.6	8.8
Singapore	2.1	3.2	3.2	4.4
Thailand	33.2	40.5	37.3	44.7
Regional:	166.5	78.7	170.6	83.2
Combined:	245.7	179.3	262.8	200.9

Source: Tables 23, 26, 30, 33, 36.

1/ In-Country costs include those for import (export) adjustments.

Under the adjusted import (export) alternatives, the in-country reserve costs include the computed costs for the adjustments. For ASEAN as a whole, the average total annual costs over the 18-year historical period would have ranged from $179.3 million for rice reserves with import adjustments to $262.8 million for all food grain reserves without import adjustments. Import adjustments reduce the total costs of regional reserves by about one-half, but add to the total costs for the individual countries. The all food grain reserves are somewhat more costly than the reserves of rice only in all cases except the Philippines. However, such reserves are a bit more efficient, providing equal stability to the greater food consumption base.

No attempt has been made to measure the benefits that would have resulted from the food reserve expenditures shown in the table, but one can expect that they would have been very large. For one approach to measurement of net benefits to be expected from food security reserve programs, the reader is referred to Special Report No. 6, "Food Grain Reserves in Developing Countries," Food and Feed Grain Institute, March, 1978, pages 48-63.

The methodology tested in this study, including the supporting computer programs and users manuals, is available through U.S. Agency for International Development or the Kansas State University Food and Feed Grain Institute to anyone interested. Policy makers and analysts concerned with these problems in the developing countries of East Asia and elsewhere are encouraged to contact the study sponsors directly, through the USAID offices or through SEARCA in Los Baños, Philippines.

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SECTION 1

SETTING AND METHODOLOGY FOR TESTING ASEAN FOOD SECURITY RESERVE ALTERNATIVES

Why ASEAN Food Security Reserves?

The ASEAN countries have good reason to be concerned about the problems which food security reserves can help solve. They are anxious to avoid the danger of mass starvation with only a few days' supply of food grain on hand prior to the new harvest. They are anxious to minimize the repercussions of serious localized food scarcity resulting from possible disasters. They are anxious to avoid the potentials for serious consumer rebellion to sky-rocketing prices in times of serious shortages. They are anxious to avoid over-adjustments in agricultural resource use caused by food grain prices which are temporarily very high, and the dangers of mass bankruptcy of farmers caused by food grain prices which are temporarily very low. In short, the ASEAN countries are anxious to develop reasonable levels of reserve stocks of food grains for the protection of their consumers, their farm producers, and their national economies.

Effectively meeting the daily food grain requirements of their people is a large and priority task for the ASEAN countries. For the 1980 crop year ASEAN daily requirements total about 102,000 metric ton, milled rice equivalent. This daily requirement is distributed by country and grain source as follows:

Projected 1979-80 Daily Requirements 1/
(MT, milled rice equivalent)

Country	Rice	Wheat	Corn	All Food Grains
Indonesia	47,980	2,490	3,810	54,280
Malaysia	3,610	900	490	5,000
Philippines	10,800	1,570	5,010	17,380
Singapore	490	380	30	900
Thailand	23,200	270	1,270	24,740
ASEAN Total	86,080	5,610	10,610	102,300

1/ Based on Tables 2 (Section 2) and the relative use of food grains from Tables 1 (Annex II).

This total requirement of 102,300 MT of food grain products (in milled rice equivalent) every day for 365 days per year is a massive challenge. It requires distribution among 258 million people an average of 0.87 pounds of milled rice each day. In equivalent whole grain, it corresponds to a supply of about 157,400 MT per day or 5,745,000 MT per year.

The challenge is magnified by great and largely unpredictable variations in food grain supplies from year to year. Climatic factors, crop pests and diseases, restrictions affecting the use of farm inputs, changing food policies and uncertain grain prices combine to cause wide variations in domestic production. Irratic world prices and shifts in other factors affecting international trade cause wide fluctuations in the opportunities to import (or export) to balance total food supplies with domestic requirements. Since 1960, Indonesia's annual food grain supply requirement balance has varied from a deficit of 1,658,000 MT to a surplus of 1,353,000 MT (see Table 8, Page 2-31) -- a variation of about ± 13 percent of total annual requirements. Over the past 18 years, comparable percentage variations in available food grain supplies have occurred in the other ASEAN countries, ranging from -11.5 percent to +8 percent in Malaysia, -10 percent to +6.5 percent in the Philippines,

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-44 percent to +28 percent in Singapore, and -10.5 percent to +20 percent in Thailand. These imbalances have occurred even after activities to offset the wide fluctuations in domestic production, including (1) imports and/or exports, (2) consumption substitution among the alternative food grains, and (3) adjustments to year-end food grain inventories.

In isolated extreme years, all five of the ASEAN countries have experienced major deficits or surpluses at the same time. For example, all five encountered shortfalls in total food grain supplies in 1965, and all but Singapore encountered surpluses in 1962 (see Table 8, Page 2-31). Much more frequently, the annual deficits in one or more of the member nations were offset by surpluses in others. For example, 1975 crop year deficits in the Philippines, Thailand, Singapore, and Malaysia were nearly offset by a larger than normal supply in Indonesia.

These conditions, and the problems and inequities that arise from them, can be prevented by an effective ASEAN food security reserve program. Food security reserves can be built up in years of surplus, stored in facilities suitable for maintaining the grain quality, and drawn upon in years of scarcity and relief of local disaster. Security reserves can be developed to a size needed to achieve any targeted degree of stability in food supplies, but excessive reserve stocks can become a costly burden. By approaching the security reserve program jointly, ASEAN member countries can achieve targeted levels of stability in food grain supplies much more efficiently than each could do alone.

The leadership and grain management agencies of ASEAN are to be congratulated as the first to implement a jointly-planned food security reserve program. The recently-formed ASEAN rice reserves held in the member countries

are an excellent beginning, and can form the foundation for a complete food reserve system in the years ahead.

Need for Effective Security Reserve Guidelines

ASEAN leaders are joined by world organizations and international donor agencies in support of goals which food security reserves of food grains can achieve. The United Nations, the World Food Council, the International Bank for Reconstruction and Development, and the International Food Policy Research Institute are among leading organizations dedicated to the need for food security reserves to serve stability, development, and humanitarian goals in all nations. All agree that the needs are particularly great in the developing nations of the world.

The lack of well-established guidelines for planning, using, and maintaining security reserves of food grains continues to represent a serious constraint to ASEAN as well as to other nations of the world. If they are to operate successfully, security reserves must be operated in conjunction with and complementary to national grain management policies and programs. Guidelines are needed (1) for determining the size, type, and location of reserve storage facilities, (2) for designing specific triggers governing additions to and withdrawals from inventories in storage reserves, (3) for interfacing reserve programs with potential stabilizing adjustments in international grain trade among the participating nations, (4) for establishing effective interrelationships among (a) security reserves held in-country, (b) regional security reserves and, (c) world security reserves, (5) for interfacing security reserves in total with grain reserves and storage inventories maintained for other purposes, (6) for interfacing security reserve programs with national, regional, and international food policies.

Successful detailed guidelines covering all dimensions of food security reserves will be evolved through time as ASEAN and other regions of the world gain experience with reserve programs. This learning experience can be facilitated greatly if policy makers have access to rigorous analysis of the consequences of the various alternatives open to them. Because of the complexities and uncertainties involved, the analysis needs to be detailed and penetrating. It needs to be multi-disciplinary and international in approach. It deserves the stimulation and support of heads of state and leaders of international organizations and donor organizations. Effective analytical teams in each nation need to have an organized way to share concepts and procedures and to benefit from one another's experiences. This is the kind of effort which will produce the analysis of alternatives needed by policy makers to facilitate the first-hand learning experience in planning and operating food security reserve programs. This is the kind of effort that will hasten the development of detailed organizational and operational guidelines for food security reserves. This is the kind of effort which will support programs to achieve more effectively and economically the stability, development, and humanitarian goals of security reserves.

It is to this need that the present report, and the methodology upon which it is based, are addressed. The work represents a part of the joint on-going effort by U.S. Agency for International Development and Kansas State University Food and Feed Grain Institute for world-wide technical assistance in grain storage, processing and marketing, and agribusiness development. The data, procedures, computer programs, manuals, and training programs are available to all who can use them. The methodology provides a general framework within which many alternatives can be evaluated; the evaluations can be made in more detail in those dimensions of direct concern to policy makers and grain management

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agencies. The analysis can be extended for projected periods into the future. It can be disaggregrated to deal with sub-areas within each nation and with sub-periods within crop years. It is hoped that the analysis and findings contained herein will be viewed as a starting point for more detailed work in each country, and more complete work on a regional and world-wide basis.

Methodology for Testing Alternatives

The methodology used to test alternative security reserve programs is based upon the historical patterns of food grain production, international trade, and utilization as they have existed within each nation over the past 18 years. Three basic procedural steps are involved. The first is to measure the needs for food security reserves by country and region. The second is to simulate the performance of alternative programs for meeting the need, had they been in operation over the historical period. The third is to measure the cost-effectiveness of the alternative schemes. A possible fourth step of cost-benefit analysis for each of the alternatives is not addressed in this study, but can be added to the methodology at any time.

The data used for the ASEAN analysis includes annual food grain supply and utilization information and aggregrate human population data for each country over the period 1960 through 1977. The country-by-country food grain supply and utilization data is taken from the USDA Foreign Agriculture Circular of March 1978 and previous issues. The country-by-country mid-year total population estimates are taken from the United Nations Demographic Yearbook of 1977 and previous issues. The source references are cited in more detail in Annexes II and III hereto, where the data are listed in the form used for computer input.

The analysis was conducted using the Master Projection Computer Program (MPJ)

in the KSU Food and Feed Grain Institute "User's Guide to Computerized System for Feasible Agribusiness Development," Volume 2, Computer Programs: Special Report No. 2 Revised August, 1979. The system is written in Fortran and designed for agricultural analysts with minimal training in computer language. It is fully user controlled so that computer programming skill is unnecessary.

The sequential steps in the methodology are described in Annex I, hereto. The body of the annex outlines the procedures in simplified non-computer terminology. The accompanying appendix contains a brief description of the MPJ Program and how the command codes are provided to complete each of the computer runs required.

The general guideline steps in the methodology can be summarized following the presentation in Annex I. Each step is done for all ijk of concern, i denoting the crop year (1960-1977), j denoting each food grain (rice, wheat, corn, all grains), and k denoting the country (Indonesia, Malaysia, Philippines, Singapore, and Thailand). The steps follow the three basic procedural steps outlined above, designated as I, II, III in the outline below.

Each of the sequential steps was used to test under ASEAN conditions, (1) security reserves of rice only, and (2) security reserves of all food grains, (rice, wheat, and corn), both in milled rice equivalent. The two types of reserves are assessed under (A) international trade unchanged, and (B) with stabilizing adjustments in international trade.

I. <u>Measuring needs for security reserves</u>

1. Develop supply-utilization balance sheets, so that the total supply quantity, Q, is equal to the total quantity utilized, U. This step is illustrated by the computer tables reproduced in Annex II.
2. For the utilization quantities of concern (domestic human consumption), prepare summary tables, as illustrated by Tables 2, pp 2-2 and 2-6.

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3. Convert the total quantities utilized to the corresponding per capita quantities, using historical mid-year population data (see Annex III and Tables 4, pp 2-4 and 2-7).

4. Fit historical time trends to the per capita quantities utilized for consumption, and plot the results, as shown in Section 2.

5. Compute the year-by-year deviations from the long-term trend in available per capita quantities (Tables 7, pp 2-28, 2-29).

6. Apply the historical population figures to compute the annual tonnage deviations from trend (Tables 8, pp 2-30, 2-31).

7. Compute the historical deviations in excess of those within targeted stability ranges (Tables 10, pp 3-4, 3-5).

8. The results from Step 7 define the need for annual transactions with security reserves, as shown in Tables 10.

II. Testing performance of alternative security reserve programs

9. Establish reasonable bounds on in-country reserve stock levels, and compute annual transactions with the in-country reserves (given the need from Step 8) subject to these bounds (see Tables 11, pp 4-4 and 4-13).

10. By subtraction, compute the residual need for annual transactions with regional reserves, and repeat as in Step 9 for the regional reserves (see Tables 13, pp 4-6, 4-16).

11. If residual needs for further transactions with reserves remain, repeat as in Step 10 for transactions with world reserves (this step was unnecessary for all ASEAN alternatives analyzed).

12. Determine the potential for stabilizing adjustments in international trade over the historical period, using realistic expectations between the date of discovery of need for adjustment and final delivery of the grain from the adjusted trades. A total lag of one-half crop

year was used for all ASEAN alternatives studied (see Tables 15, pp 3-7, 3-8).

13. Determine the need for reserve transactions after the impact of stabilizing international trade, relating the results from Step 12 to those of Step 8 (see Tables 16, pp 3-10, 3-11).

14. Repeat the procedure of Step 9 to determine the annual transactions with in-country reserves after stabilizing trade, as shown by Tables 17, pp 4-9, 4-17).

15. Repeat the procedure of Step 10 to determine annual transactions with regional reserves after stabilizing trade, as shown by Tables 19, pp 4-11, 4-19.

16. If needed, repeat the procedure of Step 11 to determine annual transactions with world reserves.

III. Measuring cost-effectiveness of alternative schemes

17. Compute the required in-country storage capacity, (see Tables 12' pp 5-4, 5-17), and apply appropriate per ton fixed costs to obtain estimated total fixed costs for each alternative, as shown in Tables 21, Annex IV. Standardized total unit costs in real terms of $21.80/MT of total storage capacity were used in this study.

18. Apply appropriate per ton variable costs to the average inventory levels in the in-country reserves to obtain estimated total variable costs for each alternative, as shown in Tables 22, Annex IV. Standardized total unit costs in real terms of $23.30/MT of average storage inventory were used in the study.

19. Sum the fixed and variable costs to obtain estimated total costs of in-country reserves under each alternative, as shown in Tables 23, pp 6-4, 6-9.

20. Repeat Steps 17-19 for the regional reserves to obtain the estimated total costs to each participating country for regional reserves under each alternative. (See Tables 26, pp 6-6, 6-10 and the supporting tables thereto).

21. Sum the estimated total costs for in-country reserves and the estimated total costs for regional reserves to obtain the estimates of combined total cost under each alternative, as shown in Tables 27, pp 6-7, 6-12.

22. Compare the relative total costs of the alternative security reserve programs to measure cost-effectiveness of the alternatives. The estimated additional cost of more complete programs is obtained by subtracting the combined total costs for the two cases, as illustrated by Table 28, p 8-4. The estimated cost savings between two alternatives capable of producing the same level of benefits is obtained by subtracting the combined total costs for the two alternatives, as illustrated by Tables 29, pp 8-7, 8-9.

23. Compute the estimated cost of using stabilizing adjustments in international trade by applying appropriate added per ton charges for such adjustments to the estimated requirements for stabilizing trade from Step 12. Estimated costs for international trade are shown in Tables 30, pp 7-2, 7-3, using a standardized trade adjustment penalty of $25.00/MT net adjustment.

24. Repeat Steps 17-19 for in-country reserves after trade adjustments to obtain the corresponding estimates of total costs for in-country reserves for each of the alternatives involving adjustments in trade. (See Tables 33, pp 7-6, 7-11).

25. Repeat Steps 17-19 for regional reserves to obtain corresponding estimates of total costs for regional reserves after stabilizing adjustments in trade. These estimates are shown by Tables 36, pp 7-7, 7-12.

26. Add the estimated costs for trade adjustments from Step 23 to the estimated total costs for in-country reserves (Step 24) and the estimated total costs for regional reserves (Step 25) to obtain combined cost estimates for each alternative involving trade adjustments. Combined cost estimates are shown in Tables 37, pp 7-8, 7-13.

27. Following the procedure in Step 22, compare the relative combined cost of alternative programs involving stabilizing trade adjustments to estimate their cost-effectiveness. The estimated relative costs for such programs for all food grain reserves compared to rice reserves for ASEAN are shown in Table 38, p 8-5.

It will be noted that the methodology represented by the above 27 steps is based on analysis of quantities of grain available for feeding the population of ASEAN. Market price analysis is not directly involved. Targeted stability ranges around the long-term trend in food requirements for each country are taken at ±3 percent. Transactions with the food reserves are simulated in years when total quantities fall outside this range. Withdrawals are made from the reserves for injection to the market in years when the supply quantity falls short of 97 percent of the trend requirement. Additions are made to the reserves by withdrawals from the market in years when the supply quantity exceeds 103 percent of the trend requirement. Comparable results can be simulated for targeted stability ranges greater or less than ±3 percent.

The methodology does not imply that quantity triggers would have to be used to signal reserve transactions. Price triggers could be used if the

relationship between changes in quantity and changes in price are known. For example, if the annual price elasticity of demand for food grain is -0.2 over the relevant range, then the price stability range corresponding to the ± 3 percent quantity target is ± 15 percent. In this case, withdrawals from rice reserves would be signaled by real prices for rice greater than 115 percent of "normal," and additions to reserves would be signaled by real prices for rice less than 85 percent of "normal." Domestic rice policies and programs would continue to be used for achieving additional price stability in those countries where a 30 percent variation in real prices is considered excessive.

It should be understood also that the methodology deals only with estimated storage capacities, inventories, transactions and costs for security reserves, i.e., additional carry-over quantities at the end of the crop year just prior to the next harvest. Grain storage for carrying grain from harvest to later consumption, for providing pipe-line capacity and for normal year end carry-over would not be affected. All such storage capacity and inventories, and the domestic programs under which they are operated, would be needed just as they now are. Issues involving these relationships for ASEAN are discussed in Section 3.

The reader interested in more formal and detailed discussion of the analytical methodology is again referred to Annex I.

SECTION 2

TRENDS AND INSTABILITIES IN ASEAN FOOD GRAIN SUPPLIES

The first step in analyzing how alternative ASEAN food security reserves might have worked had they been in effect over the 1960-1977 period is to analyze the trends and instabilities in available food grain supplies to each ASEAN country. Analysis is made separately for rice only, and for all food grains (rice, wheat, and corn), so that the results of the two can be compared. The analysis is confined to supplies of grain for food in each of the ASEAN countries. To be specific, only the data shown in column (6) of Tables 1 of Annex II are used for the analysis. No attempt is made to evaluate the potential for security reserves to stabilize grain supplies for non-food uses.

Quantities of Rice for Food Consumption

Because total annual food grain requirements in each country are a function of population growth as well as average per capita consumption, the analysis of trends and instabilities in food supplies can be done more meaningfully on a per capita basis. The average available per capita food supply each year by country is derived from the corresponding total supply figures, using the United Nations mid-year population estimates. The results can be seen by comparing the total tonnage figures in Table 2 with the corresponding grams per capita figures in Table 4. The units in both tables are expressed in terms of milled rice equivalent. As indicated by the statistical parameters shown at the bottom of Table 4, trends and deviations were fitted only to the per capita figures.

Reference to the two tables for rice only on the following pages may help one to visualize the ASEAN rice situation in perspective. Striking from Table 2 is the

TABLE 2. RICE ONLY
DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	9900	814	2274	192	4075	17255
2	1961	9525	769	2334	192	4426	17266
3	1962	10431	898	2432	162	5272	19195
4	1963	9250	865	2463	217	5334	18129
5	1964	9625	937	2543	161	4994	18260
6	1965	9477	992	2628	192	5123	18412
7	1966	9846	982	2367	155	6470	19820
8	1967	9771	883	2811	177	5241	18883
9	1968	10827	908	2921	215	5655	20526
10	1969	11905	980	2993	189	7078	23145
11	1970	12369	1035	3167	247	6773	23611
12	1971	12846	1116	3369	259	6106	23696
13	1972	13324	1172	3343	287	6868	24994
14	1973	14046	1172	3299	191	7266	25974
15	1974	14531	1265	3237	129	7557	26719
16	1975	15166	1156	3402	95	7432	27251
17	1976	15891	1118	3476	182	6965	27632
18	1977	16365	1203	3548	190	7113	28419

SOURCE:
TABLE 1, COLUMN 6

dominance of Indonesia in total ASEAN rice consumption, representing well over half the total annual consumption of the five nations. Thailand's consumption represents roughly one half that of Indonesia, while total consumption in the Philippines is roughly one half that of Thailand. Total consumption in Malaysia is roughly one-third that of the Philippines. Total annual rice consumption by Singapore is less than one percent of that for ASEAN as a whole.

The trend and deviation patterns in annual rice consumption within individual countries are much more apparent from Table 4. The annual per capita quantities available for consumption vary significantly within each nation as well as from one nation to another. The apparent year-to-year variations are relatively great for Singapore and relatively small for the Philippines.

The average annual per capita quantities over the 18-year period for each country are shown at the "YBAR" line in the lower section of Table 4. The averages range from about 82.5 kilograms in the Philippines to 174 kilograms in Thailand, and are in the range of roughly 100 kilograms per capita for the other three countries.

The long-term trends in per capita quantities are indicated by the "B" values, i.e., the average annual change over the 18-year period, for each country. The long-term trend is upward (per capita rice consumption is increasing) in Indonesia and Thailand, but downward in the other three nations. The average annual increase is slightly more than one kilogram for Indonesia, but only 295 grams in Thailand. By contrast, the annual average decrease is nearly two kilograms for Singapore, reflecting increasing substitution of vegetables, fish, poultry and other foods for rice in the Chinese diets of that country.

Perhaps even more striking from the figures in Table 4 is the relatively large year-to-year variations around the trends in per capita supplies of rice. The "RSQ" values indicate that the trend lines explain only a small fraction of

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TABLE 4. RICE ONLY
DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

EXPONENT IS 1.00

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	105419	102934	84315	117359	152416
2	1961	99233	96561	85786	113141	160548
3	1962	106271	106323	84466	92466	185503
4	1963	92102	99323	82773	120355	182042
5	1964	93571	104623	82699	86839	165266
6	1965	89973	107721	82720	100840	164341
7	1966	91259	103696	72319	79692	201250
8	1967	88337	90937	83368	89394	158076
9	1968	95400	91348	84106	106965	165356
10	1969	102241	96552	83673	92647	200663
11	1970	103532	99615	86486	119324	185225
12	1971	104771	104299	88892	122749	162870
13	1972	105880	106545	85740	133468	177973
14	1973	108757	103625	82228	87215	183069
15	1974	109627	106584	76376	56108	185311
16	1975	111482	95591	80009	42222	177502
17	1976	113816	90931	79451	79825	162128
18	1977	114217	95514	78792	82251	161073
	YBAR	101993.75	100317.88	82456.81	95826.03	173978.44
	B	1028.72	-225.19	-161.61	-1972.94	295.43
	RSQ	0.4256	0.0420	0.0549	0.2001	0.0117
	SYX	6574.37	5916.14	3691.49	21705.35	14941.46
	SB	298.68	268.78	167.71	986.10	678.81

SOURCE:
FIGURES IN TABLE 2 DIVIDED BY FIGURES IN TABLE 3.

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the variation which has existed in each country -- less than 6 percent for Thailand, Malaysia, and the Philippines; and only about 20 percent for Singapore and 43 percent for Indonesia, even though the absolute magnitude of the b-values (slope of the trend line) is relatively large in these two countries.

Quantities of All Grains for Food Consumption

Comparable but yet differing patterns may be noted in the annual quantities of all grains for food consumption by ASEAN, as shown by Tables 2 and 4 for all grains in milled rice equivalent. The total annual quantities in Table 2 highlight the relative importance of Indonesia and the relative smallness of Singapore in the total ASEAN food grain consumption picture.

Except for a few isolated years, the large variation in per capita quantities of all food grains is not so striking as for rice (Table 4, All Food Grains). Likewise, the 18-year mean consumption quantities are more comparable from one country to another, ranging from about 117 kilograms in Indonesia to 179 kilograms in Thailand.

The long-term trend in per capita quantities of all grains available for consumption is upward in all of the nations except Singapore, where it has been downward at the average annual rate of 559 grams. Average annual increases in the other countries range from about 124 grams in Malaysia to about one kilogram in Indonesia. The r-square values for all food grains shown in the lower section of Table 4 indicate that large unexplained year-to-year variations in available food grain supplies have existed, even when the long-term trends are taken into account.

Patterns of deviation in quantities of food grains available for consumption from year to year by ASEAN can be seen more clearly in graph form. The accompanying charts are reproductions of computer plots made in the run generating

TABLE 2. ALL FOOD GRAINS (RICE, WHEAT, CORN)
DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	11374	1104	3232	222	4104	20036
2	1961	10893	1092	3281	227	4459	19952
3	1962	12231	1203	3427	232	5303	22396
4	1963	10628	1167	3539	247	5369	20950
5	1964	11713	1156	3624	251	5031	21775
6	1965	10768	1194	3734	262	5169	21127
7	1966	11847	1267	3559	272	6523	23468
8	1967	11150	1166	4102	303	5305	22103
9	1968	12710	1178	4295	344	5739	24266
10	1969	13358	1339	4435	351	7184	26667
11	1970	14048	1367	4730	379	6891	27415
12	1971	14701	1460	4999	319	6254	27753
13	1972	15114	1598	4999	382	7029	29122
14	1973	15632	1564	5001	311	7438	30216
15	1974	16372	1673	5007	206	8838	32096
16	1975	17261	1612	5146	175	7624	31820
17	1976	18100	1585	5626	344	7303	32958
18	1977	18923	1694	5833	313	7376	34139

SOURCE:
TABLE 1, COLUMN 6

TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)
DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

EXPONENT IS 1.00

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	121115	139605	119832	135097	153591
2	1961	113485	133643	117754	133765	161745
3	1962	124609	142434	119326	132420	166394
4	1963	105823	133999	118934	136994	183236
5	1964	113870	129075	117654	135363	166490
6	1965	102229	129656	117532	137635	165816
7	1966	109805	133751	136736	139646	202399
8	1967	103805	122142	121685	181818	163106
9	1968	111992	118511	123666	171144	167812
10	1969	114720	131921	123537	172359	203668
11	1970	117586	131569	126358	183092	189469
12	1971	119900	138313	131900	151135	166318
13	1972	120105	145273	128212	177674	152146
14	1973	122973	140053	124651	142005	167402
15	1974	123916	143605	121235	92793	216724
16	1975	125882	134693	121072	77778	182087
17	1976	129638	128914	123594	153877	169995
18	1977	132170	134498	129536	135498	167029
	YBAR	117284.56	133983.31	122366.50	145757.96	178524.25
	B	994.11	123.57	671.90	-559.38	935.90
	RSQ	0.3511	0.0088	0.4024	0.0114	0.3852
	SYX	7436.93	7202.23	4508.20	20052.59	16923.42
	SB	337.87	327.21	204.72	1301.72	763.94

SOURCE:
FIGURES IN TABLE 2 DIVIDED BY FIGURES IN TABLE 3.

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the two Tables 4. The lines connecting the plotted points were added manually, but the observed and estimated points and the labeling of the axes was done by the MPJ program on the normal computer printer. The deviation patterns serve as the basis for analysis of the potential for food security reserves, and warrant brief discussion for each ASEAN country.

Food Supply Deviation Patterns in Indonesia

The trend and deviation patterns in per capita food supplies available to Indonesia consumers are much the same for rice and for all food grains, as shown by the accompanying charts. The points located by the + signs on the charts represent the historical Indonesia data from Table 4, Rice Only and Table 4, All Food Grains. The points located by the * signs on the charts represent the regression Y estimates of the trend in per capita food use. These estimates are shown in tabular form in the Indonesia column of Table 5, below.

The plus and minus distances along the Y-axis between the observed points and the trend estimate points represent the overruns and shortfalls in available food grain supplies per capita. These differences are shown in tabular form in the Indonesia column of Table 7, Rice Only and Table 7, All Food Grains. It will be noted that per capita supplies of rice in Indonesia were in excess of trend for the first three years of the historical period, below trend for five consecutive years, close to trend for the next four years and slightly above trend for the last four years in the series. Indonesia's consumption trend is upward, as indicated by the charts and by the positive b-values in Table 4.

Per capita supplies of all food grains in Indonesia follow a similar pattern, but one which is by no means identical, as can be seen by comparison of the two charts. All food grain supplies in milled rice equivalent were above trend the first year, near trend the second year, above trend again the third

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year, slightly below trend the fourth, at trend the fifth, well below the sixth, slightly below the seventh, far below the eighth, slightly below the ninth and tenth, close to trend the next five successive years, and above trend by increasing amounts the last three years. The corresponding numerical amounts are shown in Table 7, All Food Grains. Note that the deviation from trend for 1977 is about +6.3 kilograms per capita, for example.

It will be noted further that average all grain food supply per capita is increasing at about the same rate (exhibits about the same upward slope) as that for rice only in Indonesia. The b-values from Table 4 are 1029 grams and 994 grams, respectively, showing the slightly higher average growth rate for rice. The similar trends make direct comparison of the two charts for Indonesia less confusing than might otherwise be the case.

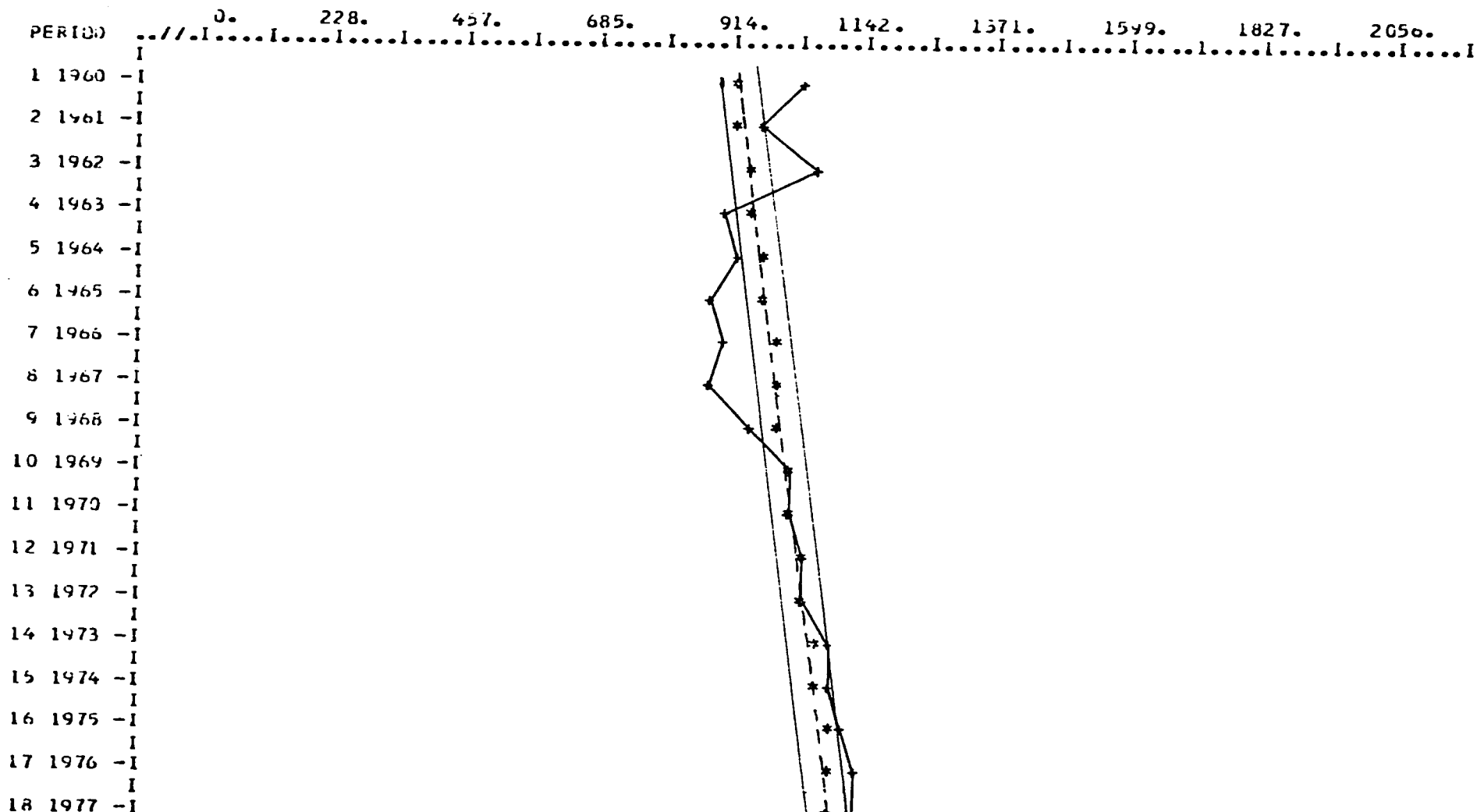
The light solid lines bounding the trend in per capita food grain supplies to Indonesia's consumers which have been drawn on the charts by hand represent the targeted stability range, ± 3 percent from the long-term trend in per capita quantities. Observations within this band are considered acceptable, signaling no simulated transactions with food security reserves. Observations above this band are considered excessive, and signal deposits to the reserves. Observations below the band are considered deficit, and signal withdrawals from the reserves for additional food supply. Thus for the rice case, Indonesia has simulated deposits to the reserves in 1960, 1961, and 1962, withdrawals from the reserves during 1963 through 1968, no transactions from 1970 through 1975 and small simulated deposits again in 1976 and 1977. The all food grains case is similar, except that transactions are virtually zero in 1961 and 1964, while the simulated deposits in 1977 are larger than for the rice case.

To summarize based on the two charts for Indonesia, the simulated test of alternative food security reserve programs is to determine whether reserve

PLOT OF OBSERVED AND ESTIMATED DATA

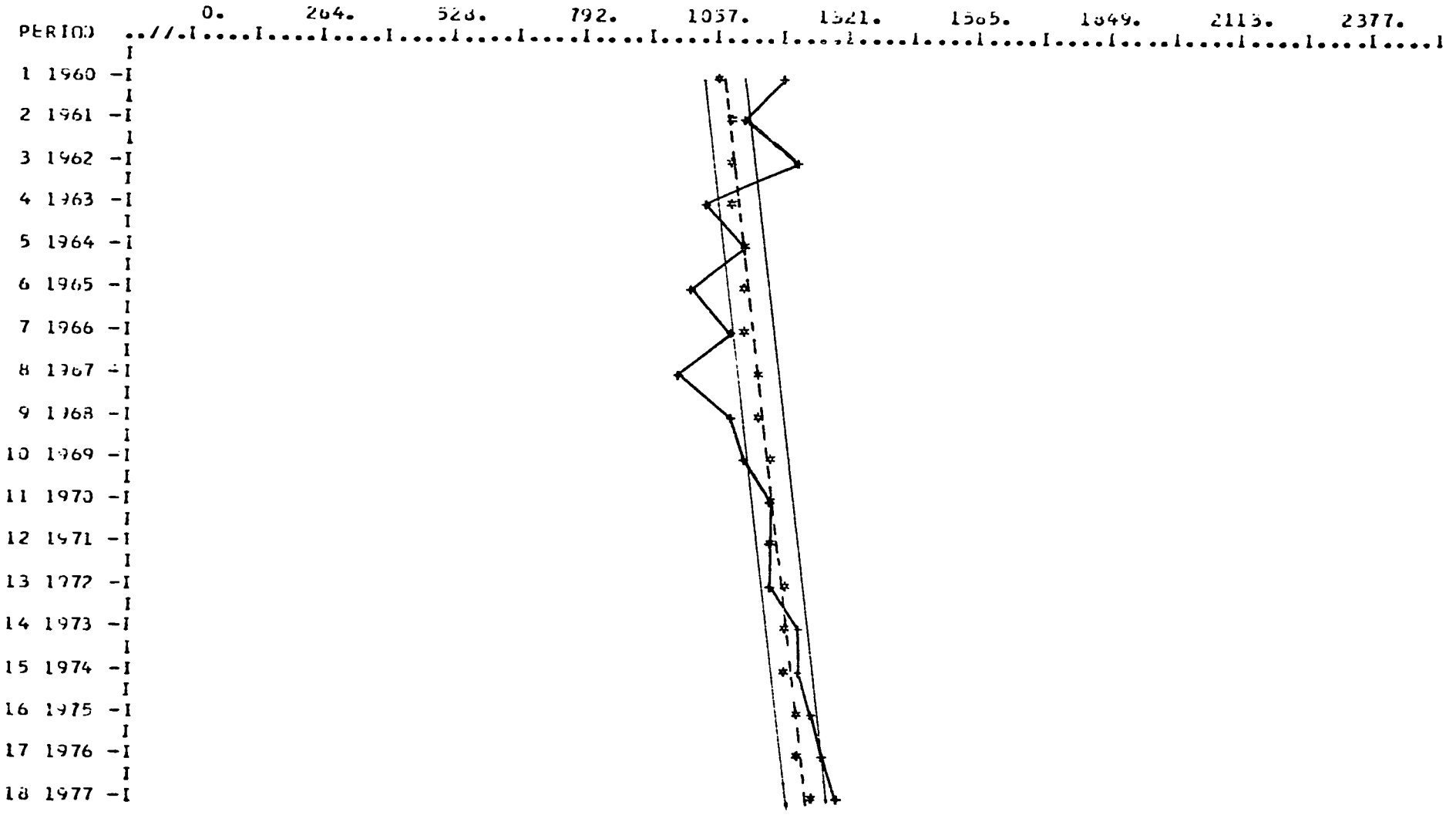
TABLE 4. RICE ONLY
INDONESIA

UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.4258)



PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)
INDONESIA UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.3511)



transactions can be used to offset the "excess" overruns and shortfalls (those outside the targeted stability band). Programs which succeed in holding net available food grain supplies per capita to amounts within this band meet the targeted stability objectives. Those which do not hold net available supplies within the targeted band fail to meet the stability goals. The methodology used is designed precisely to make this kind of test.

Food Supply Deviation Patterns in Malaysia

Differences among the per capita food supply deviation patterns between the rice case and the all food grains case are more striking for Malaysia than for Indonesia, as shown by the accompanying charts. The long-term trend in available quantities is slightly downward for rice, but slightly upward for the three food grains taken together in milled rice equivalent. Both patterns show major deficits in 1967 and 1968, overruns in 1972 to 1974 and near trend levels for 1970, 1975, and 1977; beyond this the patterns for Malaysia differ considerably.

In the case of rice only, Malaysia's food supplies per capita have exceeded trend nine years and fallen short of trend the other nine. The greatest deficit was encountered in 1967 and the greatest excess in 1974. In addition, significant deficits were encountered in 1961, 1968, and 1976. Relatively large surpluses were encountered in four successive years, 1971-1974, as well as in three successive earlier years, 1964-1966. Deviations exceeded the target stability range in all but six of the 18 years.

In the case of all food grains, Malaysian consumers have been faced with overrun quantities as often as with shortages, but many of the shortages have been more severe. The negative deviation from trend in 1968 was the equivalent of 15.4 kilograms for every man, woman, and child in Malaysia, for example. During the period 1964-1970, important shortfalls were encountered in six of

seven years. This lean-year period was preceeded by four relatively good years and followed by another four-year period of overruns. In spite of this pattern, deviations have exceeded the target band in only nine of the 18 years, falling within this band the other 9.

Food Supply Deviation Patterns in the Philippines

Somewhat different trend and deviation patterns of per capita food supplies are evident in the accompanying charts for the Philippines. As is true of Malaysia, rice quantities have exhibited a downward long-term trend while per capita food quantities of all food grains have exhibited an upward trend. However, in most years in the last 18, Philippine consumers have found food supplies within the targeted stability band. This has been true in all but five years for rice only and for all but three years for all food grains in milled rice equivalent.

Major shortfalls of both rice and all food grains were encountered by the Philippines in 1966 and again in 1974 and 1975 during the rice crisis. The major extended period of overrun in per capita consumption quantities of both rice and all food grains was encountered during the 1970-1972 period.

The major difference between Philippine patterns for rice only and all food grains is during the last two years of the observation period, 1976 and 1977. For these years quantities of rice have been below trend while the quantities of all food grains have been above trend.

Food Supply Deviation Patterns in Singapore

The charts for Singapore present an interesting and unique case among the ASEAN countries. A developed urban nation, Singapore is wholly dependent on the outside world for food grains to supply the consumption needs of her

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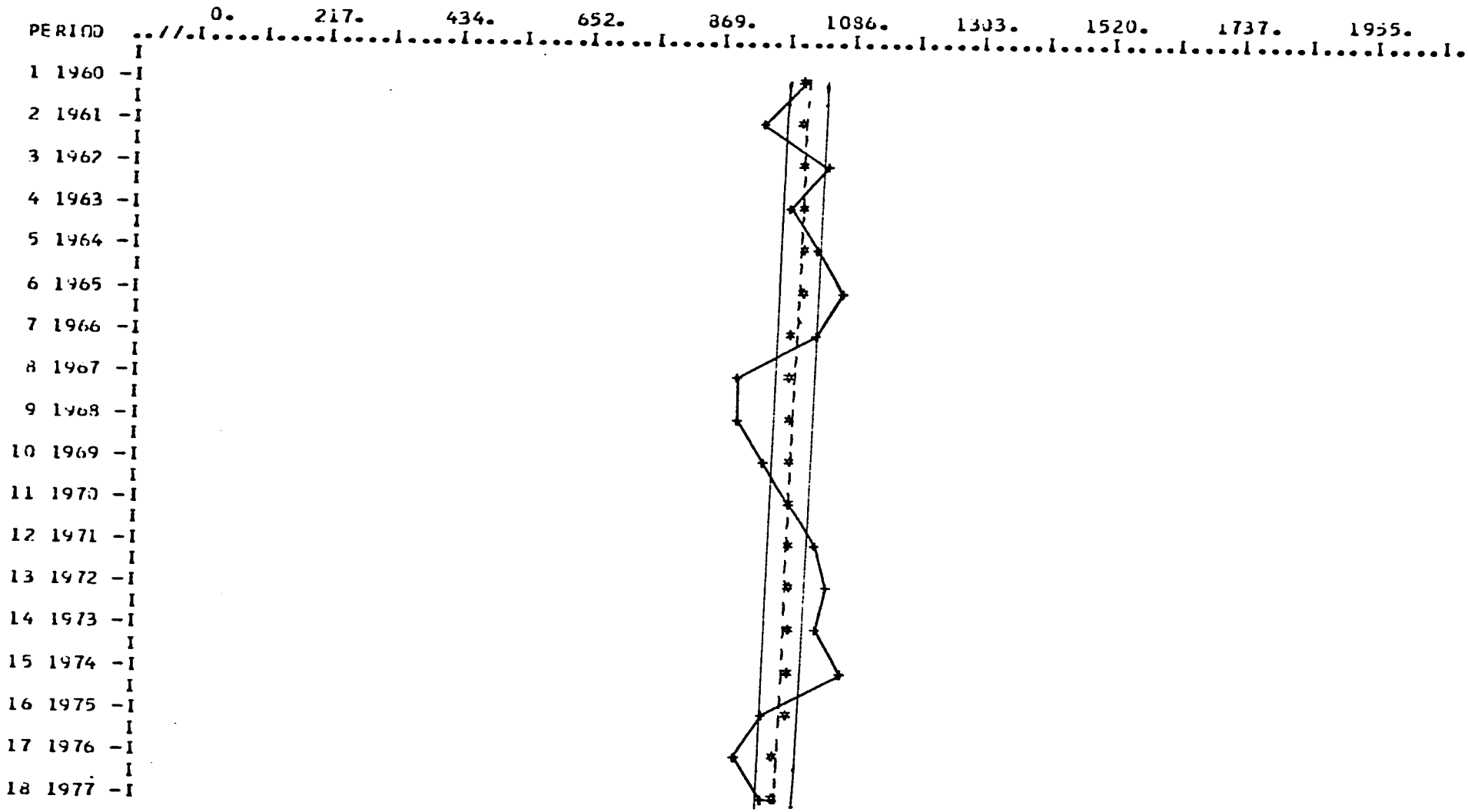
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. RICE ONLY
MALAYSIA

UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0420)



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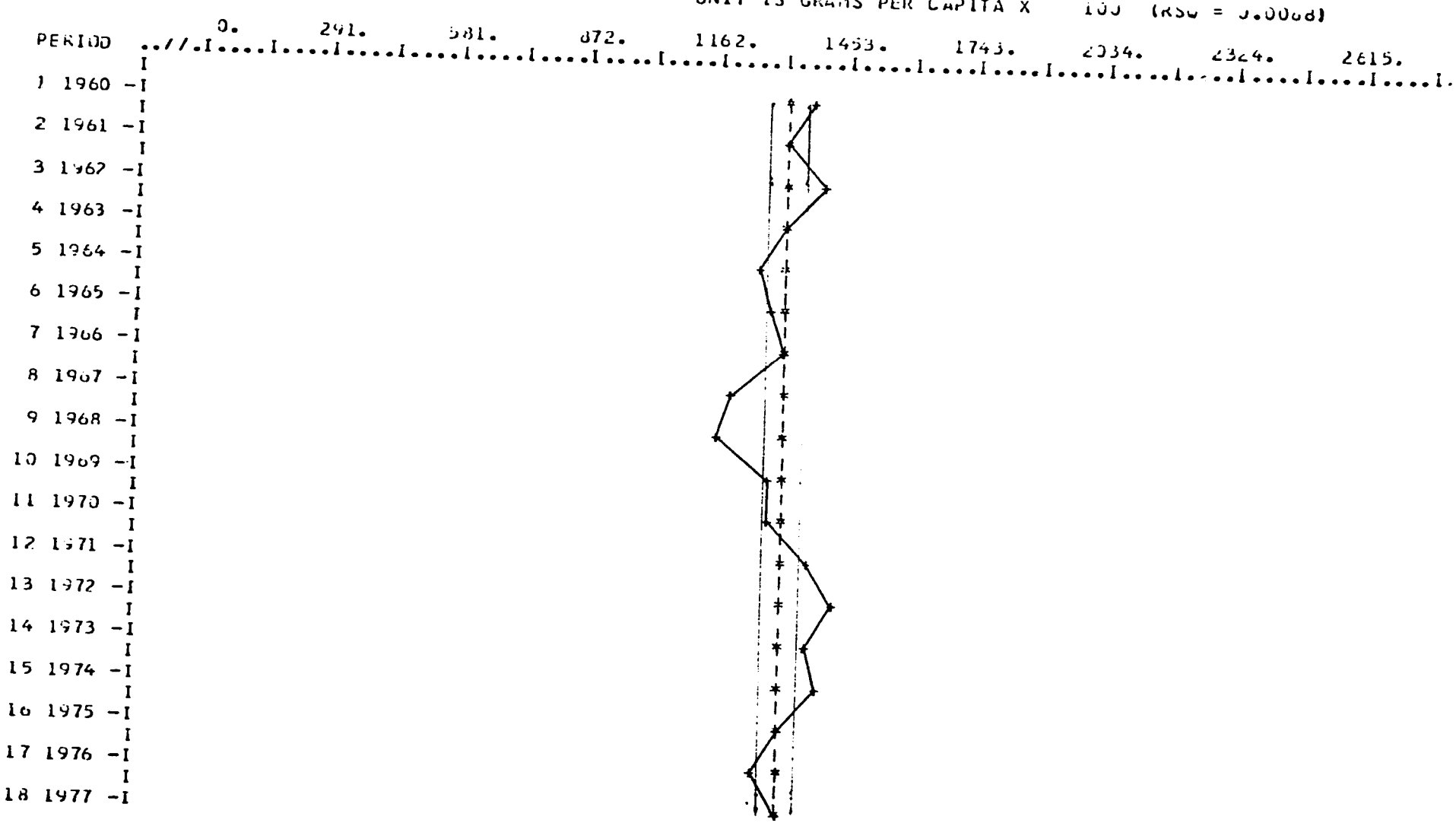
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)
MALAYSIA UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0068)



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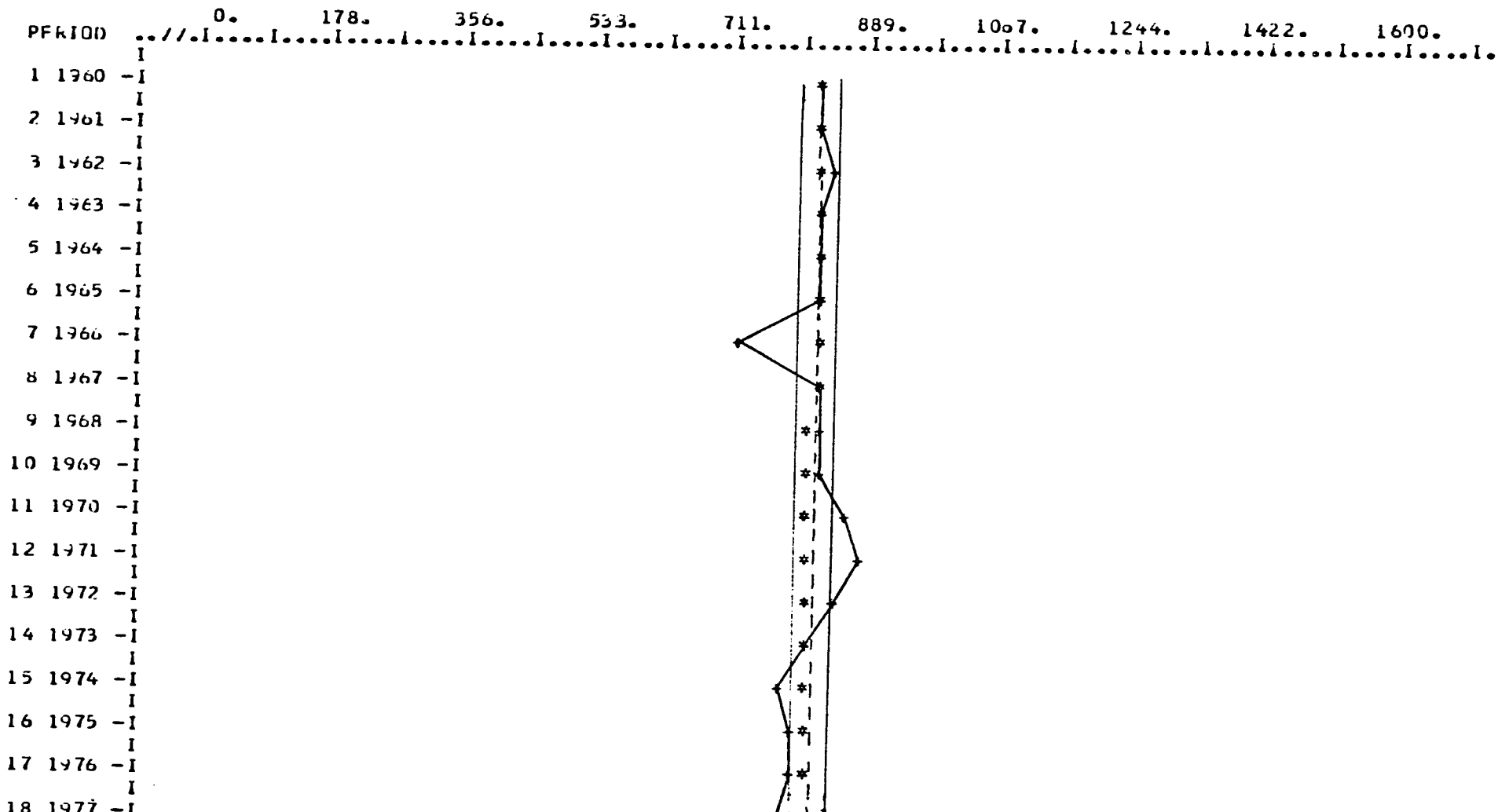
PLOT OF OBSERVED AND ESTIMATED DATA

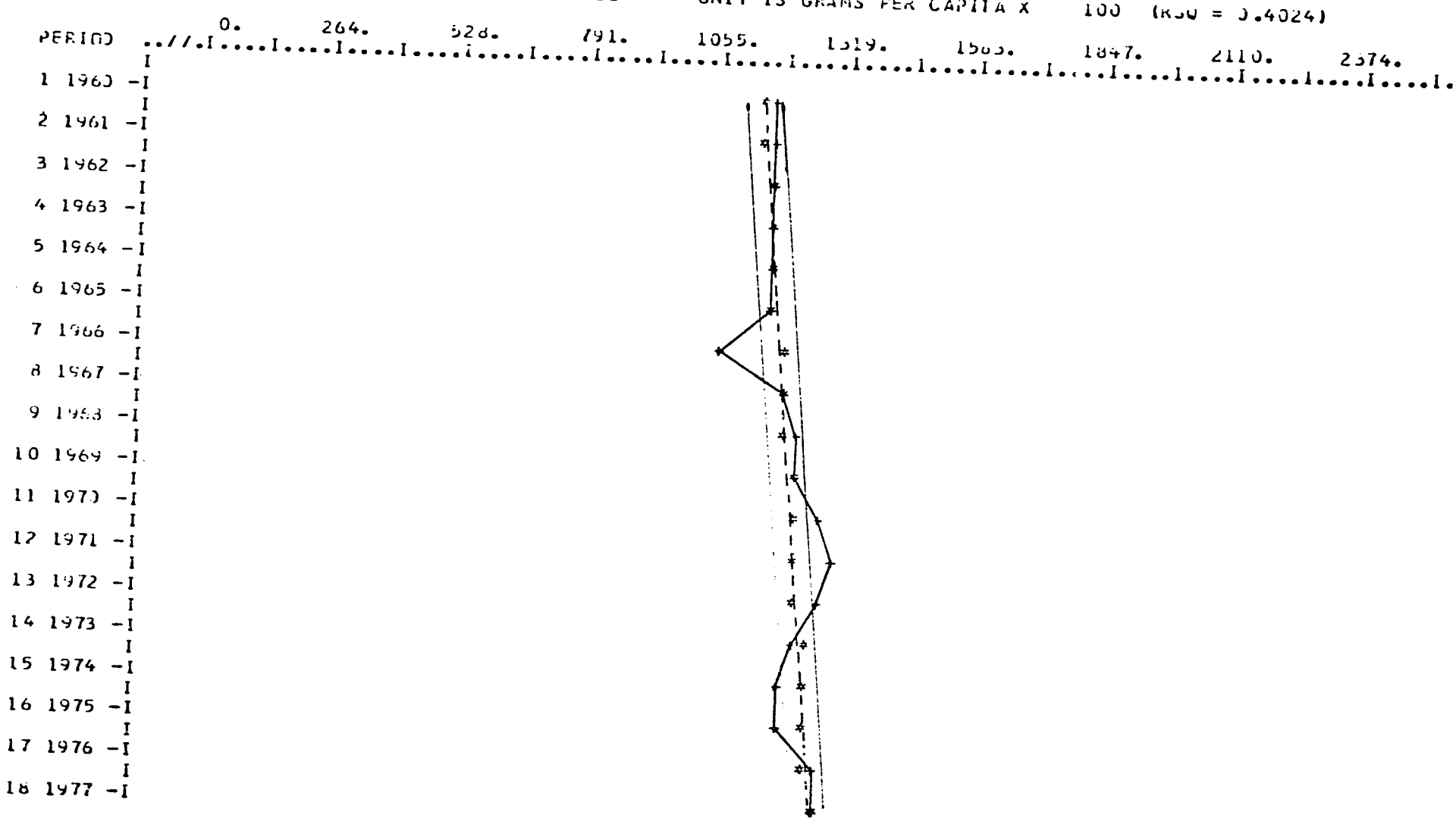
TABLE 4. RICE ONLY
PHILIPPINES UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0549)



40

PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)
PHILIPPINES UNIT IS GRAMS PER CAPITA X 100 (R30 = 0.4024)



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people. As has been noted, the long-term trends in per capita quantities available have been downward for both rice only and for all food grains, more sharply so for rice. Projected per capita consumption for the 1980 crop year of about 71 kilograms (156 pounds) is characteristic of a developed nation of rice eaters who are able to substitute against rice in their diets.

The deviation patterns shown by the Singapore charts also are interesting. Both are characterized by very large relative deviations, overruns and shortfalls alike. The Singapore pattern for rice only can be described as either very close to the trend or very divergent from it. In the earlier years the pattern is up and down in saw-tooth fashion, but since 1970, the saw-teeth have become large in both amplitude and duration; the observed quantity per capita reached an all-time low of only 42.2 kilograms in 1975. Such divergent surpluses and shortfalls certainly could not be tolerated in any other ASEAN country.

The Singapore deviation pattern for all grains exhibits a quite different picture. Although consistently below the minimum level of targeted stability, per capita quantities of all grains remained nearly parallel to the trend line for the first seven years, followed by overruns for as many more. As in the rice case, major shortfalls were encountered in 1974 and 1975, but the recovery came more quickly and sharply in all food grains than in rice.

Food Supply Deviation Patterns for Thailand

The accompanying charts for Thailand also exhibit interesting saw-tooth deviation patterns of shortfalls followed by overruns. Both the rice chart and the all food grains chart reflect Thailand's upward long-term trend in per capita quantities for consumption, with the greater slope shown by the all grains chart. But more striking is the fact that the plus and minus deviations in per capita quantities fall well outside the band of target stability levels

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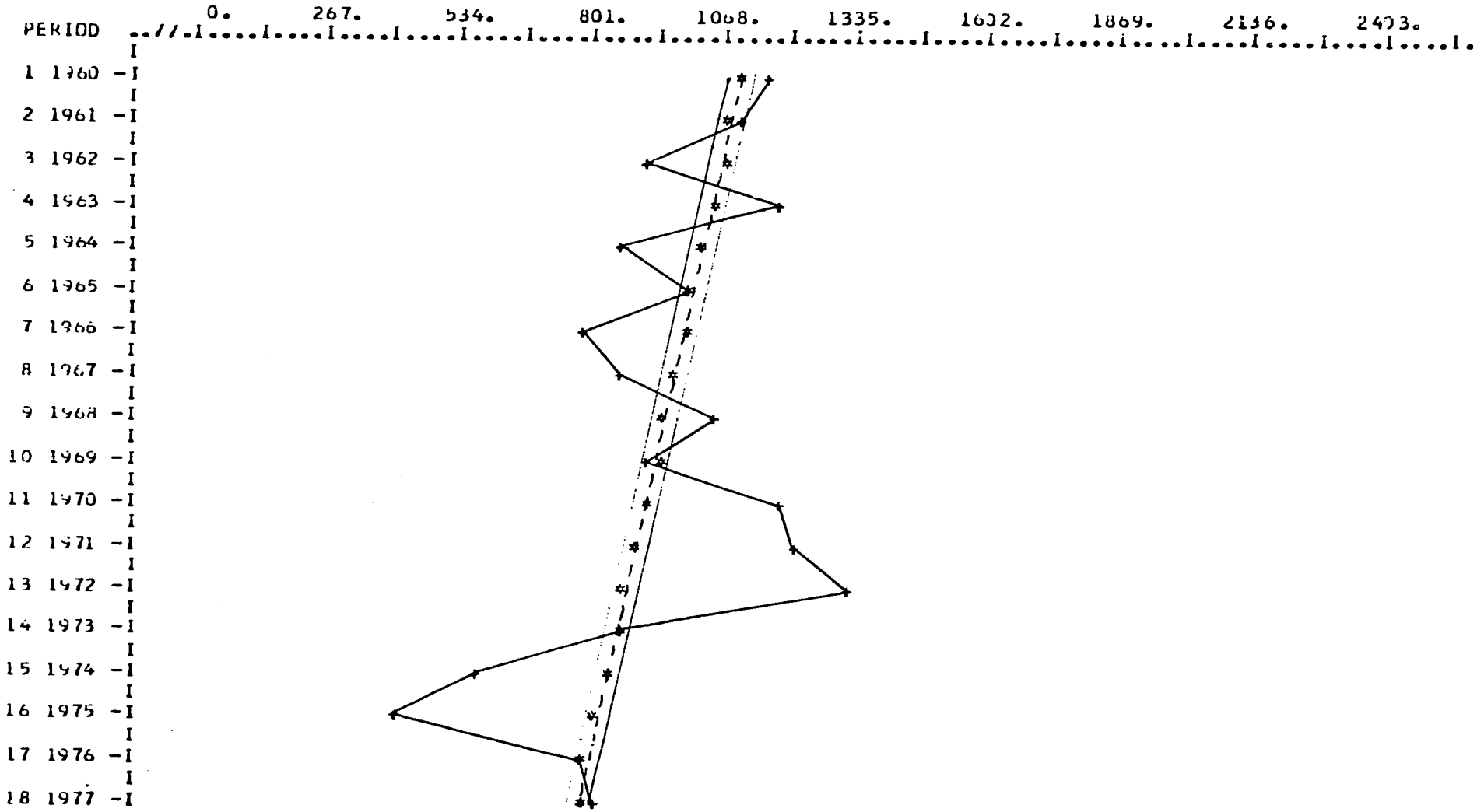
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. RICE ONLY
SINGAPORE UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.2001)



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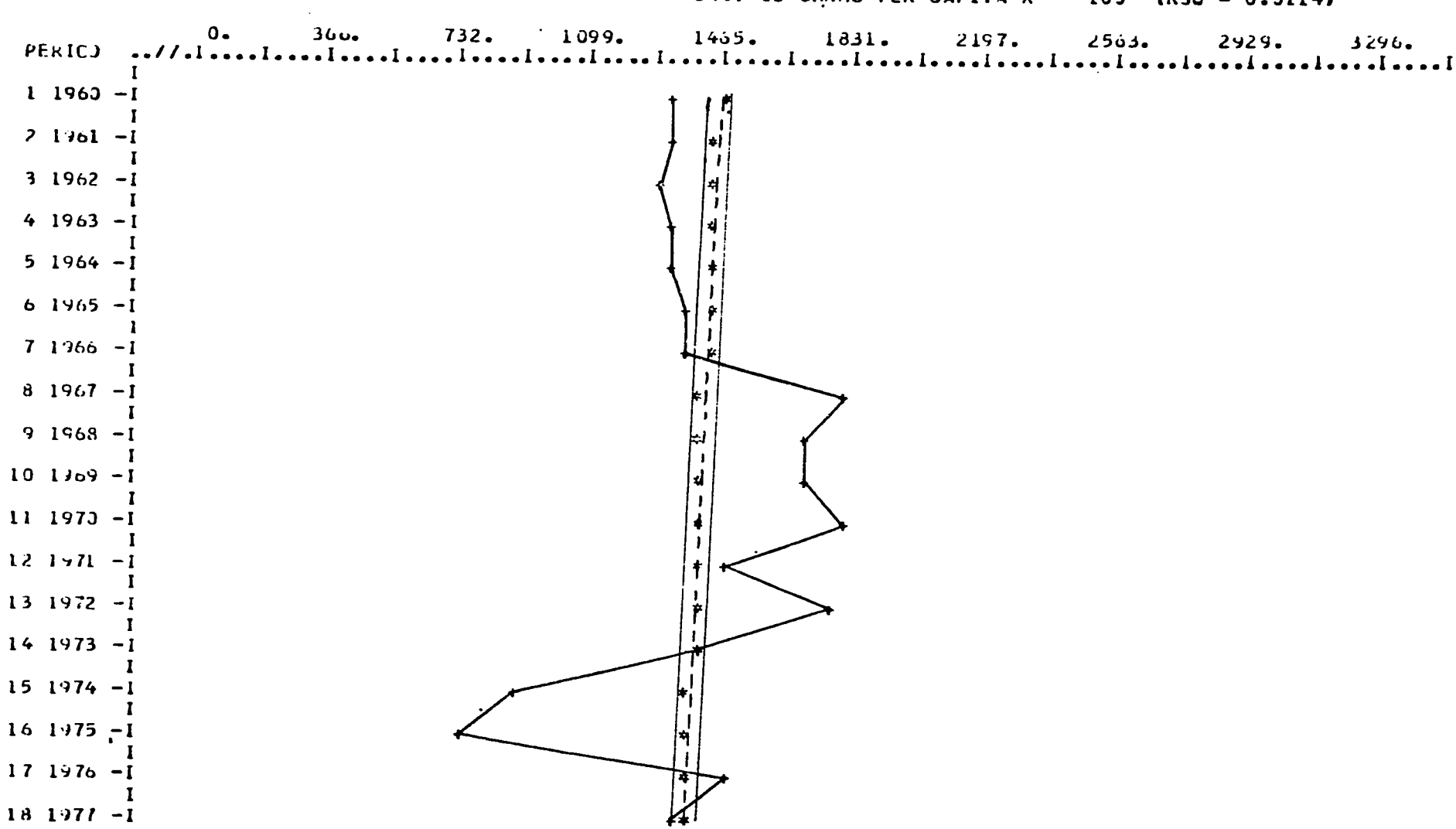
PLOT OF OBSERVED AND ESTIMATED DATA

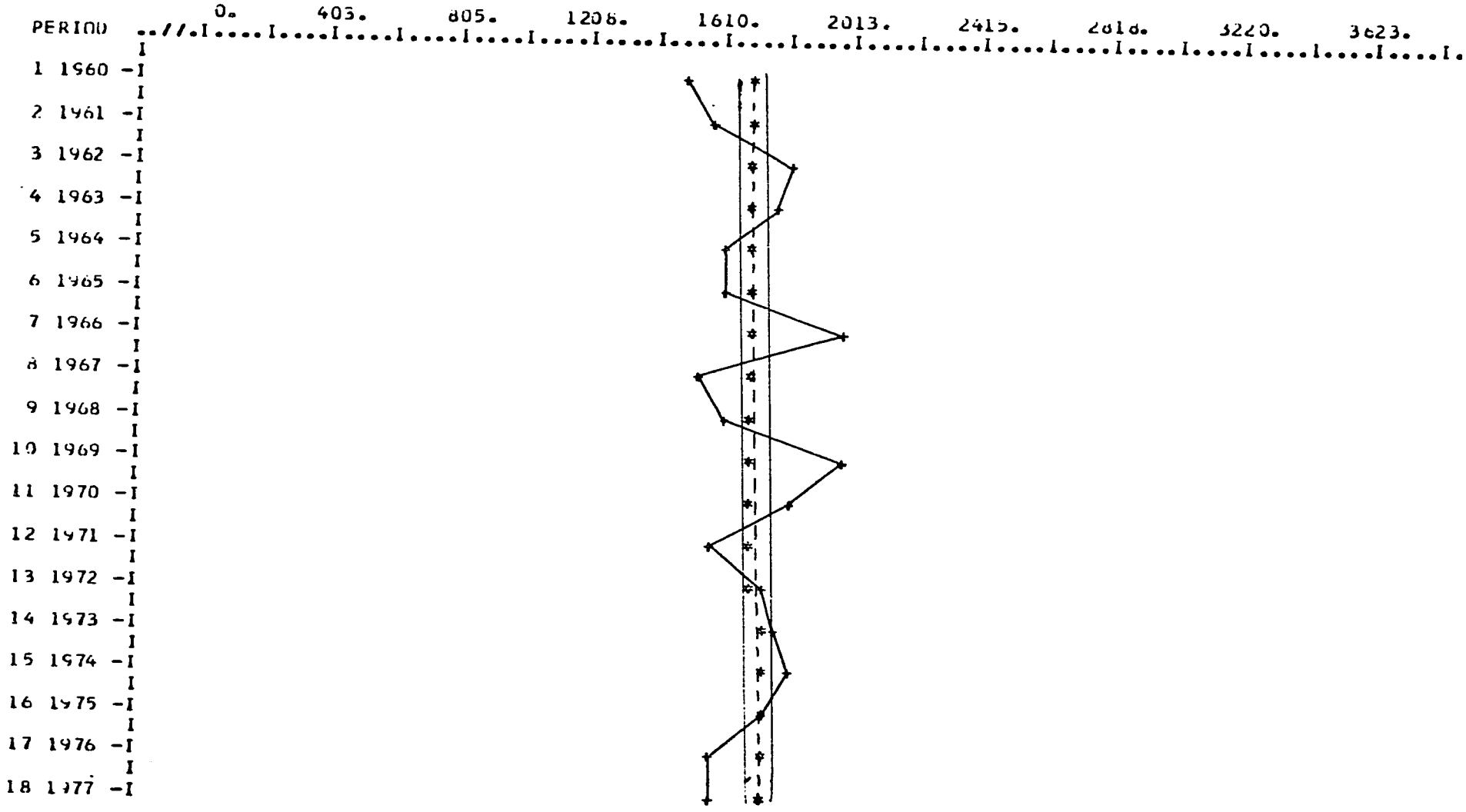
TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)
SINGAPORE UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0114)



PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. RICE ONLY
THAILAND

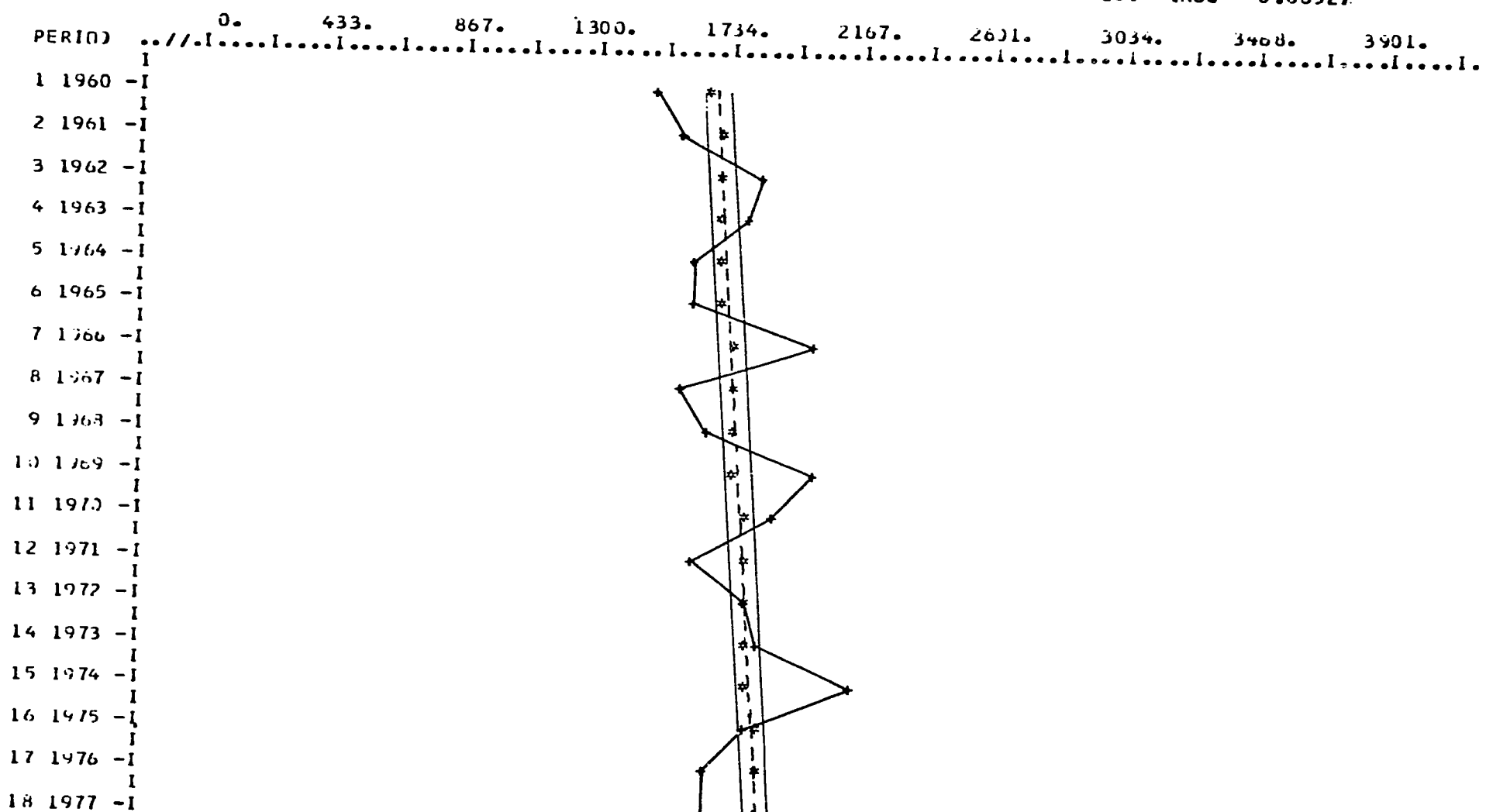
UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0117)



PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 4. ALL FOOD GRAINS (RICE, WHEAT, CORN)

THAILAND UNIT IS GRAMS PER CAPITA X 100 (RSQ = 0.0852)



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in most years -- 16 of 18 in the rice case and 15 of 18 in the all food grains case. The patterns are of even more interest because Thailand is a major exporting nation of both rice and corn.

The patterns shown by the charts certainly do not support the thesis that Thailand's export status precludes the need for her participation in ASEAN security reserves of rice and other food grains. Quite the contrary; the patterns for Thailand indicate great potential for food security reserves to stabilize year-to-year quantities of food grains to reasonable levels of deviation from the long-term in domestic per capita consumption. It would appear that Thai farmers and Thai consumers have as much or more to gain from security reserves than do the citizens of any of the other ASEAN countries. This statement is further reinforced by the analytical results reported in the sections which follow.

Deviation Patterns in Metric Tons of Food Supply

All figures in the computer-plotted charts are given on the basis of quantities per capita in each country. The corresponding numbers as plotted on these charts are shown more accurately in the accompanying Tables 5 and 7. Those in Table 5, Rice Only and Table 5, All Food Grains show the trend estimates based on the regression equations, the parameters of which are shown in the lower section of the corresponding Table 4. The regression equations are not satisfactory for long-run projection of the trend requirements because of their questionable statistical reliability. The major reason for this is the large and unpredictable year-to-year deviation between the observed and estimated quantities available for consumption in each of the ASEAN countries. It is this pattern of large and unpredictable deviation which provides the basis for quantitative assessment of the need for food security reserves. Thus

TABLE 5. RICE ONLY
ESTIMATED DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	93250	102232	85830	112597	171467
2	1961	94278	102007	83669	110624	171763
3	1962	95307	101781	83507	108651	172058
4	1963	96336	101556	83346	106678	172353
5	1964	97364	101331	83184	104705	172649
6	1965	98393	101106	83022	102732	172944
7	1966	99422	100861	82861	100759	173240
8	1967	100451	100656	82699	98786	173535
9	1968	101479	100430	82538	96813	173831
10	1969	102508	100205	82376	94840	174126
11	1970	103537	99980	82214	92867	174421
12	1971	104565	99755	82053	90894	174717
13	1972	105594	99530	81891	88921	175012
14	1973	106623	99304	81730	86948	175308
15	1974	107652	99079	81568	84975	175603
16	1975	108680	98854	81406	83002	175899
17	1976	109709	98629	81245	81030	176194
18	1977	110738	98404	81083	79057	176490

SOURCE:
STATISTICAL ESTIMATES BASED ON THE REGRESSION EQUATIONS FROM TABLE 4.

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TABLE 5. ALL FOOD GRAINS (RICE, WHEAT, CORN)
ESTIMATED DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	108835	132933	116655	148510	173544
2	1961	109829	133056	117327	147950	171482
3	1962	110823	133180	117999	147391	172421
4	1963	111817	133304	118671	146832	173360
5	1964	112811	133427	119343	146273	174299
6	1965	113805	133551	120015	145714	175238
7	1966	114799	133674	120687	145155	176177
8	1967	115793	133798	121359	144596	177116
9	1968	116788	133921	122030	144037	178055
10	1969	117782	134045	122702	143478	178994
11	1970	118776	134169	123374	142919	179932
12	1971	119770	134292	124046	142360	180871
13	1972	120764	134416	124718	141801	181810
14	1973	121758	134539	125390	141242	182749
15	1974	122752	134663	126062	140683	183688
16	1975	123746	134787	126734	140124	184627
17	1976	124740	134910	127406	139565	185566
18	1977	125734	135034	128078	139006	186505

SOURCE:
STATISTICAL ESTIMATES BASED ON DATA IN TABLE 4.

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the very factors which make the regression analysis unreliable for long-run projections make such analysis particularly useful as the starting point for assessing the potential for food security reserves.

The numerical deviations between the observed per capita quantities and the trend estimates are shown in Table 7, Rice Only and Table 7, All Food Grains. They are simply the observed quantities in Table 4 minus the trend estimates in Table 5. As indicated in Section 1, these numerical plus and minus deviations provide the complete basis for the analysis which follows. If the numbers in these tables were not significantly different from zero, there would be no need for ASEAN food security reserves of rice or other food grains. They are significantly different from zero, and their sign and magnitude can be used to determine the effectiveness of ASEAN security reserves had they been in operation over the period during which the reported deviation quantities existed.

The tonnage deviation quantities shown in Table 8 are the product of the per capita deviations from Table 7 and the mid-year total population estimates from Table 3 (Annex III). As such, they reflect the changes in total population over the 18-year historical period as well as the long-term trends in per capita quantities for food consumption. The total tonnage deviations, of course, take the sign of their Table 7 parent. For example, the 1967 shortfall of rice in Indonesia of 12.114 kilograms/capita corresponds to a shortfall for the Indonesia population of 1,340,000 metric tons of milled rice. The 1966 shortfall in Singapore of 21.067 kilograms/capita corresponds to a shortfall for the Singapore population of 41,000 metric tons of milled rice.

It will be noted that in contrast to the per capita figures in Table 7, the tonnage deviations in Table 8 are additive so that ASEAN totals are meaningful. Note also from Table 8 that shortfalls in one ASEAN country often

have been partially offset by overruns in another country the same crop year. This is as true of rice as it is of the three food grains taken together. As a result, the coefficient of variation for ASEAN as a whole is significantly less than that for any of the individual member countries. The extreme deviation in the ASEAN total quantities of rice has ranged from -1,943,000 MT in 1967 to 1,496,000 MT in 1962. That for all food grains in milled rice equivalent has ranged from -2,253,000 MT in 1967 to 1,838,000 MT in 1962.

TABLE 7. RICE ONLY
DEVIATIONS BETWEEN ACTUAL AND ESTIMATED CONSUMPTION, ASEAN, 1960-1977

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	12169	702	483	4762	-19051
2	1961	4955	-5446	119	2517	-11215
3	1962	10964	4542	961	-16185	13445
4	1963	-4234	-2233	-573	13677	9689
5	1964	-3793	3292	-485	-17866	-7383
6	1965	-8420	6615	-302	-1892	-8603
7	1966	-8163	2815	-10542	-21067	28010
8	1967	-12114	-9719	689	-9392	-15459
9	1968	-6079	-9082	1568	10152	-8475
10	1969	-267	-3653	1297	-2193	26537
11	1970	-5	-365	4272	26457	11804
12	1971	206	4544	6839	31855	-11847
13	1972	286	7015	3849	44567	2961
14	1973	2134	4321	498	267	7761
15	1974	1975	9505	-3190	-26867	9708
16	1975	2802	-2263	-1397	-40780	1603
17	1976	4107	-7698	-1794	-1205	-14066
18	1977	3479	-2890	-2291	3194	-15417

SOURCE:
FIGURES IN TABLE 4 MINUS FIGURES IN TABLE 5.

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TABLE 7. ALL FOOD GRAINS (RICE, WHEAT, CORN)
DEVIATIONS BETWEEN ACTUAL AND ESTIMATED CONSUMPTION, ASEAN, 1960-1977

(GRAMS PER CAPITA PER YEAR, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	12280	6672	3177	-12813	-17043
2	1961	3656	587	457	-14133	-9737
3	1962	13786	9254	1027	-14971	14175
4	1963	-5994	695	203	-9838	3876
5	1964	1059	-4352	-1489	-10890	-7809
6	1965	-11576	-3695	-2483	-8109	-5422
7	1966	-4994	117	-11949	-5309	25722
8	1967	-14988	-11655	325	37222	-17110
9	1968	-4796	-15410	1638	27107	-10243
10	1969	-3062	-2124	1255	28581	24674
11	1970	-1190	-2800	4984	40173	9537
12	1971	130	4026	7854	8825	-14053
13	1972	-659	10857	3494	35875	336
14	1973	1215	5514	-739	707	4653
15	1974	764	6942	-4827	-47890	33036
16	1975	2136	-94	-5662	-62346	-2540
17	1976	4898	-5996	1186	11312	-15571
18	1977	6336	-536	1456	-5596	-19476
	YBAR	117284.56	133963.31	122306.50	145757.56	178524.25
	B	594.11	123.57	671.90	-559.06	938.90
	RSQ	0.3511	0.0068	0.4024	0.0114	0.0852
	SYX	7436.93	7202.23	4506.20	28652.59	16925.42
	SB	337.87	327.21	204.72	1301.72	768.94

SOURCE:
FIGURES IN TABLE 4 MINUS FIGURES IN TABLE 5.

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TABLE 8. RICE ONLY
DEVIATIONS BETWEEN ACTUAL AND ESTIMATED CONSUMPTION, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	1143	6	13	8	-509	661
2	1961	476	-44	3	4	-309	130
3	1962	1076	38	28	-28	382	1496
4	1963	-425	-19	-17	25	284	-152
5	1964	-390	29	-15	-33	-223	-632
6	1965	-887	61	-10	-4	-268	-1108
7	1966	-881	27	-345	-41	900	-340
8	1967	-1340	-94	23	-19	-513	-1943
9	1968	-690	-90	54	20	-290	-996
10	1969	-31	-37	46	-4	936	910
11	1970	-1	-4	157	55	429	636
12	1971	25	49	259	67	-444	-44
13	1972	36	77	150	96	114	473
14	1973	276	49	20	1	308	654
15	1974	262	111	-132	-60	396	577
16	1975	381	-27	-59	-92	67	270
17	1976	573	-95	-78	-3	-604	-207
18	1977	498	-36	-103	7	-681	-315

SOURCE:
FIGURES IN TABLE 7 MULTIPLIED BY FIGURES IN TABLE 3.

TABLE 8. ALL FOOD GRAINS (RICE, WHEAT, CORN)
DEVIATIONS BETWEEN ACTUAL AND ESTIMATED CONSUMPTION, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	1153	53	86	-21	-456	615
2	1961	351	5	13	-24	-268	77
3	1962	1353	78	30	-26	403	1838
4	1963	-602	6	8	-28	289	-317
5	1964	109	-39	-46	-20	-236	-232
6	1965	-1219	-56	-79	-19	-294	-1643
7	1966	-539	1	-391	-10	859	-80
8	1967	-1658	-113	11	74	-567	-2253
9	1968	-544	-155	57	54	-350	-936
10	1969	-356	-22	46	58	870	596
11	1970	-142	-27	164	83	347	445
12	1971	16	43	298	19	-527	-151
13	1972	-83	119	136	77	13	262
14	1973	157	62	-30	2	135	376
15	1974	101	104	-199	-106	1347	1247
16	1975	427	-1	-241	-140	-106	-61
17	1976	684	-74	92	26	-669	19
18	1977	908	-7	66	-8	-660	99

SOURCE:
FIGURES IN TABLE 7 MULTIPLIED BY FIGURES IN TABLE 3.

SECTION 3

SIMULATED REQUIREMENTS FOR RESERVE TRANSACTIONS WITH AND WITHOUT STABILIZING TRADE

The requirements for annual deposits to and withdrawals from security reserves under alternative programs follow directly from the charts and analysis presented in Section 2. The simulated annual requirements under each alternative represent those plus and minus deviations which are outside the targeted range of stability in the quantity of food grain available for consumption in each country. The acceptable range of variability in available quantities for all alternatives is taken at $\pm$ 3 percent of the long-term trend in per capita consumption. This targeted range is somewhat arbitrary, being a policy-oriented parameter. If the range is made larger than $\pm$ 3 percent, the needed reserve transactions and the corresponding reserve stock levels would be correspondingly lower. The benefits to ASEAN from stability in year-to-year food supplies would be reduced as well. On the other hand, if the targeted stability range is less than $\pm$ 3 percent, needed reserve transactions, reserve stock levels and stability benefits all would be increased. However, the reserve program would tend to become massive, and might interfere with food policies and programs within each of the participating nations. It is for these reasons that the $\pm$ 3 percent stability goal was selected for testing in this study; the alternative food reserve programs can be tested under different stability goals with the same methodology, if desired.

Specification of Alternatives for Analysis

In addition to a common targeted range of stability in annual food supplies, the alternative food security reserve programs simulated in this analysis has

been structured for comparability and for potential workability under ASEAN conditions. The four basic alternatives studied are:

Alternative 1-A. Security Reserves of Rice Only, Using Historical Trade Patterns

Alternative 1-B. Security Reserves of Rice Only, Assuming Stabilizing Trade Adjustments

Alternative 2-A. Security Reserves of All Food Grains, Using Historical Trade Patterns

Alternative 2-B. Security Reserves of All Food Grains, Assuming Stabilizing Trade Adjustments

Under each of these four alternatives, the targeted stability level and the key structural parameters are identical. The common features include:

Goal: Stability to $\pm$ 3 percent deviation from the long-term trend in supply quantities available for food consumption.

In-country Reserves: In-country security reserve stocks are the front line of defense; for each country the in-country stocks are allowed to fluctuate between zero and a maximum defined by the standard error of the regression estimate for per capita supplies, applied to the long-term trend estimate of tonnages for consumption.

Regional Reserves: Regional security reserves are the second line of defense to be drawn upon in years when the needs are greater than can be met by the in-country reserves. The regional reserves for ASEAN as a whole are allowed to fluctuate between zero and a specified maximum, but constraints are not imposed on the individual country accounts in the regional reserves.

In-country Facilities: The in-country grain reserve storage facilities are assumed to be first-class grain storage structures which are well-located in the marketing system in each country. The required reserve storage capacity is assumed to be located adjacent to other storage and handling facilities, but committed to the exclusive use of reserve storage. The in-country capacity is defined by the reserve stock limits on in-country reserves in each country.

Regional Facilities: The regional grain reserve storage facilities are taken as comparable to the in-country facilities. The location of these facilities is not specified, so long as

they are in line with normal marketing channels. Regional facilities might be divided among the participating countries or concentrated in one or two ASEAN countries. The regional capacity is taken to be dedicated to the reserve program so that it is not subject to other uses.

Management: The combination in-country and regional reserve programs is assumed to be coordinated through ASEAN. Grain management agencies in each country would operate the program subject to regional guidelines and supervision. Details of the organization and management of the reserve program are not addressed at this point, but are assumed to be accomplished in a manner to insure effective coordination between the security reserve program and the grain management programs of each country.

The simulated total transactions with food security reserves needed by each nation to achieve the stability goals are shown by the tables included in this section. The needed transactions under alternative 1-A are included in Table 10, Rice Only and those under alternative 2-A are included in Table 10, All Food Grains. These correspond to the excess deviations plotted on the charts included in Section 2. The numerical values shown in these tables are obtained by subtracting the acceptable deviations in Table 9' (Annex IV) from the total deviations in Table 8.

The needed total annual transactions with security reserves after stabilizing adjustments in international trade are shown in Table 16. Those under alternative 1-B are shown in Table 16, Rice Only. Those under alternative 2-B are shown in Table 16, All Food Grains. These are computed as the corresponding total need for reserve transactions from Table 10 minus the net stabilizing adjustments from Table 15. The simulated adjustments in international trade for rice and for all food grains warrant further explanation, as given below.

Simulations of Stabilizing Adjustments in International Trade

Over the 1960-1977 period all of the ASEAN countries have been actively engaged in international trade of rice and other food grains. The historical

TABLE 10. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

NEEDED TRANSACTIONS WITH RESERVES FOR 3-PERCENT SUPPLY STABILITY

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	880	0	0	2	-371
2	1961	205	-19	0	0	-167
3	1962	795	12	0	-22	235
4	1963	-135	0	0	19	133
5	1964	-90	2	0	-27	-66
6	1965	-576	33	0	0	-106
7	1966	-559	0	-264	-35	733
8	1967	-1007	-65	0	-13	-340
9	1968	-344	-60	0	14	-112
10	1969	0	-6	0	0	752
11	1970	0	0	66	49	239
12	1971	0	17	166	61	-248
13	1972	0	44	54	90	0
14	1973	0	15	0	0	99
15	1974	0	76	-31	-54	181
16	1975	0	0	0	-86	0
17	1976	113	-59	0	0	-377
18	1977	22	0	0	2	-447

SOURCE:
FIGURES IN TABLE 8 MINUS THOSE IN TABLE 9'.

TABLE 10. ALL FOOD GRAINS (RICE, WHEAT,CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

NEEDED TRANSACTIONS WITH RESERVES FOR 3-PERCENT SUPPLY STABILITY

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	846	21	0	-14	-319
2	1961	35	0	0	-16	-126
3	1962	1027	44	0	-18	256
4	1963	-265	0	0	-10	137
5	1964	0	-3	0	-12	-78
6	1965	-859	0	0	-7	-130
7	1966	-167	0	-273	-2	689
8	1967	-1274	-74	0	65	-391
9	1968	-146	-113	0	45	-167
10	1969	0	0	0	49	681
11	1970	0	0	48	74	151
12	1971	0	0	157	10	-324
13	1972	0	75	0	68	0
14	1973	0	16	0	0	0
15	1974	0	57	-43	-97	1122
16	1975	0	0	-79	-131	0
17	1976	162	-24	0	16	-430
18	1977	368	0	0	0	-613

SOURCE:
FIGURES IN TABLE 8 MINUS THOSE IN TABLE 9'.

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volume of trade is shown for each country in the set of Tables 1 and included in Annex II. In milled rice equivalent, Indonesia's annual net imports have averaged about 1 million MT of rice and 325,000 MT of wheat, plus small quantities of corn. Annual net imports by Malaysia have averaged about 260,000 MT of rice, 250,000 MT of wheat and 100,000 MT of corn, all in milled rice equivalent. Over the period, Philippine net imports of rice have averaged about 180,000 MT, but exhibit a declining trend as this country approached self-sufficiency in rice production. In milled rice equivalent, Philippine net imports of wheat have averaged about 420,000 MT and net imports of corn about 30,000 MT, both of which are increasing. Singapore is a trading country, characteristically importing and re-exporting rice and wheat each year. In milled rice equivalent, Singapore imports have averaged about 260,000 MT of rice, 160,000 MT of wheat and over 100,000 MT of corn; her exports have averaged about 75,000 MT of rice and 65,000 MT of wheat (milled rice equivalent). Thailand exports substantial quantities of rice and corn; net exports have averaged about 1,500,000 MT of rice and 760,000 MT of corn, both in milled rice equivalent. Thailand's annual imports of wheat have averaged more than 50,000 MT, milled rice equivalent.

These historical volumes of trade make it clear that all of the ASEAN countries have the facilities and experience to handle international trade in grain. Consideration of stabilizing adjustments in the year-to-year volumes of trade represents a technically-feasible option. As discussed below, historical trade patterns have had some stabilizing effect on ASEAN domestic food supplies but international trade has not been used to reduce the need for security reserves in the manner simulated in this study. The concept warrants serious consideration and study, but has not yet been implemented by any of the ASEAN countries.

The computer-simulated pattern for stabilizing adjustments in international trade by the ASEAN countries over the 1960-1977 period is shown in Table 15,

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TABLE 15. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL NET IMPORT ADJUSTMENTS

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	-440	0	0	-1	186	-255
2	1961	-323	10	0	-1	176	-138
3	1962	-339	-1	0	11	-122	-451
4	1963	-161	-5	0	-4	-123	-293
5	1964	193	2	0	6	28	229
6	1965	237	-18	0	10	72	301
7	1966	449	-7	132	12	-350	236
8	1967	558	36	66	18	-22	656
9	1968	396	44	-33	-9	237	635
10	1969	-26	11	17	-2	-438	-438
11	1970	13	-2	-41	-23	-276	-329
12	1971	-7	-7	-95	-43	143	-9
13	1972	3	-27	-62	-54	53	-87
14	1973	-2	-16	4	-18	-76	-108
15	1974	1	-37	13	36	-102	-89
16	1975	0	-19	9	52	-39	3
17	1976	-56	39	-4	17	208	204
18	1977	-39	10	2	-10	308	271

SOURCE:
BASED ON TABLE 10, ASSUMING 50 PERCENT IMPORT (EXPORT) ADJUSTMENT EFFECTIVE CURRENT YEAR AND REMAINDER THE FOLLOWING YEAR.

TABLE 15. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL NET IMPORT ADJUSTMENTS

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	-423	-11	0	7	160	-267
2	1961	-229	-5	0	12	143	-79
3	1962	-417	-19	0	11	-136	-561
4	1963	-173	-12	0	8	-128	-305
5	1964	219	8	0	7	35	269
6	1965	320	-2	0	6	87	411
7	1966	353	1	137	1	-323	169
8	1967	544	36	68	-32	12	628
9	1968	438	75	-34	-39	273	713
10	1969	-146	19	17	-28	-393	-531
11	1970	73	-9	-33	-48	-219	-236
12	1971	-36	5	-86	-18	196	61
13	1972	18	-40	-35	-30	64	-23
14	1973	-9	-26	18	-19	-32	-68
15	1974	5	-24	13	58	-545	-493
16	1975	-2	-17	55	85	-288	-167
17	1976	-80	20	12	15	359	326
18	1977	-225	2	-6	-16	342	97

SOURCE:
BASED ON TABLE 10, ASSUMING 50 PERCENT IMPORT (EXPORT) ADJUSTMENT EFFECTIVE CURRENT YEAR AND REMAINDER THE FOLLOWING YEAR.

Rice Only, and Table 15, All Food Grains. These simulated trade adjustments are signalled by the excess deviations from targeted stability levels in food supplies (Table 10). For example, the excess deviation of rice supply shown by Table 10 for Indonesia in 1960 of 880,000 MT signals a stabilizing trade adjustment of -880,000 MT (that is, for Indonesia to reduce actual historical imports for that year from the reported 894,000 MT (Table 1) to 14,000 MT. Annual signals are continually given by the indicated needs in Table 10 to initiate stabilizing trade adjustments by each ASEAN country.

The simulated results in Table 15 are made somewhat more realistic by building in a time lag from the date that accurate domestic estimates are in and the date that adjusted trade stocks are received at port and distributed in consumption channels. The specific time lag used in the simulation is one-half crop year. In other words, it is assumed that by the date of accurate current production estimates, only one half the indicated stabilizing adjustment can become effective the current crop year. The other half will be effective during the following crop year. For example, following the above case for Indonesia, one-half the -880,000 MT stabilizing adjustment or -440,000 MT is effective in 1960. This is the figure shown for Indonesia in 1960 by Table 15, Rice Only.

Now what about the other one-half of the stabilizing adjustment--the other -440,000 MT for Indonesia? It is on its way to Indonesia ports for arrival in the 1961 crop year, regardless of whether it will be needed by then. The computer simulation program combines this carry-over adjustment of -440,000 MT to the -205,000 MT needed adjustment signalled by Table 10 for 1961. The net needed adjustment for that year becomes +235,000 MT, one half of which can be effective during 1961. This +117,500 MT adjustment is now combined with the -440,000 MT adjustment already on its way to obtain the final net adjustment of Indonesia

TABLE 16. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

NEEDED TRANSACTIONS WITH RESERVES AFTER IMPORT ADJUSTMENTS

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	440	0	0	1	-185	256
2	1961	-118	-9	0	-1	9	-119
3	1962	456	11	0	-11	113	569
4	1963	-296	-5	0	15	10	-276
5	1964	103	4	0	-21	-36	46
6	1965	-339	15	0	10	-34	-348
7	1966	-110	-7	-132	-25	383	111
8	1967	-449	-29	66	5	-362	-769
9	1968	52	-16	-33	5	125	133
10	1969	-26	5	17	-2	314	308
11	1970	13	-2	25	26	-37	25
12	1971	-7	10	71	18	-105	-13
13	1972	3	17	-8	36	53	101
14	1973	-2	-1	4	-18	23	6
15	1974	1	39	-18	-18	79	83
16	1975	0	-19	9	-34	-39	-83
17	1976	57	-20	-4	17	-169	-119
18	1977	-17	10	2	-8	-139	-152

SOURCE:
FIGURES FROM TABLE 10 PLUS THOSE IN TABLE 15.

TABLE 16. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

NEEDED TRANSACTIONS WITH RESERVES AFTER IMPORT ADJUSTMENTS

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	423	10	0	-7	-159	267
2	1961	-194	-5	0	-4	17	-186
3	1962	610	25	0	-7	120	748
4	1963	-438	-12	0	-2	9	-443
5	1964	219	5	0	-5	-43	176
6	1965	-539	-2	0	-1	-43	-585
7	1966	186	1	-136	-1	366	416
8	1967	-730	-38	68	33	-379	-1046
9	1968	292	-38	-34	6	106	332
10	1969	-146	19	17	21	288	199
11	1970	73	-9	15	26	-68	37
12	1971	-36	5	71	-8	-128	-96
13	1972	18	35	-35	38	64	120
14	1973	-9	-10	18	-19	-32	-52
15	1974	5	33	-30	-39	577	546
16	1975	-2	-17	-24	-46	-288	-377
17	1976	82	-4	12	31	-71	50
18	1977	143	2	-6	-16	-271	-148

SOURCE:
FIGURES FROM TABLE 10 PLUS THOSE IN TABLE 15.

rice for 1961 of -322,500 MT (-323,000 MT) shown by Table 15, Rice Only. The computer methodology for this simulation of net stabilizing trade adjustments is given in Annex I. The process is continued over the whole historical period for Indonesia and for the other ASEAN countries. The final results are the computed annual trade adjustments in milled rice equivalent shown for rice and for all food grains in the accompanying set of Tables 15.

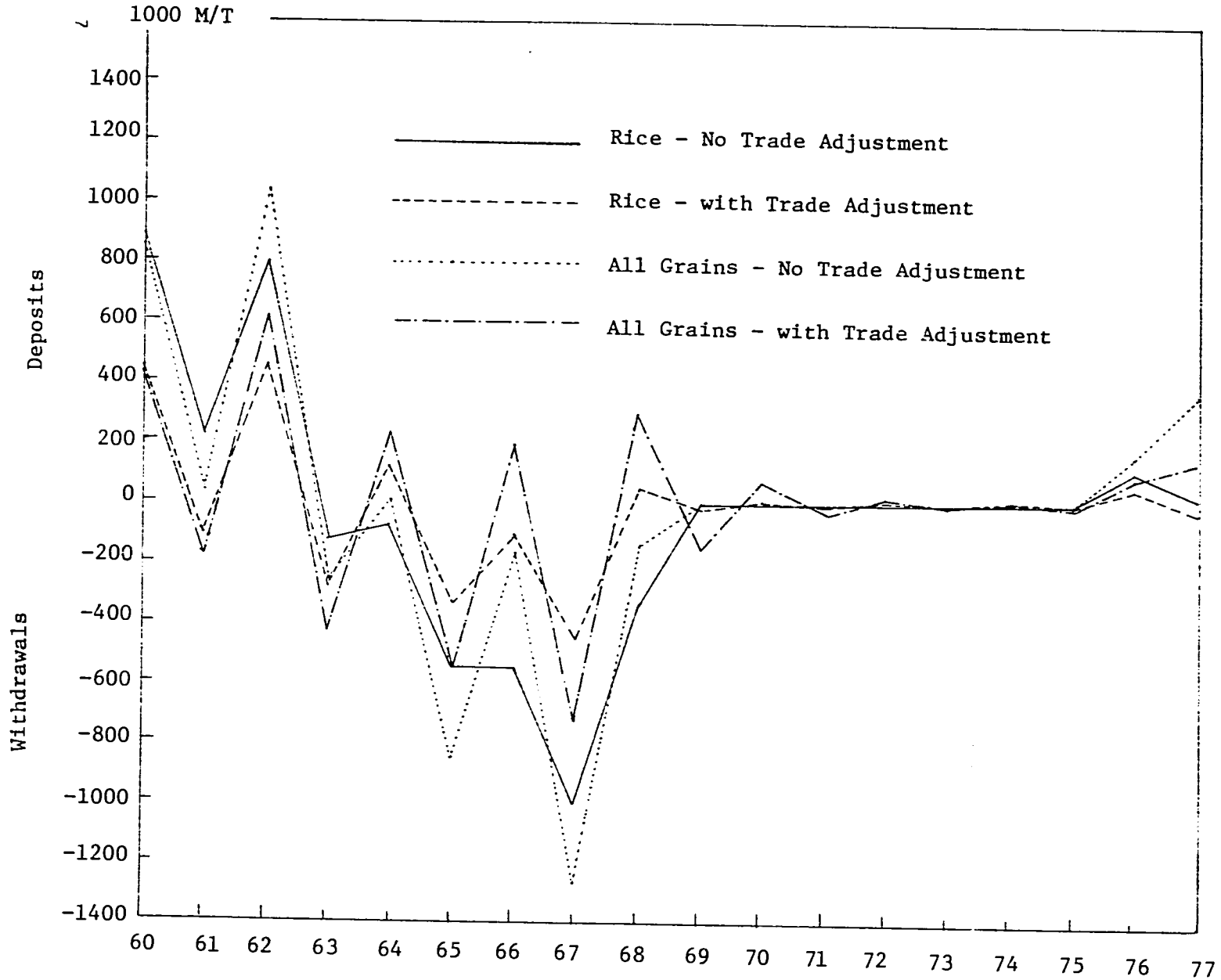
Needed Reserve Transactions by Indonesia

The simulated total need for reserve transactions for Indonesia under the four alternatives as presented in Tables 10 and 16 are shown graphically in Figure 3-1. Withdrawals from the reserves for market injection in years of shortage are indicated by the points below the zero line. Additions to the reserves by withdrawals from the market in years of surplus are indicated by the points above the zero line.

Each of the four alternatives is indicated in Figure 3-1 by a distinct line connecting the points for individual years. All plotted points are given in units of metric tons, milled rice equivalent. For most years, the indicated transactions are somewhat larger for the all food grains cases than for the rice only cases, because a greater portion of the total dietary intake of Indonesia's consumers is protected by the all food grains case. Compared to the cases of no stabilizing import adjustments, the indicated reserve transactions with stabilizing trade adjustments are smaller in absolute value but occur more frequently. In general for Indonesia, reserve transactions are more significant over the first half of the 18-year historical period than is true for the later half of the period.

For the 1-A rice only case, indicated transactions for Indonesia range from nearly +900,000 MT in 1960 to about -1,000,000 MT in 1967. Indicated transactions for this case are zero from 1969 through 1975.

Fig 3-1 Needed Reserve Transactions for 3-percent Stability in Indonesia



Source: Tables 10 and 16

For the 1-B rice only case, indicated transactions vary from about +450,000 MT in 1962 to about -450,000 MT in 1967. Although small over the period 1970-1974, transactions under this case are zero only in one year, 1975.

For the 2-A all food grains case, needed transactions with the security reserves range from about +1,000,000 MT in 1962 to about -1,250,000 MT in 1967. As with the corresponding rice case, they stand at zero over the period 1969 through 1975.

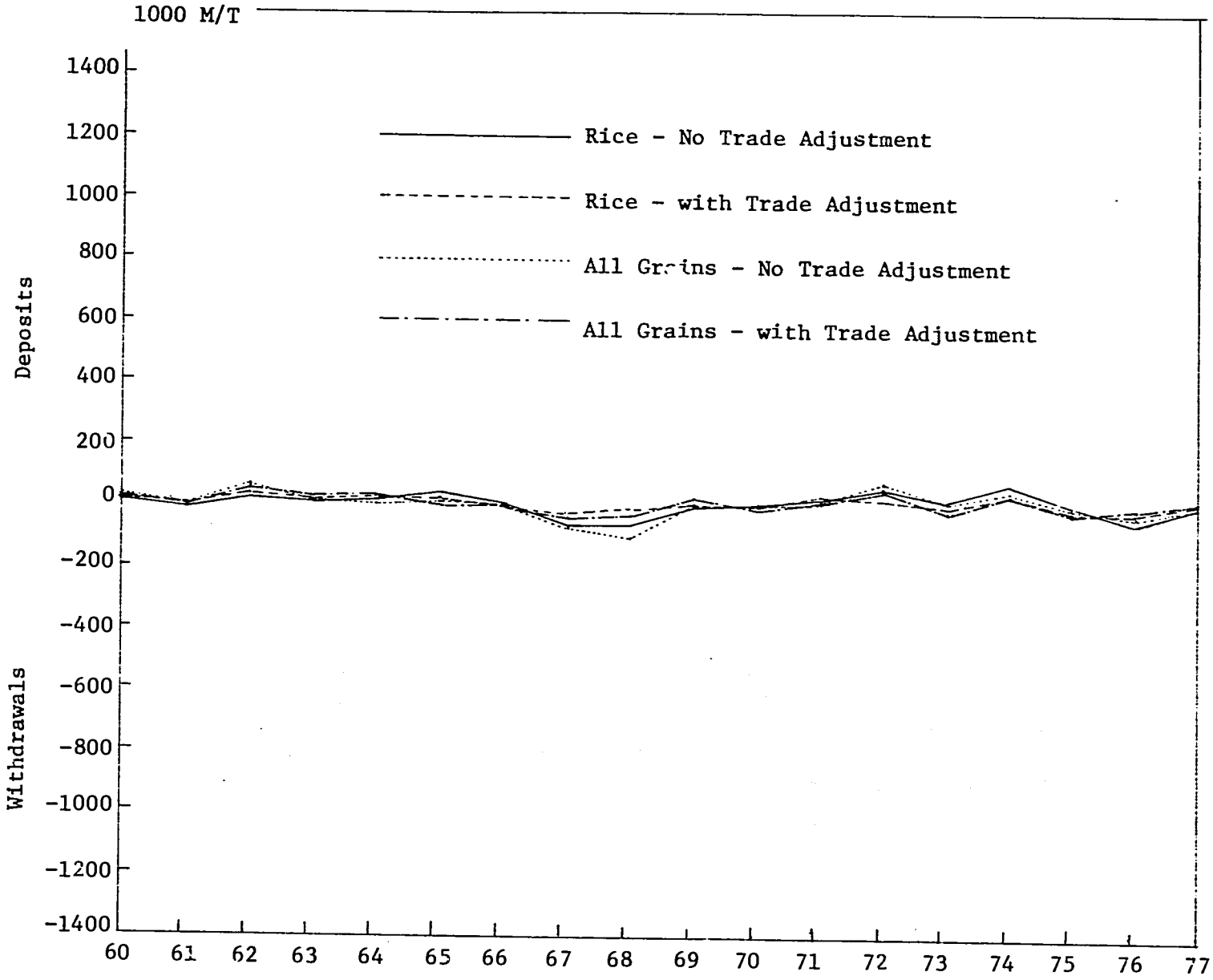
For the 2-B all food grains case, needed transactions for Indonesia in milled rice equivalent vary from about +600,000 MT in 1962 to about -725,000 MT in 1967. Although as small as -2,000 MT in 1975, reserve transactions are indicated for every historical year under this case.

Needed Reserve Transactions by Malaysia

The indicated needs for reserve transactions under the four alternative security reserve programs for Malaysia are plotted in Figure 3-2. Although relatively small in absolute terms compared to Indonesia, the needed transactions for Malaysia represent as large a fraction of the country's total food requirements as is true for Indonesia. The transactions pattern for Malaysia form more of a regular saw-tooth effect from one year to the next. In contrast to Indonesia, the rice cases for Malaysia require transactions which are nearly of the same amplitude as those for all food grain cases. This reflects the greater consumption substitution among grains, and the somewhat counter-cyclic pattern of domestic production compared to the situation in Indonesia.

The 1-A rice only case for Malaysia indicates needed transactions ranging from about -65,000 MT in 1967 to about +75,000 MT in 1974. Needed transactions for this case are zero in 1960, 1963, 1966, 1970, 1975 and 1977.

Fig 3-2 Needed Reserve Transactions for 3-percent Stability in Malaysia



Source: Tables 10 and 16

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For the 1-B rice only case, transactions are needed in all years except 1960, but the extreme range is reduced from about -30,000 MT in 1967 to about +40,000 MT in 1974.

For the 2-A all food grains case, Malaysia's needed transactions range from about -110,000 MT in 1968 to about 75,000 MT in 1972. No reserve transactions are needed in nine of the years.

For the 2-B all food grains case, Malaysia's needed transactions in milled rice equivalent range from about -40,000 MT in 1967 and 1968 to about +35,000 MT in 1972. Although small in many of the years, some transaction is indicated every year under this alternative.

Needed Reserve Transactions by the Philippines

The computed needs for reserve transactions for the Philippines under the four alternatives are plotted in Figure 3-3. The pattern is somewhat counter to that for Indonesia (Figure 3-1). Most of the needed transactions for the Philippines fall in the later half of the 18-year historical period. The pattern for all food grains case are not greatly different from those for rice only.

Needed transactions by the Philippines under the 1-A rice only case range from about -265,000 MT in 1966 to about +165,000 MT in 1971. No transactions are indicated in 13 of the 18 years.

Needed transactions under the 1-B rice only case after stabilizing trade adjustments range from about -130,000 MT in 1966 to about +70,000 MT in 1971. After the first 6 years, some transaction is indicated each year under this alternative.

For the 2-A all food grains case, needed transactions by the Philippines range from about -275,000 MT in 1966 to about +160,000 MT in 1971; none are needed in 13 years.

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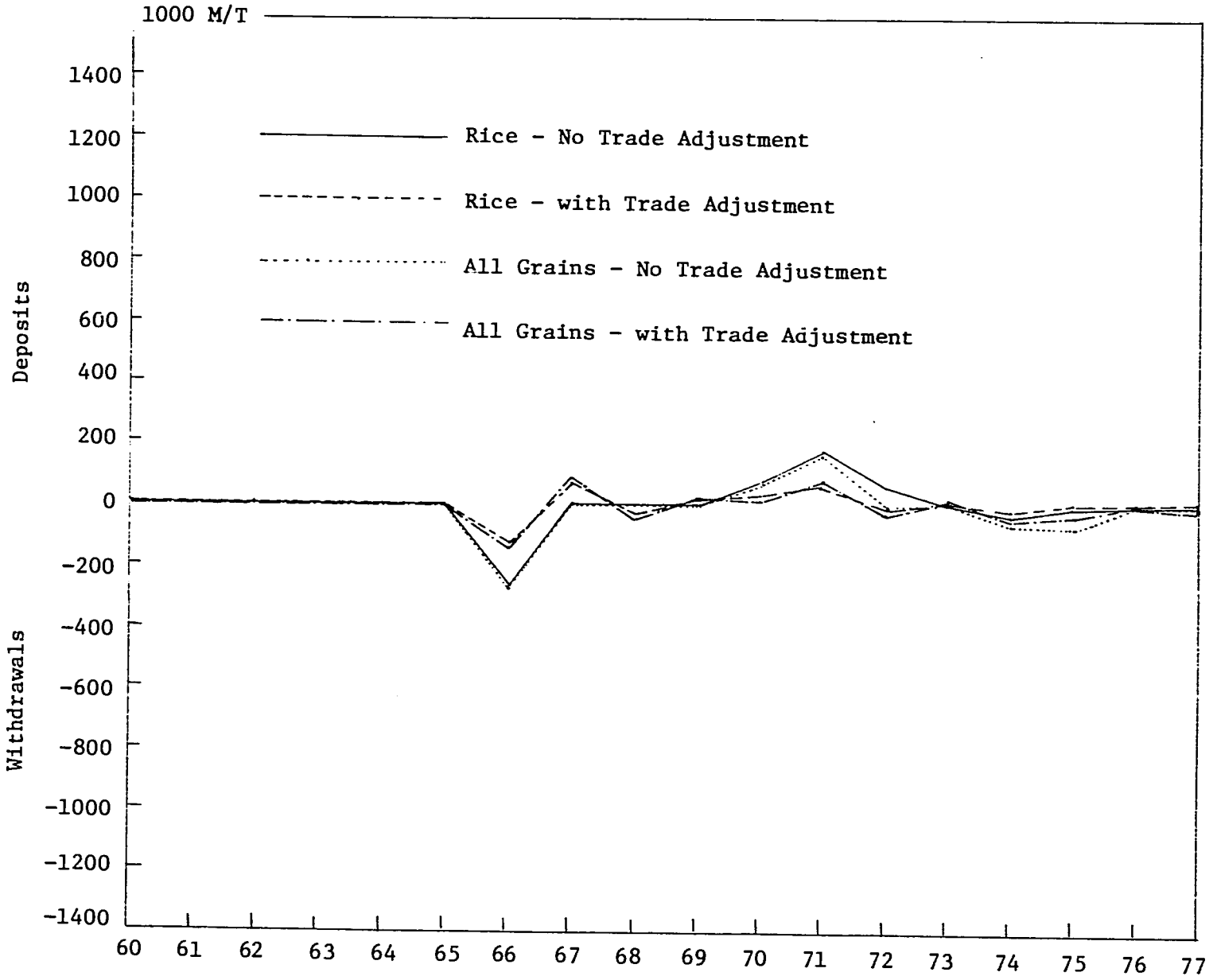
Fig 3-3 Needed Reserve Transactions for 3-percent Stability in Philippines



Source: Tables 10 and 16

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For the 2-B all food grains case, needed transactions in milled rice equivalent range from about -135,000 MT in 1966 to about 70,000 MT in 1971. Transactions are indicated each year beginning with 1966.

Needed Reserve Transactions by Singapore

The computed needs for reserve transactions by Singapore under each of the four alternatives are relatively large for the size of the country (Figure 3-4). Transactions are needed in most years, and increase in amplitude in the latter half of the period.

Needed transactions under the 1-A rice only case range from about +90,000 MT in 1972 to about -85,000 MT in 1975. Those under the 2-A all food grains case range from about 75,000 MT in 1970 to about -130,000 MT in 1975. Those under the 1-B rice only case range from +35,000 MT in 1972 to about -35,000 MT in 1975. Those under the 2-B all food grains case range from +40,000 MT in 1972 to about -45,000 MT in 1975. All figures plotted in Figure 3-4 are in terms of milled rice equivalent.

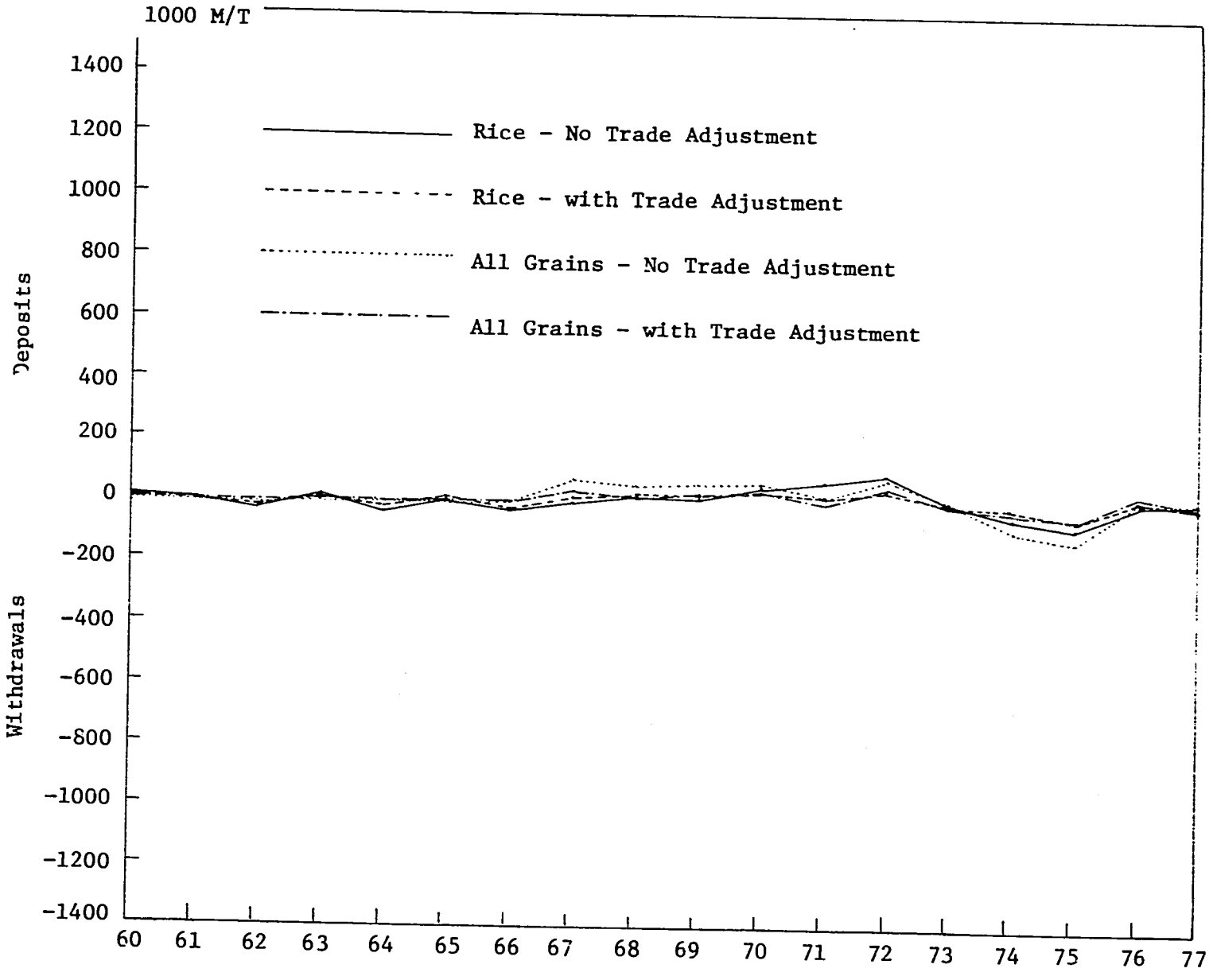
Needed Reserve Transactions by Thailand

The indicated annual needs for reserve transactions by Thailand under each of the alternative security reserve programs are shown in Figure 3-5. The up-down saw-tooth pattern is particularly apparent in this chart, with some indicated need for transactions in most years.

Needed transactions for the 1-A rice only case for Thailand are negative in nine years and positive or zero the remaining nine. The outside range extends from about +750,000 MT in 1969 to about -450,000 MT in 1977.

Needed transactions under the 1-B rice only alternative are negative in 9 years and positive in 9 years, ranging from about +380,000 MT in 1966 to about -360,000 MT in 1967.

Fig 3-4 Needed Reserve Transactions for 3-percent Stability in Singapore



Source: Tables 10 and 16

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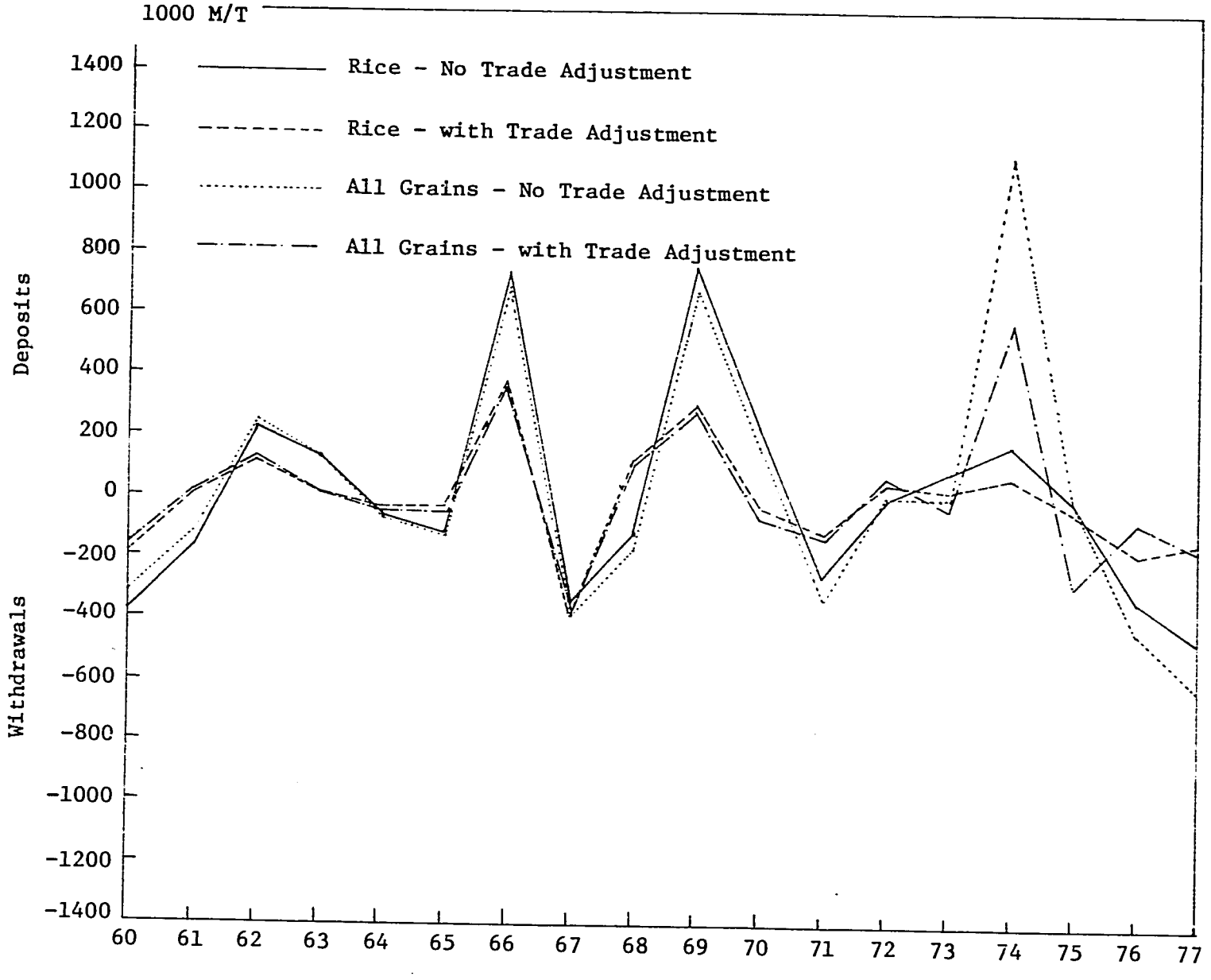
Fig 3-5 Needed Reserve Transactions for 3-percent Stability in Thailand



Source: Tables 10 and 16

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Annual security reserve transactions by Thailand indicated under the 2-A all food grains case range from about +1,120,000 MT in 1974 to about -615,000 MT in 1977, milled rice equivalent. Those indicated under the 2-B all food grains case with stabilizing trade adjustments range from about +580,000 MT in 1974 to about -380,000 MT in 1967.

Relationships between Reserves, Trade and Carry-Over Stocks

The annual data for the five ASEAN countries over the 18-year historical period provide a basis for examining the relationships among (1) needed reserve transactions (2) carry-over stocks, (3) international trade and (4) domestic production. Questions of interest include such items as:

1. Have changes in ending stocks functioned at least in part as a food security reserve, or have such changes resulted from changes in trade and/or domestic production?

2. Have trade adjustments been made in the past to help stabilize food grain supplies?

3. Have annual deviations in domestic production trends been anticipated, and, at least in part, reflected in trade adjustments?

4. Have consistent and significant patterns emerged in the relationships among the year-to-year changes in production, trade and ending inventories?

In order to determine the answers to these kinds of questions for the ASEAN countries over the last 18 years, the production, trade, utilization and carryover figures for rice were examined in more detail. The changes from one year to the next were computed for these variables for each country. The resulting year-to-year changes were organized as a data set for step-wise multiple regression analysis to measure the interrelationships that have been evidenced over the period since 1960 in each of the ASEAN countries.

The variables used for the analysis and summarized in the accompanying Table 15', Variables in Data Set for each of the 5 countries. The first variable,

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TABLE 15'. VARIABLES IN DATA SET -- NO TRANSFORMATIONS

	CONS DEV	D STOCKS	D TRADES	D PRD TR
INDONESIA				
OBS 1	476.00	165.00	170.00	-838.00
OBS 2	1076.00	-150.00	-39.00	459.00
OBS 3	-425.00	35.00	18.00	-1385.00
OBS 4	-390.00	35.00	-33.00	223.00
OBS 5	-887.00	-55.00	-807.00	391.00
OBS 6	-881.00	140.00	106.00	252.00
OBS 7	-1340.00	-56.00	45.00	-620.00
OBS 8	-690.00	300.00	274.00	1003.00
OBS 9	-31.00	-75.00	178.00	290.00
OBS 10	-1.00	230.00	-33.00	584.00
OBS 11	25.00	30.00	-249.00	254.00
OBS 12	36.00	-225.00	710.00	-885.00
OBS 13	276.00	325.00	-9.00	1193.00
OBS 14	262.00	365.00	-77.00	302.00
OBS 15	381.00	-830.00	-478.00	-472.00
OBS 16	573.00	-105.00	856.00	279.00
OBS 17	498.00	-185.00	974.00	-1043.00
MALAYSIA				
OBS 1	-44.00	25.00	-39.00	34.00
OBS 2	38.00	-51.00	-24.00	52.00
OBS 3	-19.00	116.00	82.00	47.00
OBS 4	29.00	11.00	15.00	-75.00
OBS 5	61.00	-102.00	-109.00	61.00
OBS 6	27.00	-152.00	-52.00	-29.00
OBS 7	-94.00	0.0	38.00	-20.00
OBS 8	-90.00	50.00	-44.00	103.00
OBS 9	-37.00	51.00	-2.00	67.00
OBS 10	-4.00	102.00	61.00	25.00
OBS 11	49.00	-51.00	-142.00	50.00
OBS 12	77.00	-152.00	-36.00	-14.00
OBS 13	49.00	0.0	57.00	80.00
OBS 14	111.00	20.00	49.00	29.00
OBS 15	-27.00	-92.00	-149.00	-99.00
OBS 16	-95.00	20.00	46.00	-10.00
OBS 17	-36.00	9.00	94.00	-47.00
PHILIPPINES				
OBS 1	3.00	140.00	-177.00	62.00
OBS 2	28.00	-71.00	-146.00	-39.00
OBS 3	-17.00	58.00	233.00	-159.00
OBS 4	-15.00	305.00	240.00	22.00
OBS 5	-10.00	53.00	-214.00	-26.00
OBS 6	-345.00	222.00	-85.00	-60.00
OBS 7	23.00	-82.00	-32.00	223.00
OBS 8	54.00	-348.00	-182.00	-164.00
OBS 9	46.00	68.00	0.0	427.00
OBS 10	157.00	-42.00	20.00	-31.00
OBS 11	259.00	211.00	251.00	-266.00
OBS 12	150.00	-471.00	-307.00	-544.00
OBS 13	20.00	286.00	24.00	679.00
OBS 14	-132.00	278.00	-109.00	-65.00
OBS 15	-59.00	79.00	-127.00	-26.00
OBS 16	-78.00	97.00	53.00	69.00
OBS 17	-103.00	311.00	-58.00	264.00

	CONS DEV	D STOCKS	D TRADES	D PRD TR
THAILAND				
OBS 1	-309.00	0.0	1305.00	-132.00
OBS 2	332.00	0.0	-147.00	914.00
OBS 3	284.00	0.0	-478.00	378.00
OBS 4	-223.00	0.0	1.00	-616.00
OBS 5	-268.00	0.0	387.00	-516.00
OBS 6	900.00	66.00	25.00	1322.00
OBS 7	-513.00	343.00	415.00	-1785.00
OBS 8	-290.00	694.00	45.00	580.00
OBS 9	936.00	-176.00	-41.00	416.00
OBS 10	429.00	-289.00	-512.00	-159.00
OBS 11	-444.00	-54.00	-536.00	-152.00
OBS 12	114.00	-459.00	1263.00	-1276.00
OBS 13	308.00	212.00	-197.00	1166.00
OBS 14	396.00	63.00	53.00	-183.00
OBS 15	67.00	-273.00	-877.00	179.00
OBS 16	-604.00	-488.00	-1015.00	71.00
OBS 17	-681.00	0.0	1385.00	-771.00
SINGAPORE				
OBS 1	4.00	-30.00	-45.00	15.00
OBS 2	-28.00	55.00	-35.00	90.00
OBS 3	25.00	-56.00	114.00	-170.00
OBS 4	-33.00	31.00	10.00	21.00
OBS 5	-4.00	-37.00	-8.00	-29.00
OBS 6	-41.00	22.00	28.00	-6.00
OBS 7	-19.00	38.00	6.00	32.00
OBS 8	20.00	-26.00	25.00	-51.00
OBS 9	-4.00	58.00	1.00	57.00
OBS 10	55.00	12.00	0.0	12.00
OBS 11	67.00	28.00	-24.00	52.00
OBS 12	96.00	-96.00	27.00	-123.00
OBS 13	1.00	-62.00	29.00	-91.00
OBS 14	-60.00	-34.00	4.00	-30.00
OBS 15	-92.00	87.00	13.00	74.00
OBS 16	-3.00	8.00	-4.00	12.00
OBS 17	7.00	-50.00	0.0	-50.00

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CONS DEV, is taken directly from Table 8, Rice Only (Section 2), Deviations between Actual and Estimated Consumption. The 1960 figures are omitted from the data set to maintain proper alignment with the year-to-year changes represented by other variables. The second variable, D STOCKS, is the year-to-year change in ending stocks, taken directly from Column 3 of Table 1, Rice (Annex II). The third variable, D TRADES, is the year-to-year change in net imports from Column 2 of Table 1. The fourth variable, D PRD TR, is the year-to-year deviation between the observed and the estimated domestic production, based on the data from Column 1 of Table 1, Rice.[1/]

It will be observed from the variables in the data set that there is little apparent positive correlation between the first two variables. Ending carry-over stocks have not functioned as a stabilizing factor against year-to-year food supplies for domestic consumption. It appears that changes in ending stocks may have had some de-stabilizing effect, at least in some of the countries. Apparent relationships are indicated between the second variable, stocks and the third variable, trades, and between the second variable and the fourth variable, deviations in production.

The step-wise multiple regression analysis was structured with the second variable as the dependent variable, set as a function of the other three. The other variables were reordered with D TRADES as X_1, D PRD TR as X_2 and CONS DEV as X_3. On the basis of this reordering, the raw correlation matrix may be summarized as follows:

[1/] In the case of Singapore which has no domestic production of rice, the third variable is the change from the previous year in the quantity exported and the fourth variable is the change from the previous year in the quantity imported.

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Correlation Matrix, Reordered Variables

Country	Y/X_1	Y/X_2	Y/X_3	X_1/X_2	X_1/X_3	X_2/X_3
Indonesia	.05	.45	-.22	-.28	.29	-.00
Malaysia	.64	.34	-.43	.04	-.18	.08
Philippines	.52	.52	-.43	.18	.16	-.22
Thailand	.15	.16	-.11	-.46	-.22	.58
Singapore	-.35	.89	-.52	-.75	.09	-.43

Variables:

Y ~ change from previous year in reported ending stocks

X_1 ~ change in reported net imports from previous year

X_2 ~ change in deviation from production trend from previous year

X_3 ~ deviation between observed and estimated consumption for current year

The correlations indicate a positive relationship between Y (D STOCKS) and X_1 (D TRADES) for all countries except Singapore and between Y and X_2 (D PRD TR) for all countries; apparently Y is negatively correlated with X_3 (CONS DEV). The matrix is saying that change in ending stocks have been a de-stabilizing factor rather than a stabilizing factor for year-to-year variation in the quantities of rice for domestic consumption. Changes in stocks have been largely the result of changes in imports and deviations from trend in domestic production.

The correlation between X_1 and X_2 is negative in Indonesia, Thailand and Singapore, indicating that imports have been increased when domestic supplies fall short of trend. The reverse seems to have been true of the Philippines, perhaps because of the downward time trend in imports as the Philippines has grown to self-sufficiency in rice.

The correlation between X_1 and X_3 is relatively low and irratic from one country to another. This appears to reflect the phenomenon caused by the time lag between detection of the need and realization of stabilizing supplies of imported rice (see Table 15 and the discussion related to it, above).

The correlation between X_2 and X_3 is near zero for Indonesia and Malaysia, negative for the Philippines and positive for Thailand. The correlations indicate that there is not a single straight-forward relationship between year-to-year deviations from production trends and the deviation in the quantities available for domestic consumption.

The results of the step-wise multiple regression analysis based on the reordered variables in Table 15' are summarized in Table 16'. The year-to-year changes in ending stocks are positively associated with changes in imports and production deviations. The b-values for one or both X_1 and X_2 are significant for all countries, except Thailand. The b-values for X_3 are negative for all countries except Singapore, but are not significant except for the Philippines. The proportionate reduction in the sum of squares deviation due to regression supports acceptance of the relative importance of X_1 and/or X_2 rather than X_3 in explaining the variations in reported ending stocks from one year to the next.

The regression equation for Thailand follows its general pattern of the other ASEAN countries, but explains only 16 percent of the variation in change in ending rice stocks. None of the b-values are statistically significant, so that little confidence can be placed in any of the estimators. Because Thailand is a rice exporting nation, changes in carry-over stocks of Thai rice may be more directly related to factors in the world market than to stable food supplies for domestic consumption.

It appears clear from the regression analysis that an important need exists in ASEAN for the kind of year-to-year stability that only food security reserves can address. Adjustments in international trade can reduce the size of the security reserves needed to achieve targeted stability levels, but neither trade adjustments nor changes in carry-over stocks can meet the total need. The factors

TABLE 16'. SUMMARY OF REGRESSION ANALYSIS
D STOCKS = f (D TRADES, D PRD TR, CONS DEV)

Country	Parameter	Intercept	X_1	X_2	X_3	R^2
Indonesia	b	-27.9	.18	.20*	-.13	.31
	ΔR^2		.06	.20	.05	
Malaysia	b	-13.4	.59**	.48*	-.45	.63
	ΔR^2		.41	.11	.11	
Philippines	b	83.9	.72**	.27	-.73*	.64
	ΔR^2		.19	.27	.18	
Thailand	b	-18.1	.12	.17	-.19	.16
	ΔR^2		.06	.03	.07	
Singapore	b	- 0.5	1.03**	1.02**	.02	1.00
	ΔR^2		.21	.79	.00	

*Significant at 95% probability level
**Significant at 99% probability level

governing domestic food grain programs and international trade are related to those governing food security reserve programs, but the two kinds of programs serve different goals. Both are needed to insure adequate supplies of staple foods to feed the growing population around the world.

SECTION 4

SIMULATED ANNUAL TRANSACTIONS UNDER ALTERNATIVE ASEAN SECURITY RESERVE PROGRAMS

Given the historical trends and year-to-year variations in available food grain supplies, the next step in the analysis is to determine the transactions with reserves and year-end reserve balances had they been in operation in the ASEAN countries from 1960 through 1977. The sequence of steps at this stage includes the following:

1. Establish reasonable limits on in-country reserve balances, and compute annual transactions subject to these limits.

2. Compute residual requirements for transactions with regional reserves, and compute and test regional reserve balances for each ASEAN country.

The above steps are performed separately for (1) ASEAN rice reserve programs (2) ASEAN all food grain reserve programs. Under each of these, analysis is made for (A) international trade at historical levels and (B) stabilizing adjustments in international trade. The basic data in these steps are defined by the need for reserve programs under the four alternatives as shown in Tables 10 and 16 (Section 3).

The year-end storage balances in any food reserve program are direct functions of the starting balances and the net plus or minus transactions during the year. If the year-end reserve balances are kept too small, sufficient stocks may not be available for subsequent needs for withdrawals from the reserve. If the year-end balances are allowed to become too large, excessive storage capacity and costs are required for the reserve program.

The dilemma can be resolved by a combination of in-country reserves and regional reserves for ASEAN. Reasonable restrictions can be placed on ending balances for the in-country reserves, and the regional reserves can be drawn upon to make up deficits caused by short-falls in the in-country reserves. Thus, the

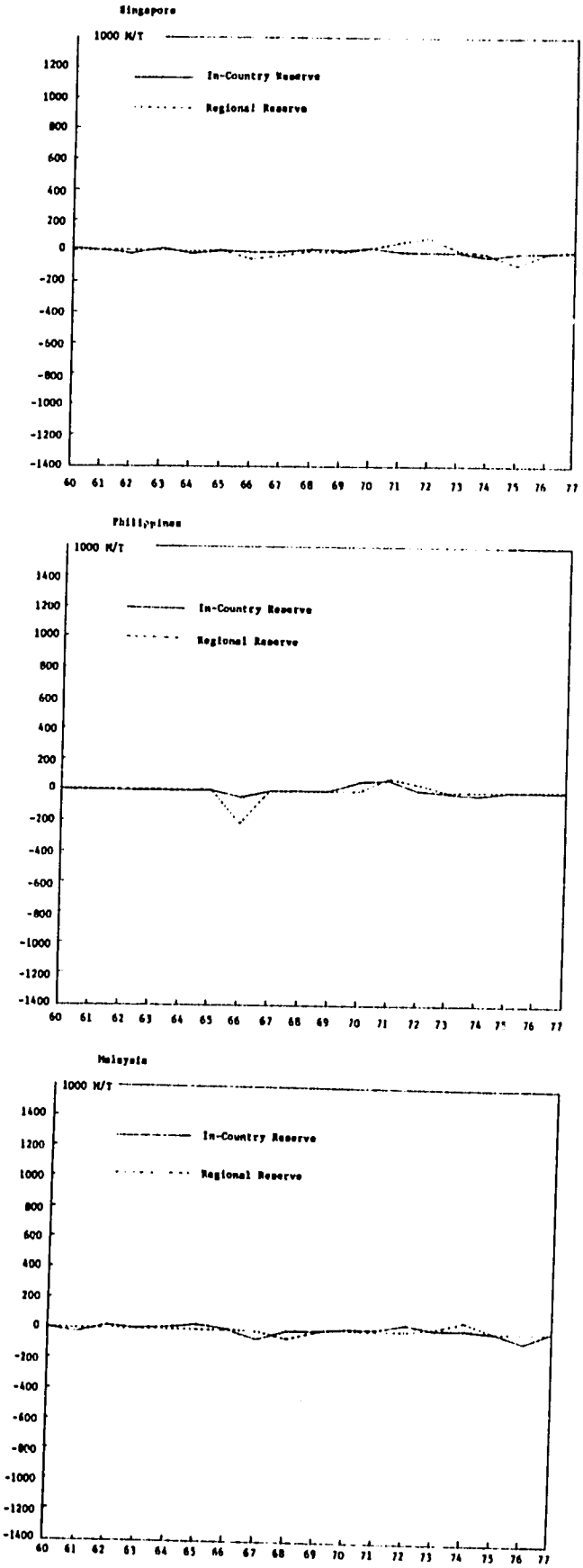
in-country reserves in a combined ASEAN reserve program can serve as the first line of defense for the ASEAN countries. When needed, the ASEAN regional reserve can serve as the second line of defense to supplement the in-country reserves. The following findings show how such combined reserve programs would have worked for ASEAN from 1960 through 1977.

Rice Reserve Transactions Using Historical Trade

The computed annual transactions with rice reserves using historical trade patterns are shown in Figure 4-1A by ASEAN country. The transactions with in-country reserves are based on the accompanying Table 11, as computed from Table 10 data subject to reasonable constraints on the ending inventory levels in Table 12 (Section 5). Transaction points above the zero line in Figure 4-1A indicate deposits to the reserves and those below the zero line indicate withdrawals from the reserves.

Indicated transactions with in-country reserves are those bounded by the lines closest to the center line in Figure 4-1A. Total transactions (those with in-country reserves plus those with regional reserves) are indicated by the points most distant from the center line in the charts.

Indicated annual transactions with the in-country rice reserves in units of 1,000 MT, milled rice equivalent, range from +267 to -378 for Indonesia, +44 to -59 for Malaysia, +73 to -51 for the Philippines, +29 to -43 for Singapore, and +501 to -377 for Thailand. It will be noted that under the historical patterns existing for the five countries from 1960 through 1977, transactions with in-country reserves would have taken place about one-half the time. Over the 18-year period computed, transactions are zero for 10 years in Indonesia, 8 years in Malaysia, 13 years in the Philippines, 10 years in Singapore, and



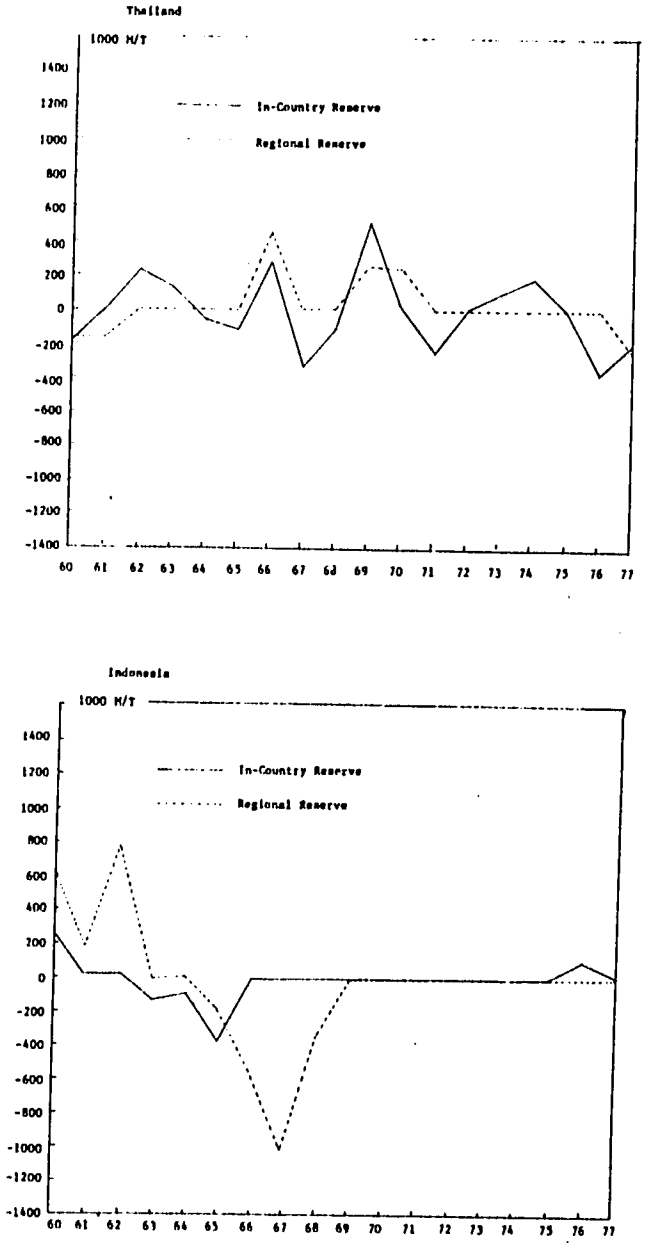


Fig 4-1A Computed Transaction with ASEAN Security Reserves (Rice only with Historical Trade)

TABLE 11. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	267	0	0	2	-197	72
2	1961	19	-19	0	0	0	0
3	1962	20	12	0	-22	235	245
4	1963	-135	0	0	19	133	17
5	1964	-90	2	0	-20	-66	-174
6	1965	-378	33	0	0	-106	-451
7	1966	0	0	-51	0	282	231
8	1967	0	-52	0	0	-340	-392
9	1968	0	0	0	14	-112	-98
10	1969	0	0	0	0	501	501
11	1970	0	0	66	29	18	113
12	1971	0	17	73	0	-248	-158
13	1972	0	44	4	0	0	48
14	1973	0	5	0	0	99	104
15	1974	0	2	-31	-43	181	109
16	1975	0	0	0	0	0	0
17	1976	113	-59	0	0	-377	-323
18	1977	22	0	0	2	-200	-176

SOURCE:
TABLE 10 DATA, SUBJECT TO THE CONSTRAINTS THAT TABLE 12 FIGURES BE NO LESS THAN ZERO AND NO MORE THAN MAXIMUMS FROM TABLE 11'.

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3 years in Thailand. However, only during one year (1975) would there have been no transactions with in-country rice reserves in any of the five ASEAN nations.

In addition to those with in-country reserves, transactions are needed with ASEAN regional rice reserves by all five countries in order to achieve the targeted stability levels in food supplies. The needed transactions with regional reserves are shown by added areas to the more distant points from the zero line in Figure 4-1A. The total distance to each "outside" transaction point on the chart represents combined transactions with in-country plus regional reserve. The regional reserve transactions plotted in Figure 4-1A are shown numerically in Table 13, Rice Only.

The regional reserve transactions are obtained by subtracting the annual transactions with in-country reserves (Table 11) from total annual transactions needed to achieve targeted stability (Table 10). Over the 18-year historical period, simulated transactions with regional rice reserves are needed by Indonesia during seven years, by Malaysia during five years, by the Philippines during three years, by Singapore during eight years, and by Thailand during six years. The five countries together need 29 transactions with the regional reserves during the 18-year period. Thirteen of the needed transactions are deposits and the 16 are withdrawals. In only two years are no transactions with regional reserves needed by any of the member nations under the 1-A alternative reserve program.

Rice Reserve Transactions With Stabilizing Trade

The simulated annual transactions with rice reserves under alternative 1-B are shown by ASEAN country in Figure 4-1B, using the same format and notations as in Figure 4-1A. The annual transactions and year-end reserve

TABLE 13. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	613	0	0	0	-174	439
2	1961	186	0	0	0	-167	19
3	1962	775	0	0	0	0	775
4	1963	0	0	0	0	0	0
5	1964	0	0	0	-7	0	-7
6	1965	-198	0	0	0	0	-198
7	1966	-559	0	-213	-35	451	-356
8	1967	-1007	-13	0	-13	0	-1033
9	1968	-344	-60	0	0	0	-404
10	1969	0	-6	0	0	251	245
11	1970	0	0	0	20	221	241
12	1971	0	0	93	61	0	154
13	1972	0	0	50	90	0	140
14	1973	0	10	0	0	0	10
15	1974	0	74	0	-11	0	63
16	1975	0	0	0	-86	0	-86
17	1976	0	0	0	0	0	0
18	1977	0	0	0	0	-247	-247

SOURCE:
FIGURES FROM TABLE 10 MINUS THOSE IN TABLE 11.

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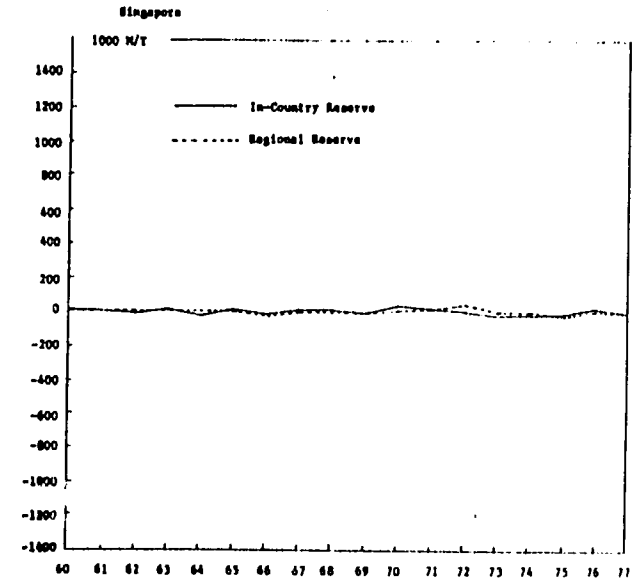

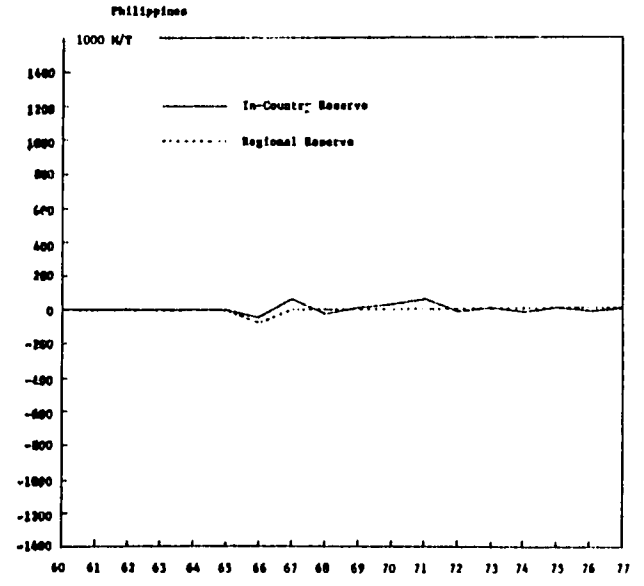

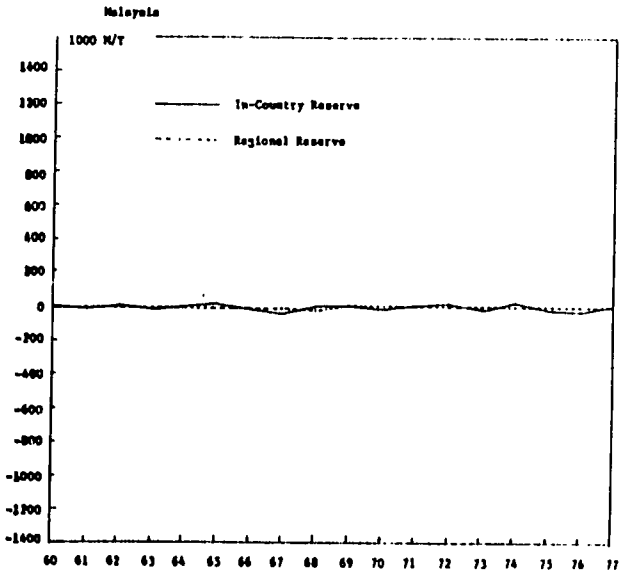

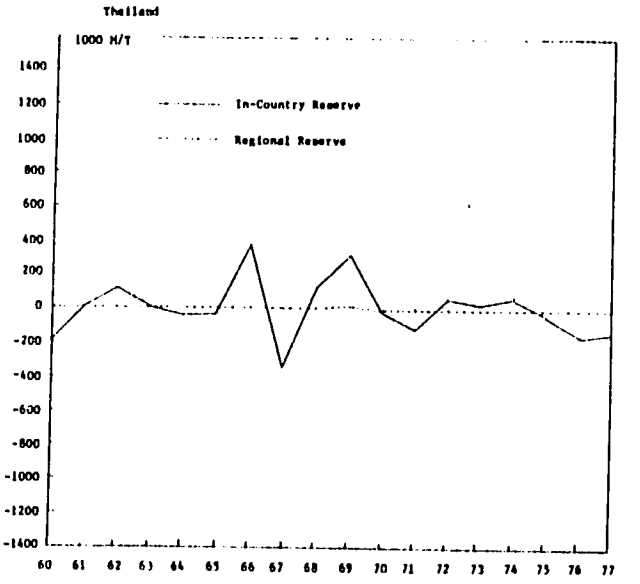

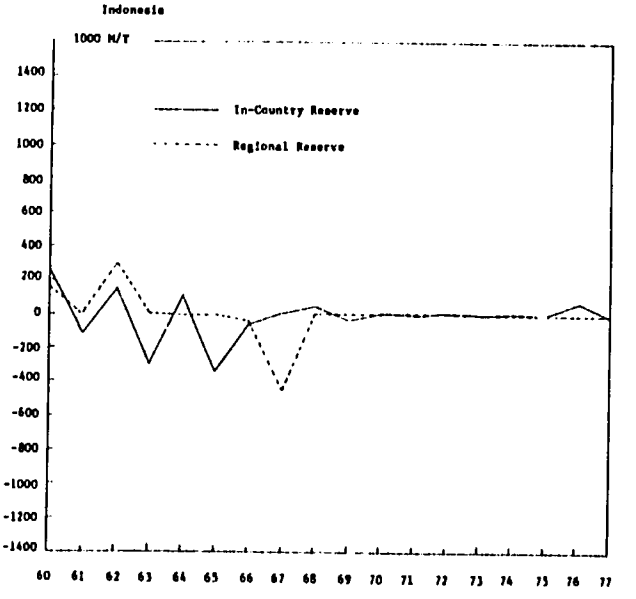

Fig 4-1B Computed Transactions with ASEAN Security Reserve (Rice only with Stabilizing Trade)

balances for in-country rice reserves after import (export) adjustments were determined simultaneously by computer program in the same manner as those using imports and exports as have occurred historically. The computations are based on the data in Table 16, subject to constraints that year-end balances be no less than zero and no greater than the standard error of estimate applied to the trend in total requirements for each country.

The computed annual transactions with in-country rice reserves after import adjustments in Figure 4-1B are shown numerically in Table 17. Transactions are indicated every year for Thailand, every year but one in Malaysia and Singapore, and all but two in Indonesia. No transactions are indicated for the first six years in the Philippines. The computed transactions follow a relatively randomized pattern, although the tendency for alternate plus and minus transactions occurs more frequently than under the case without import adjustments.

In milled rice equivalent, computed annual transactions with in-country reserves after import adjustments range from +267,000 MT to -339,000 MT in Indonesia, from +39,000 MT to -29,000 MT in Malaysia, from +66,000 MT to -51,000 MT in the Philippines, from +26,000 to -21,000 in Singapore, and from +383,000 MT to -362,000 MT in Thailand. Transactions of $\pm$5,000 MT or less are indicated 28 percent of the time (years) in Indonesia, 39 percent of the time in Malaysia, 33 percent of the time in Singapore, 50 percent of the time in the Philippines and none of the time in Thailand.

The computed annual transactions with regional rice reserves after import adjustments plotted in Figure 4-1B are shown numerically in Table 19. Transactions with the regional reserves are needed infrequently--in only four years by Indonesia and Singapore, two years in the Philippines, and in only one year in each of the other two countries. Deposit transactions are indicated for

TABLE 17. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	267	0	0	1	-185	83
2	1961	-118	-9	0	-1	9	-119
3	1962	157	11	0	-11	113	270
4	1963	-296	-5	0	15	10	-276
5	1964	103	4	0	-21	-38	48
6	1965	-339	15	0	10	-34	-348
7	1966	-71	-7	-51	-14	383	240
8	1967	0	-29	66	5	-362	-320
9	1968	52	-4	-33	5	125	145
10	1969	-26	5	17	-2	309	303
11	1970	13	-2	25	26	-37	25
12	1971	-7	10	64	9	-105	-29
13	1972	3	17	-8	0	53	65
14	1973	-2	-1	4	-18	23	6
15	1974	1	39	-18	-18	79	83
16	1975	0	-19	9	-7	-39	-56
17	1976	57	-20	-4	17	-169	-119
18	1977	-17	10	2	-8	-139	-152

SOURCE:
TABLE 16 DATA, SUBJECT TO THE CONSTRAINTS THAT TABLE 18 FIGURES BE NO LESS THAN ZERO AND NO MORE THAN MAXIMUMS FROM TABLE 11'.

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Indonesia in 1960 and 1962, for Thailand in 1969, and for the Philippines and Singapore in 1972, and for Singapore in 1973. Withdrawal transactions are indicated by Indonesia, Singapore and the Philippines in 1966, by Indonesia in 1967, by Malaysia in 1968, and by Singapore in 1975.

For the ASEAN regional rice reserve as a whole, deposits are indicated in five years and withdrawals in four years. No transactions are indicated for the remaining ten years. In terms of milled rice equivalent, the peak annual deposit is 299,000 MT in 1962; the peak annual withdrawal is 449,000 MT in 1967. Over the 18-year period, deposits underrun withdrawals by 88,000 MT (Table 19).

Transactions with All Food Grain Reserves Using Historical Trade

Simulated annual transactions with all food grain reserves using historical trade are shown by country in Figure 4-2A. The plotted transactions with in-country food grain reserves are shown by Table 11 in units of 1,000 MT, milled rice equivalent, subject to the constraints of zero to the maximums from Table 11 on the year-end balances for such reserves (Table 12). The positive values indicate deposits to the reserves, and the negative values indicate withdrawals from the reserves. Indicated annual transactions in units of 1,000 MT, milled rice equivalent, range from +368 to -425 for Indonesia, +75 to -57 for Malaysia, +125 to -79 for the Philippines, +57 to -61 for Singapore, and +599 to -430 for Thailand.

Under the historical patterns existing for the five countries, transactions with in-country food grain reserves would not have taken place every year. Over the 18-year period, computed transactions are zero for 11 years in Indonesia, 10 years in Malaysia, 13 years in the Philippines, 9 years in Singapore, and 4 years in Thailand. However, there would have been at least one transaction with in-country food grain reserves within ASEAN every year.

In addition to those shown in Table 11, transactions are needed with ASEAN regional food grain reserves by all five nations in order to achieve the targeted

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TABLE 19. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	173	0	0	0	0	173
2	1961	0	0	0	0	0	0
3	1962	299	0	0	0	0	299
4	1963	0	0	0	0	0	0
5	1964	0	0	0	0	0	0
6	1965	0	0	0	0	0	0
7	1966	-39	0	-81	-9	0	-129
8	1967	-449	0	0	0	0	-449
9	1968	0	-12	0	0	0	-12
10	1969	0	0	0	0	5	5
11	1970	0	0	0	0	0	0
12	1971	0	0	7	9	0	16
13	1972	0	0	0	36	0	36
14	1973	0	0	0	0	0	0
15	1974	0	0	0	0	0	0
16	1975	0	0	0	-27	0	-27
17	1976	0	0	0	0	0	0
18	1977	0	0	0	0	0	0

SOURCE:
FIGURES FROM TABLE 17 MINUS THOSE IN TABLE 16.

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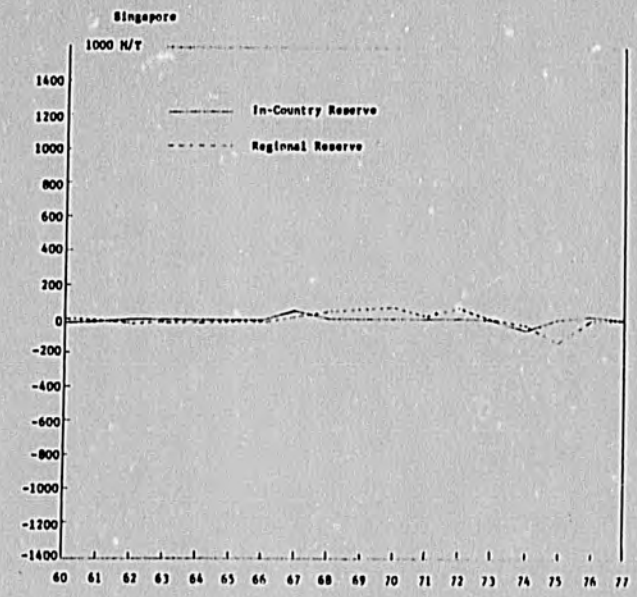

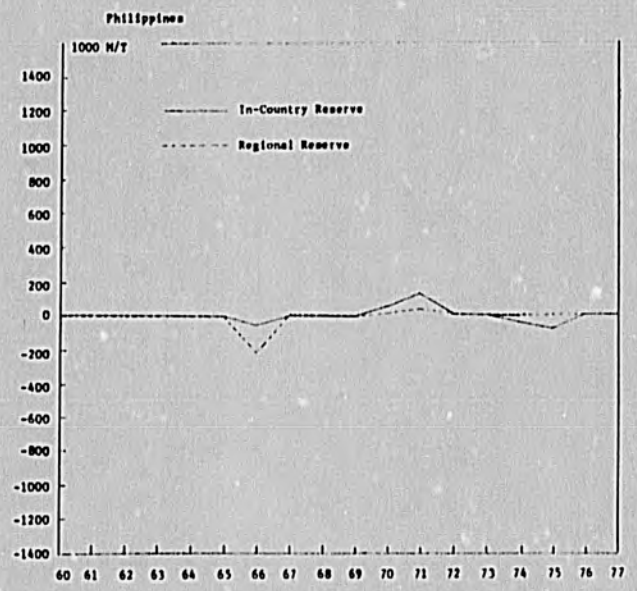

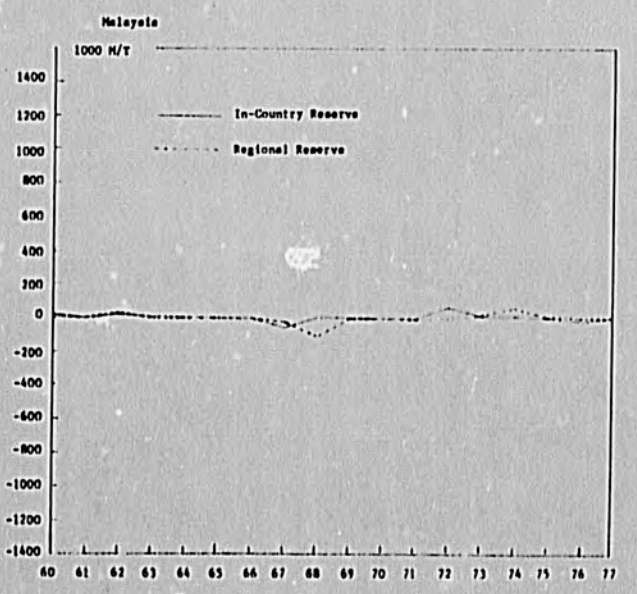

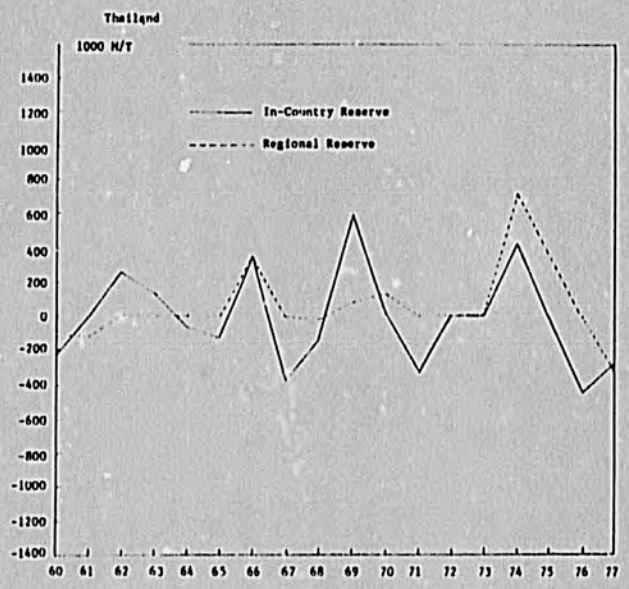

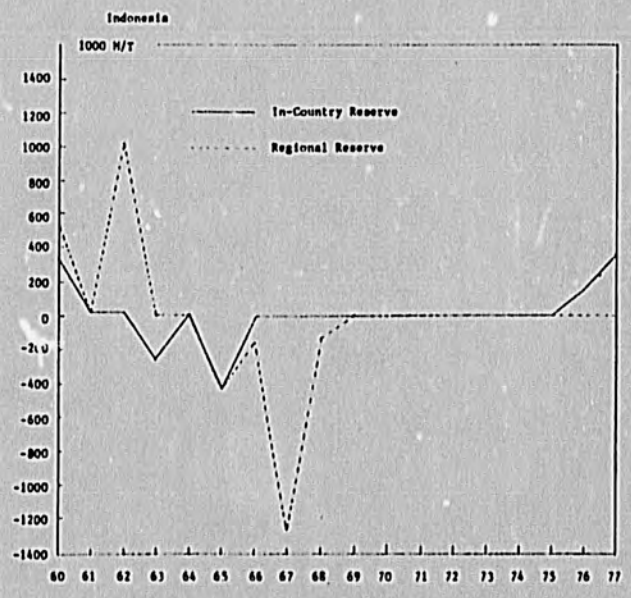

Fig 4-2A Computed Transactions with ASEAN Security Reserves
(All Grains with Historical Trade)

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TABLE 11. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	324	21	0	-14	-216	115
2	1961	20	0	0	-10	0	10
3	1962	22	19	0	0	256	297
4	1963	-265	0	0	0	137	-128
5	1964	0	-3	0	0	-78	-81
6	1965	-425	0	0	0	-130	-555
7	1966	0	0	-58	0	352	294
8	1967	0	-57	0	57	-391	-391
9	1968	0	0	0	1	-146	-145
10	1969	0	0	0	0	599	599
11	1970	0	0	48	1	21	70
12	1971	0	0	125	1	-324	-198
13	1972	0	75	0	1	0	76
14	1973	0	7	0	0	0	7
15	1974	0	2	-43	-61	414	312
16	1975	0	0	-79	0	0	-79
17	1976	162	-24	0	16	-430	-276
18	1977	368	0	0	0	-280	88

SOURCE:
TABLE 10 DATA, SUBJECT TO THE CONSTRAINTS THAT TABLE 12 FIGURES BE NO LESS THAN ZERO AND NO MORE THAN MAXIMUMS FROM TABLE 11'.

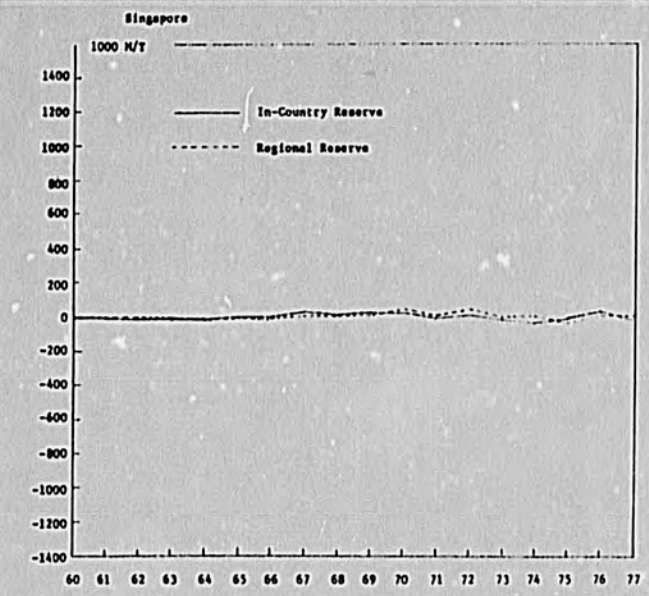
stability levels in food supplies (Figure 4-2A). The needed regional reserve transactions are shown numerically in Table 13. Over the 18-year period transactions with regional food grain reserves would have been needed by Indonesia during seven years, by Malaysia during five years, by Singapore during fourteen years, by the Philippines during two years, and by Thailand during eight years. The five countries together would have needed 36 transactions with the regional reserves over the 18-year period. Of these, 17 would have been deposits totaling 5,770,000 MT and 19 would have been withdrawals totaling 5,808,000 MT, milled rice equivalent.

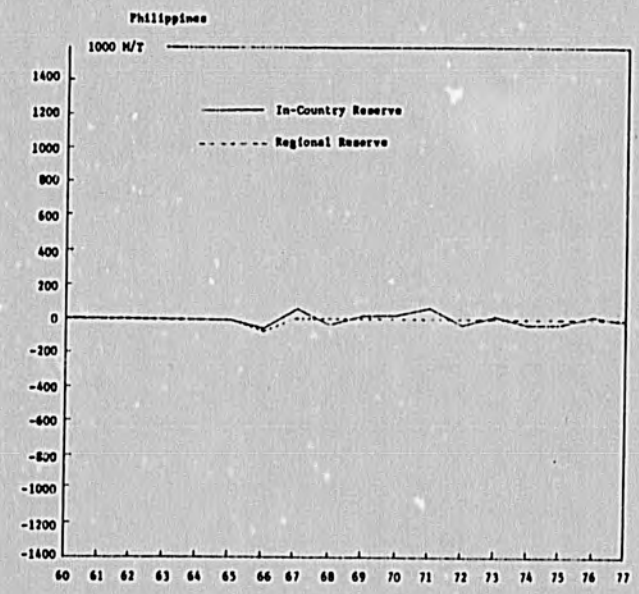
Transactions With All Food Grain Reserves With Stabilizing Trade

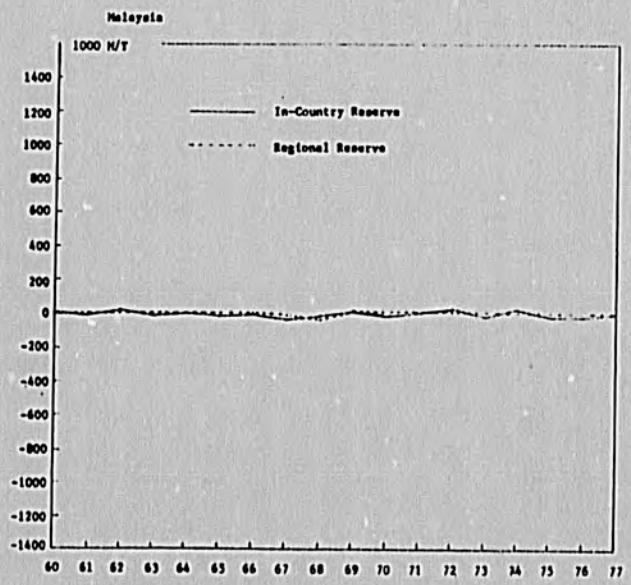
Simulated annual transactions with ASEAN all food grain reserves with stabilizing trade are shown in Figure 4-2B following the same notation as the previous charts. The annual transactions and year-end reserve balance for in-country food grain reserves after import (export) adjustments were determined simultaneously by computer program in the same manner as those without import adjustments. The computation is based on data for all food grains in Table 13, subject to constraints year-end balances in each country.

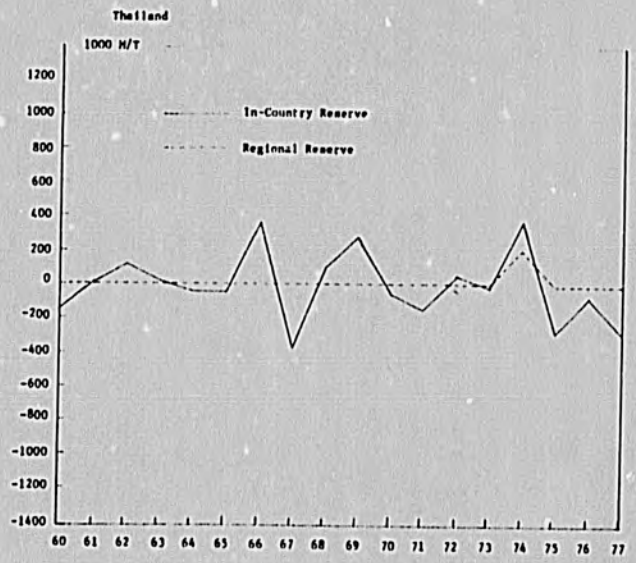
The computed annual transactions with in-country food grain reserves shown in Figure 4-2B are listed in Table 17. Transactions are indicated for every year in all countries except for the Philippines from 1960 through 1965 and Singapore in 1965 and 1966. The computed transactions follow a reasonably randomized pattern, although the tendency for alternate plus and minus transactions occur more frequently than under case 2-A without import adjustments.

In milled rice equivalent, computed annual transactions with in-country food grain reserves after import adjustments range from +324,000 MT to -471,000 MT for Indonesia, from +35,000 MT to -38,000 MT for Malaysia, from +33,000 MT to -39,000 MT









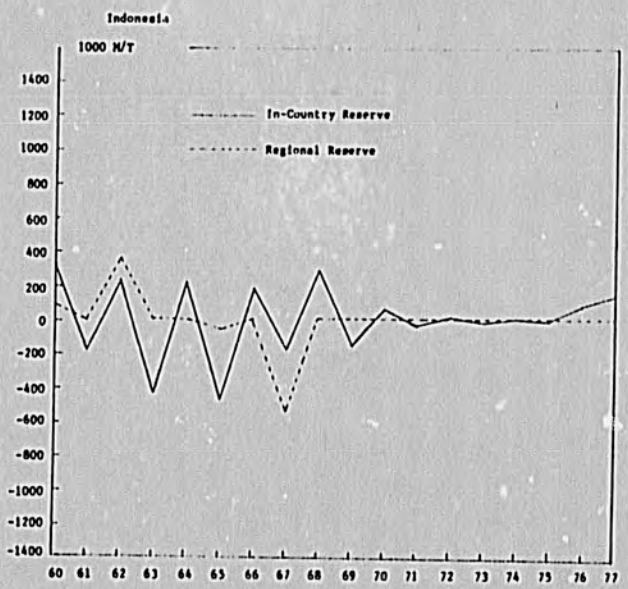


Fig 4-2B Computed Transaction with ASEAN Security Reserve
(All Grains with Stabilizing Trade)

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TABLE 13. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	522	0	0	0	-103	419
2	1961	15	0	0	-6	-126	-117
3	1962	1005	25	0	-18	0	1012
4	1963	0	0	0	-10	0	-10
5	1964	0	0	0	-12	0	-12
6	1965	-434	0	0	-7	0	-441
7	1966	-167	0	-215	-2	337	-47
8	1967	-1274	-17	0	8	0	-1283
9	1968	-146	-113	0	44	-21	-236
10	1969	0	0	0	49	82	131
11	1970	0	0	0	73	130	203
12	1971	0	0	32	9	0	41
13	1972	0	0	0	67	0	67
14	1973	0	9	0	0	0	9
15	1974	0	55	0	-36	708	727
16	1975	0	0	0	-131	0	-131
17	1976	0	0	0	0	0	0
18	1977	0	0	0	0	-333	-333

SOURCE:
FIGURES FROM TABLE 10 MINUS THOSE IN TABLE 11.

TABLE 17. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	324	10	0	-7	-159	168
2	1961	-194	-5	0	-4	17	-186
3	1962	236	25	0	-7	120	374
4	1963	-438	-12	0	-2	9	-443
5	1964	219	5	0	-4	-43	177
6	1965	-471	-2	0	0	-43	-516
7	1966	186	1	-58	0	366	495
8	1967	-186	-38	68	53	-379	-502
9	1968	292	-4	-34	6	106	366
10	1969	-146	19	17	19	288	197
11	1970	73	-9	15	1	-68	12
12	1971	-36	5	71	-8	-128	-56
13	1972	18	35	-35	10	64	92
14	1973	-9	-10	18	-19	-32	-52
15	1974	5	33	-30	-39	376	345
16	1975	-2	-17	-24	-3	-288	-334
17	1976	82	-4	12	31	-71	50
18	1977	143	2	-6	-16	-271	-148

SOURCE:
TABLE 16 DATA, SUBJECT TO THE CONSTRAINTS THAT TABLE 18 FIGURES BE NO LESS THAN ZERO AND NO MORE THAN MAXIMUMS FROM TABLE 11'.

a9

for Singapore, from +71,000 MT to -58,000 MT for the Philippines and +376,000 MT to -379,000 MT for Thailand. Transactions of $\pm$5,000 MT or less are indicated for two years in Indonesia, eight years in Malaysia, seven years in Singapore, six years in the Philippines, and no years in Thailand.

The annual transactions with regional food grain reserves after import adjustments shown in Figure 4-2B are taken from Table 19, All Food Grains. The transactions are relatively infrequent, occurring in only four years for Indonesia, seven years for Singapore, and in one year in the other three countries. Deposit transactions are indicated for Indonesia in 1960 and 1962, Singapore in 1969, 1970, and 1972, and Thailand in 1974. Withdrawal transactions are indicated in 1964 for Singapore, 1965 for Indonesia and Singapore, 1966 for the Philippines and Singapore, 1967 for Indonesia, 1968 for Malaysia, and 1975 for Singapore. For the ASEAN regional reserves as a whole, deposits are indicated in six years and withdrawals in six years. In milled rice equivalent, the peak deposit is 374,000 MT in 1962, and the peak withdrawal is 544,000 MT in 1967. Over the 18-year period, withdrawals exceed deposits by 41,000 MT.

TABLE 19. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED ANNUAL TRANSACTIONS WITH REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	99	0	0	0	0	99
2	1961	0	0	0	0	0	0
3	1962	374	0	0	0	0	374
4	1963	0	0	0	0	0	0
5	1964	0	0	0	-1	0	-1
6	1965	-68	0	0	-1	0	-69
7	1966	0	0	-78	-1	0	-79
8	1967	-544	0	0	0	0	-544
9	1968	0	-34	0	0	0	-34
10	1969	0	0	0	2	0	2
11	1970	0	0	0	25	0	25
12	1971	0	0	0	0	0	0
13	1972	0	0	0	28	0	28
14	1973	0	0	0	0	0	0
15	1974	0	0	0	0	201	201
16	1975	0	0	0	-43	0	-43
17	1976	0	0	0	0	0	0
18	1977	0	0	0	0	0	0

SOURCE:
FIGURES FROM TABLE 17 MINUS THOSE IN TABLE 16.

SECTION 5

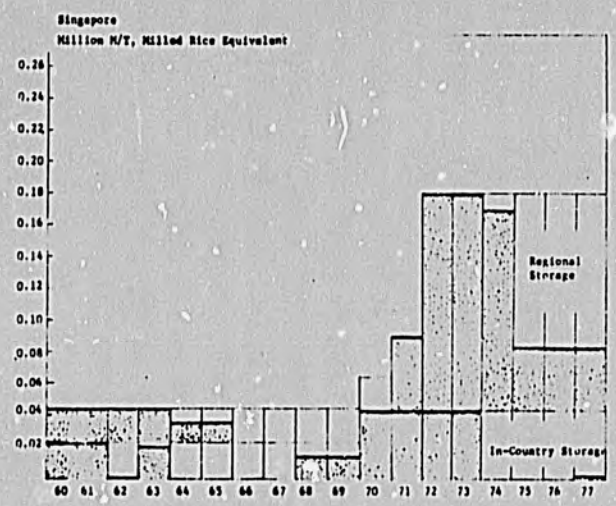
STORAGE CAPACITY AND INVENTORIES FOR SIMULATED SECURITY RESERVE ALTERNATIVES

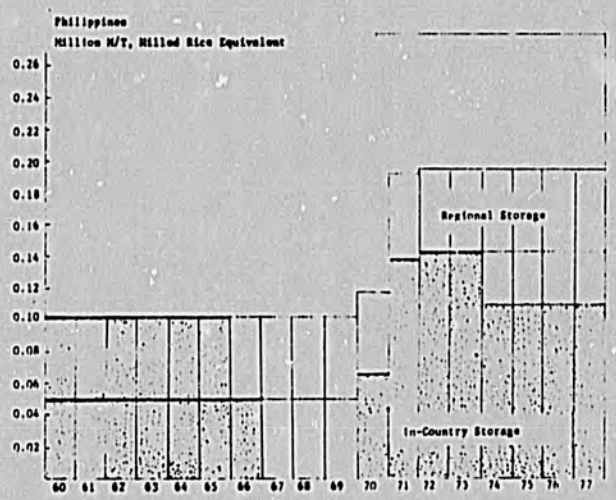
The storage inventories (year-end balances) for both in-country and regional reserves under each of the four alternatives analyzed for ASEAN are determined simultaneously with the reserve transactions in the methodology followed in the study (see Section 1 and Annex I). The required grain storage capacities are defined by the maximum balances in inventory, so that the capacity requirements increase, but do not decrease through time. All computations in the ASEAN analysis are made in units of metric tons, milled rice equivalent. The ending inventories and capacities for whole storage grain need to be converted to whole grain equivalent. The conversion has been reflected in the cost-effectiveness analysis reported in Sections 6 and 7, but not in the figures reported in the present section.

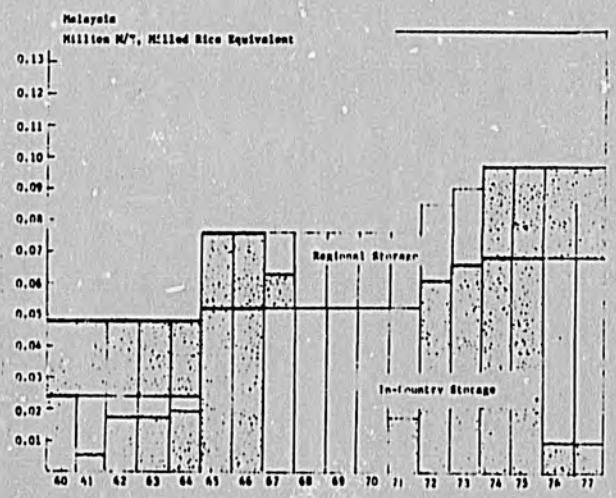
Capacities and Inventory Levels for Rice Reserves with Historical Trade

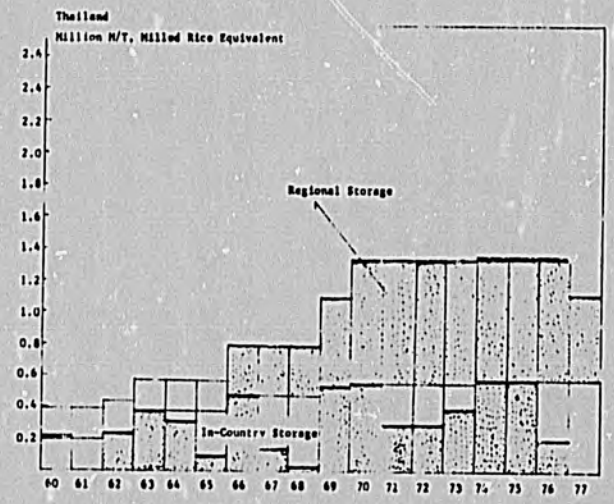
The computed grain storage capacity and inventory requirements for the alternative 1-A rice reserves are pictured for each of the ASEAN countries in Figure 5-1A. The capacities are depicted by the height of the bar chart, resembling a grain silo in appearance. The inventory levels are depicted by the height of the levels of grain within the silos. For each country, the in-country reserve storage is presented in the lower section of the chart. The regional storage for each country is depicted as sitting on top of the in-country storage.

The corresponding year-end balances for in-country rice reserves, depicted in Figure 5-1A, are shown in Table 12 and the corresponding capacities in Table 12'.









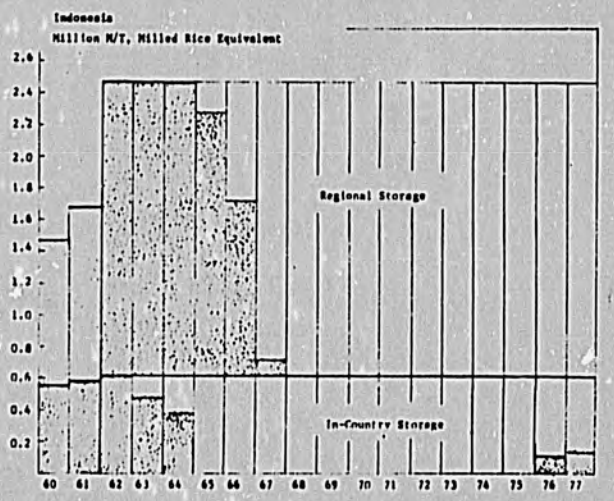


Fig 5-1A Computed Storage Capacity and Inventory for ASEAN Security Reserves (Rice Only with Historical Trade)

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TABLE 12. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	564	24	51	23	0	662
2	1961	583	5	51	23	0	662
3	1962	603	17	51	1	235	907
4	1963	468	17	51	20	368	924
5	1964	378	19	51	0	302	750
6	1965	0	52	51	0	196	299
7	1966	0	52	0	0	478	530
8	1967	0	0	0	0	138	138
9	1968	0	0	0	14	26	40
10	1969	0	0	0	14	527	541
11	1970	0	0	66	43	545	654
12	1971	0	17	139	43	297	496
13	1972	0	61	143	43	297	544
14	1973	0	66	143	43	396	648
15	1974	0	68	112	0	577	757
16	1975	0	68	112	0	577	757
17	1976	113	9	112	0	200	434
18	1977	135	9	112	2	0	258

SOURCE:
CUMULATIVE TOTALS FROM TABLE 11, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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TABLE 12'. RICE ONLY
REQUIRED TOTAL STORAGE CAPACITY FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	564	24	51	23	197	859
2	1961	583	24	51	23	197	878
3	1962	603	24	51	23	235	936
4	1963	603	24	51	23	368	1069
5	1964	603	24	51	23	368	1069
6	1965	603	52	51	23	368	1097
7	1966	603	52	51	23	478	1207
8	1967	603	52	51	23	478	1207
9	1968	603	52	51	23	478	1207
10	1969	603	52	51	23	527	1256
11	1970	603	52	66	43	545	1309
12	1971	603	52	139	43	545	1382
13	1972	603	61	143	43	545	1395
14	1973	603	66	143	43	545	1400
15	1974	603	68	143	43	577	1434
16	1975	603	68	143	43	577	1434
17	1976	603	68	143	43	577	1434
18	1977	603	68	143	43	577	1434

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 12.

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The reserve balances for Indonesia are substantial for the first five years, and thereafter decline to zero except for the last two years when small balances are indicated. Those for Malaysia continue to build up through 1966, then remain at zero for four years, build up again through 1975, and then decrease during the last two years. Those for the Philippines remain at a constant level for six years, decline to zero for four years, and then again build up and remain positive. Those for Singapore remain positive for four years, decline to zero for four years, build up and remain relatively large for six years, and again decline to zero or nearly so. The reserve balances for Thailand remain at about zero for two years and thereafter build up and fluctuate from year to year, again declining to zero in 1977.

The average annual utilization of the in-country storage capacity under this alternative is 26.3 percent for Indonesia, 54.8 percent for Malyasia, 79.1 percent for the Philippines, 46.9 percent for Singapore and 63.1 percent for Thailand. It will be noted that maximum constraints on the size of the in-country rice reserves are effective in one or more years for all five countries (Table 12 and Table 11', Rice Only). Over the 18-year period, the maximum constraints come into play three years for Indonesia, two years for Malaysia, four years for Singapore, two years for the Philippines and two years for Thailand.

The required regional capacities depicted in Figure 5-1A are shown in Table 14'. The required regional capacity is large for the Indonesia over the total period. That for Malaysia remains at 24,000 MT through 1973 and then increases to 29,000 MT. That for the Philippines remains constant at 51,000 MT. That for Singapore holds at 21,000 MT through 1970, then increases to 47,000 MT in 1971 and 137,000 MT in 1972. That for Thailand remains at 197,000 MT through 1965, at 307,000 MT through 1969, at 558,000 MT until 1970 when it reaches 779,000 MT.

TABLE 14'. RICE ONLY
REQUIRED TOTAL STORAGE CAPACITY REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	910	24	51	21	197	1203
2	1961	1096	24	51	21	197	1389
3	1962	1871	24	51	21	197	2164
4	1963	1871	24	51	21	197	2164
5	1964	1871	24	51	21	197	2164
6	1965	1871	24	51	21	197	2164
7	1966	1871	24	51	21	307	2274
8	1967	1871	24	51	21	307	2274
9	1968	1871	24	51	21	307	2274
10	1969	1871	24	51	21	558	2525
11	1970	1871	24	51	21	779	2746
12	1971	1871	24	51	47	779	2772
13	1972	1871	24	51	137	779	2862
14	1973	1871	24	51	137	779	2862
15	1974	1871	29	51	137	779	2867
16	1975	1871	29	51	137	779	2867
17	1976	1871	29	51	137	779	2867
18	1977	1871	29	51	137	779	2867

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 14.

The balances in the regional reserves shown in Figure 5-1A are given in Table 14. All five countries encounter negative balances -- Indonesia from 1968-1977, Malaysia from 1968-1973, the Philippines from 1966-1977, Singapore from 1966-1970, and Thailand from 1961-1965. The ASEAN total regional reserve balance is negative only in 1968. A withdrawal from world reserves of 175,000 MT, milled rice equivalent, would have been required that year to support the reserve program under the 1-A alternative.

The average annual utilization of the regional storage capacities for this alternative is 34.1 percent.

Capacities and Inventory Levels for Rice Reserves with Stabilizing Trade

The computed grain storage capacity and inventory requirements for the alternative 1-B rice reserves for the ASEAN countries are depicted in Figure 5-1B. The information is presented in the same manner as in Figure 5-1A. The required total capacity requirements for in-country rice reserves are taken from Table 18'. The capacities for this alternative follow patterns similar to those for alternative 1-A. The peak in-country capacities are 603,000 MT for Indonesia, 68,000 MT for Malaysia, 139,000 MT for the Philippines, 43,000 MT for Singapore and 540,000 MT for Thailand.

The corresponding ending balances for after-import-adjustment in-country rice reserves are shown in milled rice equivalent in Table 18. The ending balances are bound by the upper or lower constraints in some years in all five countries. The zero lower bound is effective in 1966 for Indonesia, Singapore and the Philippines, in 1967 for Indonesia, in 1968 for Malaysia, and in 1975 for Singapore. The upper bound is limiting in 1960 and 1962 for Indonesia, in 1969 for Thailand, in 1971 for the Philippines and Singapore, in 1972 for Singapore.

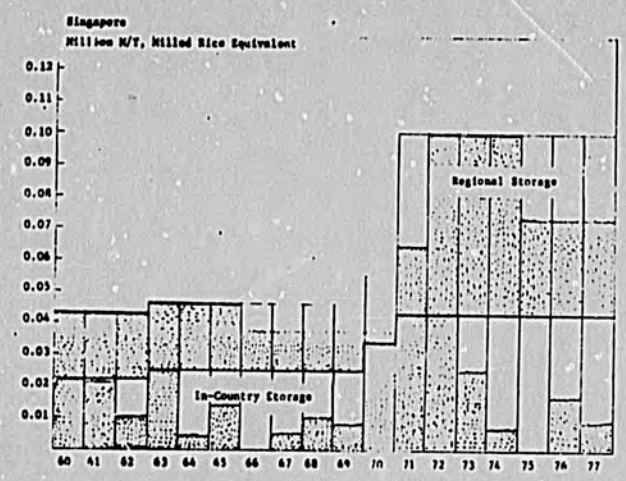
TABLE 14. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

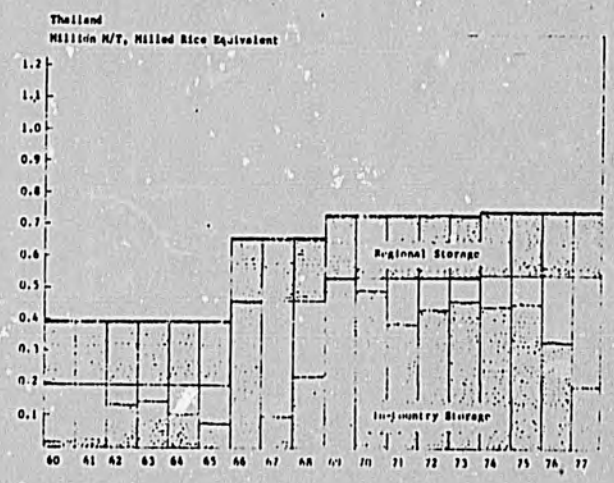
COMPUTED YEAR-END BALANCES FOR REGIONAL RESERVES

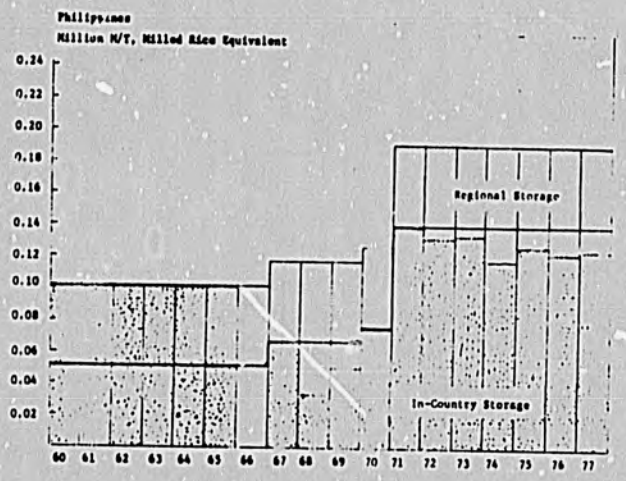
BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

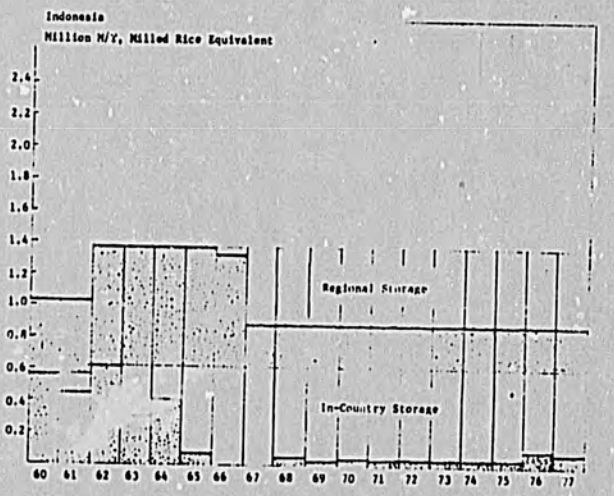
PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	910	24	51	21	23	1029
2	1961	1096	24	51	21	-144	1048
3	1962	1871	24	51	21	-144	1823
4	1963	1871	24	51	21	-144	1823
5	1964	1871	24	51	14	-144	1816
6	1965	1673	24	51	14	-144	1618
7	1966	1114	24	-162	-21	307	1262
8	1967	107	11	-162	-34	307	229
9	1968	-237	-49	-162	-34	307	-175
10	1969	-237	-55	-162	-34	558	70
11	1970	-237	-55	-162	-14	779	311
12	1971	-237	-55	-69	47	779	465
13	1972	-237	-55	-19	137	779	605
14	1973	-237	-45	-19	137	779	615
15	1974	-237	29	-19	126	779	678
16	1975	-237	29	-19	40	779	592
17	1976	-237	29	-19	40	779	592
18	1977	-237	29	-19	40	532	345

SOURCE:
CUMULATIVE TOTALS FROM TABLE 13, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').









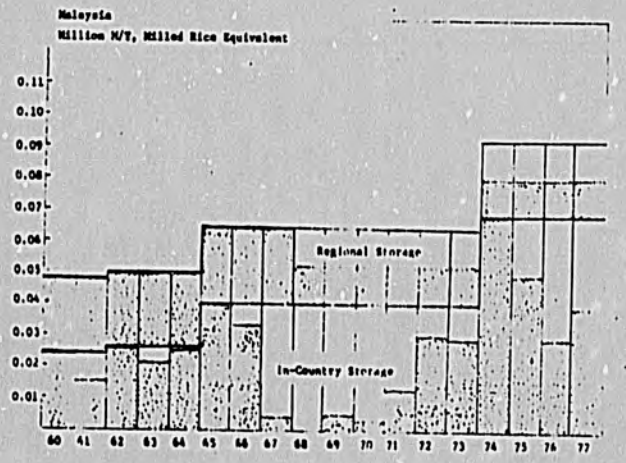


Fig 5-1B Computed Storage Capacity and Inventory for ASEAN Security Reserve (Rice Only with Stabilizing Trade)

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TABLE 18'. RICE ONLY
REQUIRED TOTAL STORAGE CAPACITY FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING TRADE ADJUSTMENTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	564	24	51	22	197	858
2	1961	564	24	51	22	197	858
3	1962	603	26	51	22	197	899
4	1963	603	26	51	25	197	902
5	1964	603	26	51	25	197	902
6	1965	603	40	51	25	197	916
7	1966	603	40	51	25	455	1174
8	1967	603	40	66	25	455	1189
9	1968	603	40	66	25	455	1189
10	1969	603	40	66	25	527	1261
11	1970	603	40	75	34	527	1279
12	1971	603	40	139	43	527	1352
13	1972	603	40	139	43	527	1352
14	1973	603	40	139	43	527	1352
15	1974	603	68	139	43	540	1393
16	1975	603	68	139	43	540	1393
17	1976	603	68	139	43	540	1393
18	1977	603	68	139	43	540	1393

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 18.

TABLE 18. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	564	24	51	22	12	673
2	1961	446	15	51	21	21	554
3	1962	603	26	51	10	134	824
4	1963	307	21	51	25	144	548
5	1964	410	25	51	4	106	596
6	1965	71	40	51	14	72	248
7	1966	0	33	0	0	455	488
8	1967	0	4	66	5	93	168
9	1968	52	0	33	10	218	313
10	1969	26	5	50	8	527	616
11	1970	39	3	75	34	490	641
12	1971	32	13	139	43	385	612
13	1972	35	30	131	43	438	677
14	1973	33	29	135	25	461	683
15	1974	34	68	117	7	540	766
16	1975	34	49	126	0	501	710
17	1976	91	29	122	17	332	591
18	1977	74	39	124	9	193	439

SOURCE:
CUMULATIVE TOTALS FROM TABLE 17, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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The ending balances for the in-country reserves in Indonesia remain at relatively high levels for the first five years and then decline to modest levels. Those in Malaysia exhibit an upward trend through 1965, remain at near zero through 1970 and then build up again, reaching a peak in 1974. Those in the Philippines remain at relatively constant levels through 1969, and then build up and remain at relatively high levels thereafter. Those in Singapore show a fluctuating pattern, reaching peak levels in 1971 and 1972, and exhibiting a declining trend thereafter. Those in Thailand increase gradually in the early years, reaching peaks in 1969 and 1974, and exhibit a gradual declining trend thereafter.

The average annual utilization of the in-country storage capacity under this alternative is 26.5 percent for Indonesia, 59.8 percent for Malaysia, 88.8 percent for the Philippines, 51.6 percent for Singapore and 69.8 percent for Thailand.

The required regional storage capacities under this alternative as depicted in Figure 5-1B are shown in Table 20'. The level off regional capacities in milled rice equivalent are 769,000 MT for Indonesia, 24,000 MT for Malaysia, 51,000 MT for the Philippines, 57,000 MT for Singapore, and 202,000 MT for Thailand, making a ASEAN total of 1,103,000 MT. The ASEAN total is reached in 1972.

The corresponding annual ending balances in the regional rice reserves shown in Figure 5-1B come from Table 20. The regional reserves are subject only to the constraint that the ASEAN total be no less than zero, so that the balances for the Philippines are negative for the years 1966 through 1977. The year-end balances in the regional rice reserves are relatively stable for Indonesia and Thailand but decline after 1965 for the Philippines and after 1967 for Malaysia. The reserves for Singapore build to a peak during 1972-1974.

TABLE 20'. RICE ONLY
REQUIRED TOTAL STORAGE CAPACITY REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING TRADE ADJUSTMENTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	470	24	51	21	197	763
2	1961	470	24	51	21	197	763
3	1962	769	24	51	21	197	1062
4	1963	769	24	51	21	197	1062
5	1964	769	24	51	21	197	1062
6	1965	769	24	51	21	197	1062
7	1966	769	24	51	21	197	1062
8	1967	769	24	51	21	197	1062
9	1968	769	24	51	21	197	1062
10	1969	769	24	51	21	202	1067
11	1970	769	24	51	21	202	1067
12	1971	769	24	51	21	202	1067
13	1972	769	24	51	57	202	1103
14	1973	769	24	51	57	202	1103
15	1974	769	24	51	57	202	1103
16	1975	769	24	51	57	202	1103
17	1976	769	24	51	57	202	1103
18	1977	769	24	51	57	202	1103

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 20.

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TABLE 20. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	470	24	51	21	197	763
2	1961	470	24	51	21	197	763
3	1962	769	24	51	21	197	1062
4	1963	769	24	51	21	197	1062
5	1964	769	24	51	21	197	1062
6	1965	769	24	51	21	197	1062
7	1966	730	24	-30	12	197	933
8	1967	281	24	-30	12	197	484
9	1968	281	12	-30	12	197	472
10	1969	281	12	-30	12	202	477
11	1970	281	12	-30	12	202	477
12	1971	281	12	-23	21	202	493
13	1972	281	12	-23	57	202	529
14	1973	281	12	-23	57	202	529
15	1974	281	12	-23	57	202	529
16	1975	281	12	-23	30	202	502
17	1976	281	12	-23	30	202	502
18	1977	281	12	-23	30	202	502

SOURCE:
CUMULATIVE TOTALS FROM TABLE 19, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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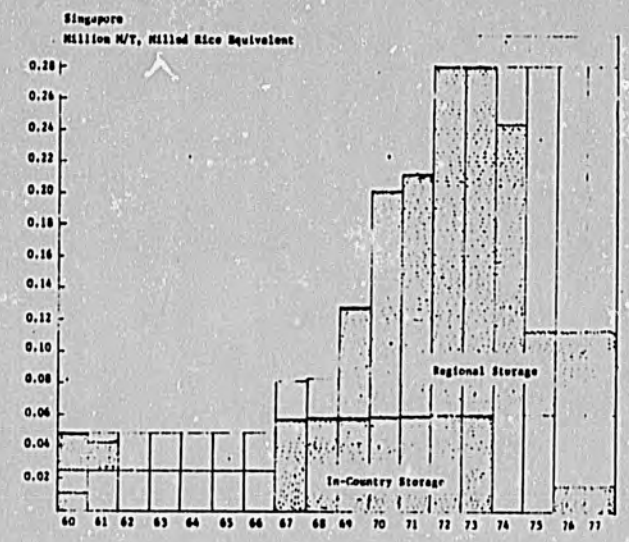
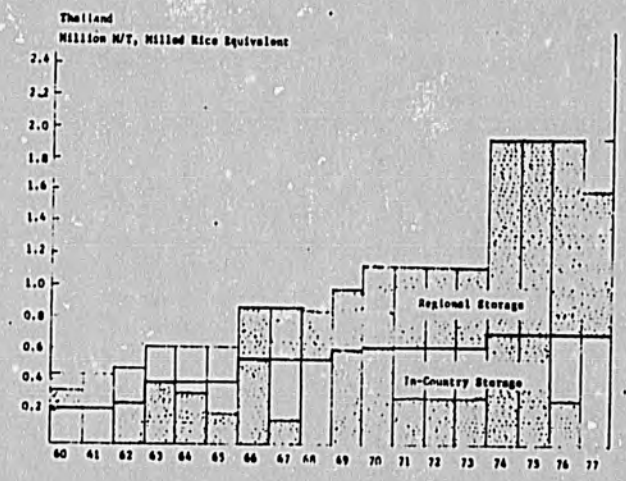
The average annual utilization of the regional reserve storage capacity under this alternative is 65 percent.

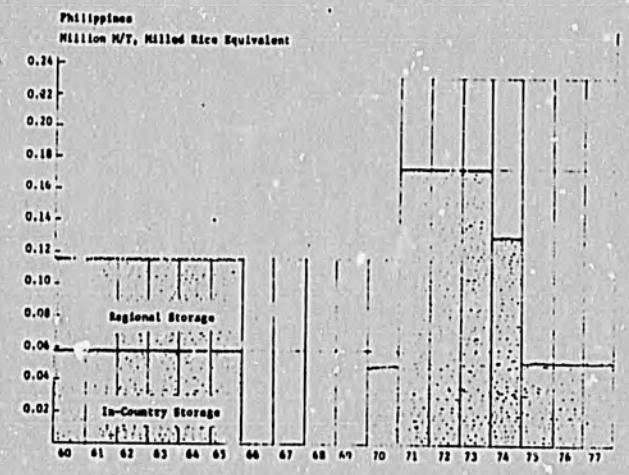
Capacities and Inventory Levels for All Grain Reserves with Historical Trade

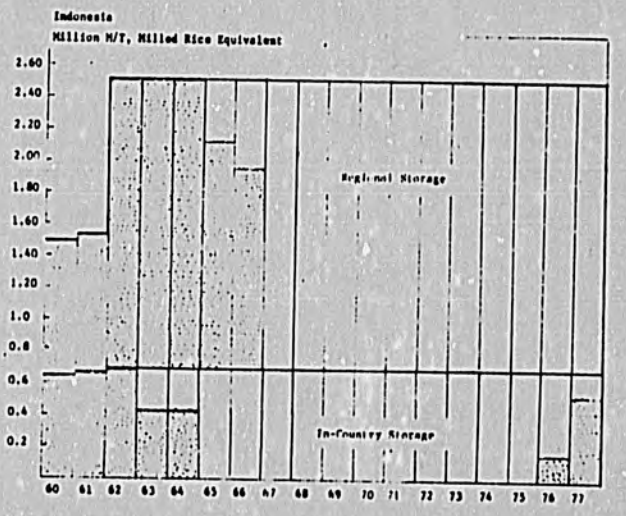
Capacity and inventory levels associated with this alternative are depicted in Figure 5-2A, following the same method of presentation as that used for Figures 5-1A. The tabular listing of the required capacity for in-country facilities for this alternative are shown in Table 12', All Food Grains. The maximum capacities in milled rice equivalent and year in which they are reached are: Indonesia, 690,000 MT in 1962; Malaysia, 84,000 MT in 1974; Philippines, 173,000 MT in 1971; Singapore, 61,000 MT in 1972; and Thailand, 710,000 MT in 1974.

The corresponding year-end balances for in-country food grain reserves shown in Figures 5-1A are taken from Table 12. The reserve balances for Indonesia are substantial the first five years, and then remain at zero until the last two years. Those for Malaysia build up through 1966, decline to zero for five years and thereafter build up and remain at positive levels. Those for the Philippines remain at a constant level through 1965, decline to zero for four years, then again build up and remain at substantial levels over the remainder of the period. Those for Singapore decline to zero through 1966, build up and remain at maximum levels through 1973, and again decline to zero until 1976 when a small positive balance is indicated. The reserve balances for Thailand remain at zero for two years, and thereafter build up and remain positive (except for 1968) until the last year when they again decline to zero. The maximum constraints on the size of in-country food grain reserves are effective in one or more years in all five countries (Table 12 and 11', All Food Grains). Over the 18-year period, the maximum constraints are effective two









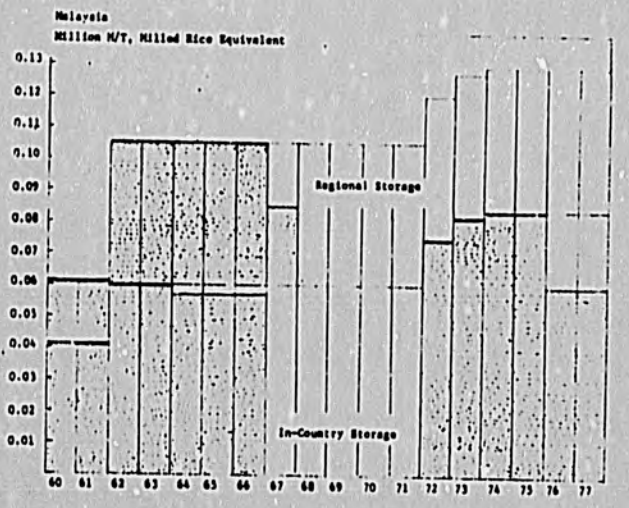


Fig 5-2A Computed Storage Capacity and Inventory for ASEAN Security Reserves (All Grains with Historical Trade)

TABLE 12'. ALL FOOD GRAINS (RICE, WHEAT, CORN)
REQUIRED TOTAL STORAGE CAPACITY FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	648	41	58	24	216	987
2	1961	668	41	58	24	216	1007
3	1962	690	60	58	24	256	1088
4	1963	690	60	58	24	393	1225
5	1964	690	60	58	24	393	1225
6	1965	690	60	58	24	393	1225
7	1966	690	60	58	24	537	1369
8	1967	690	60	58	57	537	1402
9	1968	690	60	58	58	537	1403
10	1969	690	60	58	58	599	1465
11	1970	690	60	58	59	620	1487
12	1971	690	60	173	60	620	1603
13	1972	690	75	173	61	620	1619
14	1973	690	82	173	61	620	1626
15	1974	690	84	173	61	710	1718
16	1975	690	84	173	61	710	1718
17	1976	690	84	173	61	710	1718
18	1977	690	84	173	61	710	1718

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 12.

TABLE 12. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	648	41	58	10	0	757
2	1961	668	41	58	0	0	767
3	1962	690	60	58	0	256	1064
4	1963	425	60	58	0	393	936
5	1964	425	57	58	0	315	855
6	1965	0	57	58	0	185	300
7	1966	0	57	0	0	537	594
8	1967	0	0	0	57	146	203
9	1968	0	0	0	58	0	58
10	1969	0	0	0	58	599	657
11	1970	0	0	48	59	620	727
12	1971	0	0	173	60	296	529
13	1972	0	75	173	61	296	605
14	1973	0	82	173	61	296	612
15	1974	0	84	130	0	710	924
16	1975	0	84	51	0	710	845
17	1976	162	60	51	16	280	569
18	1977	530	60	51	16	0	657

SOURCE:
CUMULATIVE TOTALS FROM TABLE 11, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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TABLE 14'. ALL FOOD GRAINS (RICE,WHEAT, CORN)
REQUIRED TOTAL STORAGE CAPACITY REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	846	20	58	24	216	1164
2	1961	861	20	58	24	216	1179
3	1962	1866	45	58	24	216	2209
4	1963	1866	45	58	24	216	2209
5	1964	1866	45	58	24	216	2209
6	1965	1866	45	58	24	216	2209
7	1966	1866	45	58	24	324	2317
8	1967	1866	45	58	24	324	2317
9	1968	1866	45	58	24	324	2317
10	1969	1866	45	58	70	385	2424
11	1970	1866	45	58	143	515	2627
12	1971	1866	45	58	152	515	2636
13	1972	1866	45	58	219	515	2703
14	1973	1866	45	58	219	515	2703
15	1974	1866	45	58	219	1223	3411
16	1975	1866	45	58	219	1223	3411
17	1976	1866	45	58	219	1223	3411
18	1977	1866	45	58	219	1223	3411

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 14.

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TABLE 14. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	846	20	58	24	113	1061
2	1961	861	20	58	18	-13	944
3	1962	1866	45	58	0	-13	1956
4	1963	1866	45	58	-10	-13	1946
5	1964	1866	45	58	-22	-13	1934
6	1965	1432	45	58	-29	-13	1493
7	1966	1265	45	-157	-31	324	1446
8	1967	-9	28	-157	-23	324	163
9	1968	-155	-85	-157	21	303	-73
10	1969	-155	-85	-157	70	385	58
11	1970	-155	-85	-157	143	515	261
12	1971	-155	-85	-125	152	515	302
13	1972	-155	-85	-125	219	515	369
14	1973	-155	-76	-125	219	515	378
15	1974	-155	-21	-125	183	1223	1105
16	1975	-155	-21	-125	52	1223	974
17	1976	-155	-21	-125	52	1223	974
18	1977	-155	-21	-125	52	890	641

SOURCE:
CUMULATIVE TOTALS FROM TABLE 13, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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years in Indonesia, four years in Malaysia, two years in the Philippines, seven years in Singapore, and three years in Thailand.

Based on the capacities in Table 12', the 18-year annual average utilization of in-country capacity would have been 28.7 percent in Indonesia, 69.6 percent in Malaysia, 64.8 percent in the Philippines, 55.2 percent in Singapore and 60.0 percent in Thailand.

The required regional storage capacities depicted in Figure 5-2A are taken from Table 14'. The level-off capacities in milled rice equivalent are 1,866,000 MT for Indonesia, 45,000 MT for Malaysia, 58,000 MT for the Philippines, 219,000 MT for Singapore, and 1,223,000 MT for Thailand, making the total for ASEAN 3,411,000 MT. This total is reached in 1974 when a substantial increment of additional capacity is needed by Thailand.

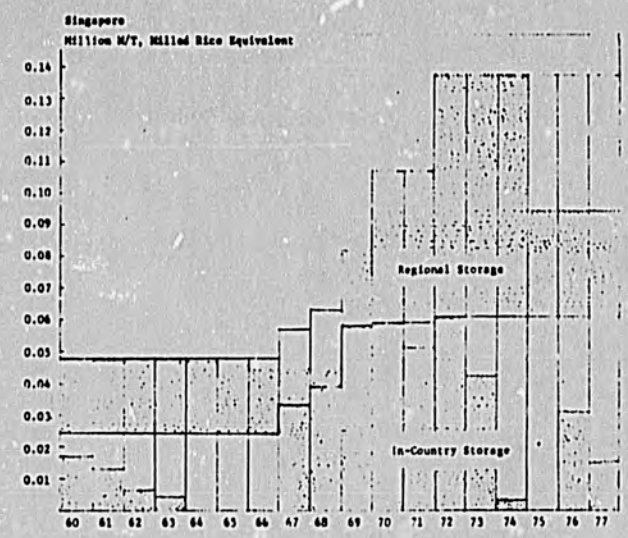
The corresponding year-end balances in regional food grain reserves shown in Figure 5-2A come from Table 14. As with the regional rice reserves, the ending balances for the regional food grain reserves are subject only to the constraint that the ASEAN total for each year be no less than zero. As a result, all five countries incur negative balances in the regional reserves in some years--Indonesia in eleven, Malaysia in ten, the Philippines in twelve, Singapore in five, and Thailand in five.

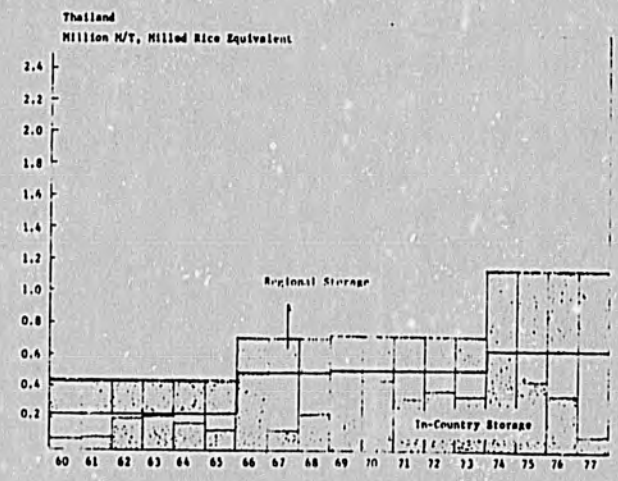
The ASEAN total balance goes to -73,000 MT in 1968, so that this alternative would require withdrawal of this amount from a world reserve in that year.

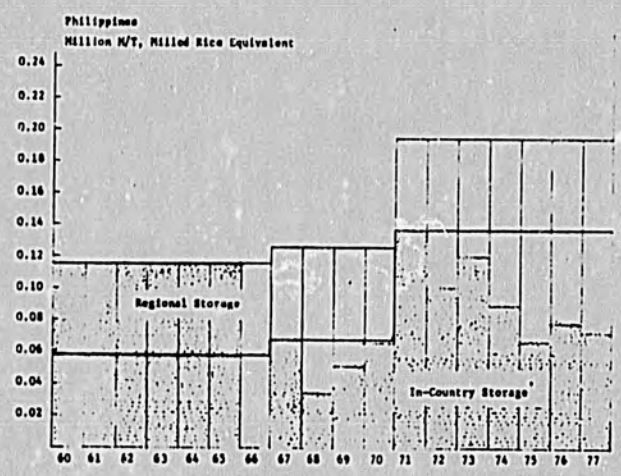
In milled rice equivalent, the year-end balances in the ASEAN food grain reserve would have ranged from 0 in 1968 to 1,956,000 MT in 1962. Annual average utilization of required storage capacity would have been 35.5 percent.

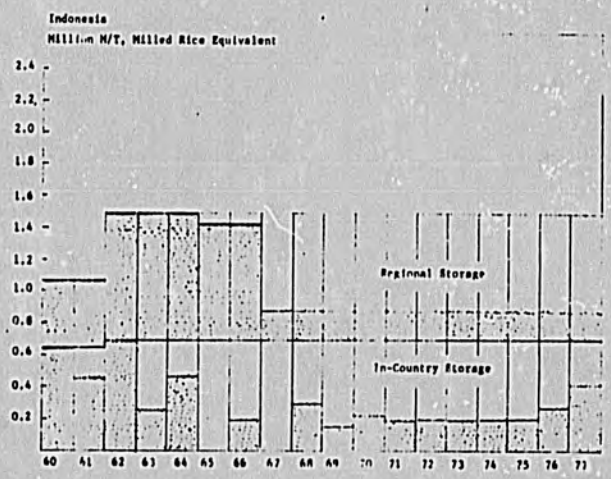
Capacities and Inventory Levels for all Grain Reserves with Stabilizing Trade

The grain storage capacities and average inventory levels associated with alternative 2-B are depicted in Figure 5-2B. The tabular listing of the required









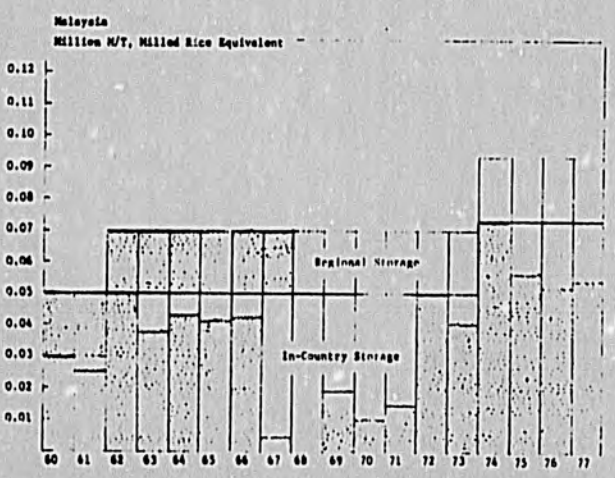


Fig 5-2B Computed Storage Capacity and Inventory for ASEAN Security Reserves (All Grains with Stabilizing Trade)

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TABLE 18'. ALL FOOD GRAINS (RICE, WHEAT, CORN)
REQUIRED TOTAL STORAGE CAPACITY FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING TRADE ADJUSTMENTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	648	30	58	24	216	976
2	1961	648	30	58	24	216	976
3	1962	690	50	58	24	216	1038
4	1963	690	50	58	24	216	1038
5	1964	690	50	58	24	216	1038
6	1965	690	50	58	24	216	1038
7	1966	690	50	58	24	483	1305
8	1967	690	50	66	33	483	1324
9	1968	690	50	68	39	483	1330
10	1969	690	50	68	58	498	1364
11	1970	690	50	68	59	498	1365
12	1971	690	50	137	59	498	1434
13	1972	690	50	137	61	498	1436
14	1973	690	50	137	61	498	1436
15	1974	690	73	137	61	710	1671
16	1975	690	73	137	61	710	1671
17	1976	690	73	137	61	710	1671
18	1977	690	73	137	61	710	1671

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 18.

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TABLE 18. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	648	30	58	17	57	810
2	1961	454	25	58	13	74	624
3	1962	690	50	58	6	194	998
4	1963	252	38	58	4	203	555
5	1964	471	43	58	0	160	732
6	1965	0	41	58	0	117	216
7	1966	186	42	0	0	483	711
8	1967	0	4	68	33	104	209
9	1968	292	0	34	39	210	575
10	1969	146	19	51	58	498	772
11	1970	219	10	66	59	430	784
12	1971	183	15	137	51	302	688
13	1972	201	50	102	61	366	780
14	1973	192	40	120	42	334	728
15	1974	197	73	90	3	710	1073
16	1975	195	56	66	0	422	739
17	1976	277	52	78	31	351	769
18	1977	420	54	72	15	80	641

SOURCE:
CUMULATIVE TOTALS FROM TABLE 17, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

in-country capacities is shown in Table 18'. The level-off capacities in milled rice equivalent are 690,000 MT for Indonesia (reached in 1962), 73,000 MT for Malaysia (reached in 1974), 137,000 for the Philippines (reached in 1971), 61,000 MT for Singapore (reached in 1972) and 710,000 MT for Thailand (reached in 1974).

The year-end balances in the in-country food grain reserves indicated in Figure 5-2A are taken from Table 18. The ending balances are bound by the upper or lower constraints in one or more years in each of the five countries. The zero lower bound is effective for 1965 and 1967 in Indonesia, 1964-1966 and 1975 in Singapore, 1966 in the Philippines and in 1968 for Malaysia. The upper bound is limiting for 1960 and 1962 in Indonesia, in 1969, 1970, and 1972 for Singapore and 1974 for Thailand.

The ending balances for the in-country food grain reserves in Indonesia remain at relatively high levels through 1964 and then decline to moderate levels until 1977 when they again increase. Those for Malaysia remain at moderate levels through 1966, decline to low levels through 1971 and thereafter again remain at moderate levels. Those for the Philippines remain at moderate levels through 1970 (except for the zero balance in 1966), and then increase to relatively high levels. Those for Singapore decline through 1966, increase to moderate levels through 1972, and then again decline to relatively low levels. Those for Thailand continue to increase through 1963, remain at moderate levels through 1968 (except for a minor peak in 1966), increase at relatively high levels through 1975, and then again decline to moderate levels.

Over the 18-year period, the average utilization of in-country capacity is 40.7 percent in Indonesia, 67.4 percent in Malaysia, 75.3 percent in the Philippines, 55.2 percent in Singapore and 63.1 percent in Thailand.

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TABLE 20'. ALL FOOD GRAINS (RICE, WHEAT, CORN)
REQUIRED TOTAL STORAGE CAPACITY REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING TRADE ADJUSTMENTS

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	423	20	58	24	216	741
2	1961	423	20	58	24	216	741
3	1962	797	20	58	24	216	1115
4	1963	797	20	58	24	216	1115
5	1964	797	20	58	24	216	1115
6	1965	797	20	58	24	216	1115
7	1966	797	20	58	24	216	1115
8	1967	797	20	58	24	216	1115
9	1968	797	20	58	24	216	1115
10	1969	797	20	58	24	216	1115
11	1970	797	20	58	48	216	1139
12	1971	797	20	58	48	216	1139
13	1972	797	20	58	76	216	1167
14	1973	797	20	58	76	216	1167
15	1974	797	20	58	76	417	1368
16	1975	797	20	58	76	417	1368
17	1976	797	20	58	76	417	1368
18	1977	797	20	58	76	417	1368

SOURCE:
BASED ON MAXIMUM BALANCES FROM TABLE 20.

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TABLE 20. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

COMPUTED YEAR-END BALANCES FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	423	20	58	24	216	741
2	1961	423	20	58	24	216	741
3	1962	797	20	58	24	216	1115
4	1963	797	20	58	24	216	1115
5	1964	797	20	58	23	216	1114
6	1965	729	20	58	22	216	1045
7	1966	729	20	-20	21	216	966
8	1967	185	20	-20	21	216	422
9	1968	185	-14	-20	21	216	388
10	1969	185	-14	-20	23	216	390
11	1970	185	-14	-20	48	216	415
12	1971	185	-14	-20	48	216	415
13	1972	185	-14	-20	76	216	443
14	1973	185	-14	-20	76	216	443
15	1974	185	-14	-20	76	417	644
16	1975	185	-14	-20	33	417	601
17	1976	185	-14	-20	33	417	601
18	1977	185	-14	-20	33	417	601

SOURCE:
CUMULATIVE TOTALS FROM TABLE 19, STARTING WITH BEGINNING RESERVES EQUAL TO ONE STANDARD DEVIATION (SEE TABLE 11').

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The needed regional storage capacity for this alternative indicated in Figure 5-2A is taken from Table 20'. Peak capacities in milled rice equivalent are 797,000 MT for Indonesia, 20,000 MT for Malaysia, 58,000 MT for the Philippines, 76,000 MT for Singapore and 417,000 MT for Thailand, bringing the ASEAN total to 1,368,000 MT, starting in 1974.

The annual ending balances in the regional food grain reserves shown in Figure 5-2A come from Table 20. The regional reserves are subject only to the constraint that the ASEAN total balance be no less than zero, so that negative balances are indicated for the Philippines from 1966 through 1977 and for Malaysia from 1968 to 1977. The year-end balances in the regional reserves are reasonably stable for Indonesia and Thailand, but decrease in 1965 for the Philippines and in 1968 for Malaysia. The balances for Singapore remain stable through 1968 and then increase to a peak from 1972 through 1974, and again decrease somewhat.

Over the 18-year period, the average utilization of regional storage capacity is 59.6 percent.

SECTION 6

COMPUTED COSTS OF ASEAN RESERVES WITH INTERNATIONAL TRADE AT HISTORICAL LEVELS

Comparable analyses of fixed, variable and total costs for ASEAN food security reserves for 1960-1977 are made under the four alternatives as follows:

1. Rice reserves with historical imports and exports (Section 6).
2. All food grain reserves with historical imports and exports (Section 6).
3. Rice reserves with stabilizing trade adjustments (Section 7).
4. All food grain reserves with stablizing trade adjustments (Section 7).

For each of the four alternatives, the estimated costs include the in-country reserves in each nation plus the ASEAN regional reserves serving the five nations jointly.

The analyses are based on the storage capacities and volumes from Section 5 and general estimates of per ton fixed and variable costs for maintaining the reserves from KSU Food and Feed Grain Institute Special Report No. 6.[1/]

Fixed Cost

The fixed costs for the security reserve programs include the annual costs for the grain storage facilities and the costs of administering the program. These costs are taken as functions of the required storage capacities, regardless of the volumes of grain stored in the reserves. The average annual fixed cost per MT is assumed to be uniform in all five countries at $18.80 for storage facilities plus $3.00 for administration, for a total of $21.80 per ton. The fixed cost for

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[1/] Phillips, R. and Sorenson, O. L., "Food Grain Reserves in Developing Countries." Food and Feed Grain Institute, Kansas State University, Special Report No. 6. Manhattan, Kansas. March 1978.

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storage facilities is based on one-half the capacity in flat warehouses for storage of bagged grain constructed at a total capital cost of $100.00 per MT and one-half the capacity in bulk silo storage constructed at a capital cost of $150.00 per MT. Thus, the average facility cost is $125.00 per MT. The annualized average per MT fixed cost is as follows:

Building depreciation (straight line, $100 @ 40 years) . . .	$ 2.50
Equipment depreciation (straight line, $25 @ 10 years) . . .	2.50
Interest on investment ($125/2 x 12 percent)	7.50
Maintenance ($125 x 2.0 percent)	2.50
Insurance	2.50
All other	1.30
Facilities total	18.80
Administration	3.00
Total fixed cost per MT	$21.80

In order to convert the capacity estimates based on milled rice equivalent to the corresponding capacity for rough rice storage, the standardized per unit fixed cost is multiplied by 2, giving a standard fixed cost multiplied against the milled rice-equivalent capacities of $43.60 per metric ton.

The computation of fixed costs under the four alternatives was completed by applying this factor as follows:

Alternative	Level	Capacity Table	Fixed Cost Table
1-A	Country	12' Rice	21 Rice
	Region	14' Rice	24 Rice
2-A	Country	12' All Grain	21 All Grain
	Region	14' All Grain	24 All Grain
1-B	Country	18' Rice	31 Rice
	Region	20' Rice	34 Rice
2-B	Country	18' All Grain	31 All Grain
	Region	20' All Grain	34 All Grain

All of the fixed cost tables are included in Annex IV of the report.

Variable Cost

The average annual per MT variable costs for the food security reserve

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programs include interest on the grain inventories, quality maintenance and other operating costs, shrinkage and related expenses. These costs are taken as a function of the average inventory levels in the reserve programs regardless of the total storage capacity. These costs are estimated as follows:

Inventory cost ($127.50 x 12 percent)	$15.30
Shrinkage ($127.50 x 0.50 percent)	.64
Quality maintenance	4.36
Other operating expense	3.00
Total variable cost per MT	$23.30

The average inventory levels for all alternatives are specified in terms of milled rice equivalent in the study. In order to convert to the equivalent inventory of whole grain the standardized unit variable cost of $23.30 per metric ton is multiplied by 2, giving a standard variable cost multiplied against the milled rice equivalent storage inventories of $46.60 per metric ton.

The computation of variable costs under the four alternatives was completed by applying this factor as follows:

Alternative	Level	Inventory Table	Variable Cost Table
1-A	Country	12 Rice	22 Rice
	Region	14 Rice	25 Rice
2-A	Country	12 All Grain	22 All Grain
	Region	14 All Grain	25 All Grain
1-B	Country	18 Rice	32 Rice
	Region	20 Rice	35 Rice
2-B	Country	18 All Grain	32 All Grain
	Region	20 All Grain	35 All Grain

All variable cost tables are included in Annex IV.

Combined Cost for Rice Reserves With Historical Trade

The computed combined total cost for this alternative is the sum of the total cost for in-country reserves and the total cost for regional reserves.

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TABLE 23. RICE ONLY
(US $1000)

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

COMPUTED ANNUAL TOTAL COSTS FOR IN-COUNTRY RESERVES

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	50872	2164	4601	2075	8589	68301
2	1961	52587	1279	4601	2075	8589	69131
3	1962	54391	1836	4601	1050	21197	83077
4	1963	48100	1838	4601	1935	33194	89668
5	1964	43906	1931	4601	1003	30118	81559
6	1965	26291	4690	4601	1003	25179	61764
7	1966	26291	4690	2224	1003	43116	77324
8	1967	26291	2267	2224	1003	27272	59057
9	1968	26291	2267	2224	1655	22053	54490
10	1969	26291	2267	2224	1655	47535	79972
11	1970	26291	2267	5954	3879	49159	87550
12	1971	26291	3059	12537	3879	37602	83368
13	1972	26291	5503	12899	3879	37602	86174
14	1973	26291	5954	12899	3879	42216	91239
15	1974	26291	6134	11454	1875	52045	97799
16	1975	26291	6134	11454	1875	52045	97799
17	1976	31557	3384	11454	1875	34477	82747
18	1977	32582	3384	11454	1968	25157	74545

SOURCE:
FIGURES IN TABLE 21 PLUS FIGURES IN TABLE 22.

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The separate total costs are the sum of the fixed cost and the variable cost at each level.

The total annual costs for the in-country rice reserves are shown in Table 23. The figures represent a direct summation of those in Tables 21 and 22. In Indonesia the computed total costs vary from a low of $26.3 million in 1966-1975 to a high of $54.4 million in 1962. In Malaysia they vary from $1.3 million in 1961 to $6.1 million in 1974-1975, and in Singapore from $1.0 million in 1964-1967 to $3.9 million in 1970-1973. The total annual costs for in-country reserves in the Philippines vary from $2.2 million in 1966-1969 to $12.9 million in 1972-1973, and in Thailand from $8.6 million in 1960-1961 to $52.0 million in 1974-1975. For ASEAN as a whole, the total annual costs for the in-country rice reserves range from $54.5 million in 1968 to $97.8 million in 1974-1975.

The computed annual total costs for the regional rice reserves are shown in Table 26. The total costs are a direct summation of the corresponding fixed and variable costs. The total costs vary from $82.0 million to $168.8 million for Indonesia, from $1.6 million to $3.6 million for Malaysia, from $3.1 million to $9.8 million for the Philippines, from $1.6 million to $12.4 million for Singapore, and from $9.7 million to $70.3 million for Thailand. For the ASEAN regional rice reserves as a whole, the computed annual total costs vary from $100.4 million in 1960 to $192.7 million in 1962-1963.

The computed annual total costs for the combined rice reserve program for the ASEAN countries without adjustments to historical imports are shown in Table 27. The totals represent the sum of the totals for in-country reserves from Table 23 and the totals for the regional reserves from Table 26. The combined total costs for Indonesia range from $112.9 million in 1967 to $223.2 million in 1962; those for Malaysia range from $3.4 million in 1961 to $9.1 million in 1972-1973; those for the Philippines range from $9.2 million in

TABLE 26. RICE ONLY
COMPUTED ANNUAL TOTAL COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	82082	2164	4601	1895	9661	100403
2	1961	98860	2164	4601	1895	15299	122819
3	1962	168765	2164	4601	1895	15299	192724
4	1963	168765	2164	4601	1895	15299	192724
5	1964	168765	2164	4601	1568	15299	192397
6	1965	159538	2164	4601	1568	15299	183170
7	1966	133488	2164	9773	1895	27691	175011
8	1967	86562	1559	9773	2500	27691	128085
9	1968	92620	3329	9773	2500	27691	135913
10	1969	92620	3609	9773	2500	50332	158834
11	1970	92620	3609	9773	1568	70265	177835
12	1971	92620	3609	5439	4239	70265	176172
13	1972	92620	3609	3109	12357	70265	181960
14	1973	92620	3143	3109	12357	70265	181494
15	1974	92620	2615	3109	11845	70265	180454
16	1975	92620	2615	3109	7837	70265	176446
17	1976	92620	2615	3109	7837	70265	176446
18	1977	92620	2615	3109	7837	58755	164936

SOURCE:
FIGURES IN TABLE 24 PLUS FIGURES IN TABLE 25.

TABLE 27. RICE ONLY
COMPUTED ANNUAL TOTAL COSTS FOR COMBINED RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	132954	4328	9202	3970	13250	168704
2	1961	151447	3443	9202	3970	23888	191950
3	1962	223156	4002	9202	2945	36496	275801
4	1963	216865	4002	9202	3830	43493	282392
5	1964	212671	4095	9202	2571	45417	273956
6	1965	185829	6854	9202	2571	40478	244934
7	1966	159779	6854	11997	2878	70807	252335
8	1967	112853	3826	11997	3503	54963	187142
9	1968	118911	5596	11997	4155	49744	190403
10	1969	118911	5876	11997	4155	97867	238806
11	1970	118911	5876	15727	5447	119424	265385
12	1971	118911	6668	17976	8118	107867	259540
13	1972	118911	9112	16008	16236	107867	268134
14	1973	118911	9097	16008	16236	112481	272733
15	1974	118911	8749	14563	13720	122310	278253
16	1975	118911	8749	14563	9712	122310	274245
17	1976	124177	5999	14563	9712	104742	259193
18	1977	125202	5999	14563	9805	83912	239481

SOURCE:
FIGURES IN TABLE 23 PLUS FIGURES IN TABLE 26.

1960-1965 to $18 million in 1971; those for Singapore range from $2.6 million in 1964-1965 to $16.2 million in 1972-1973; and those for Thailand range from $18.3 million in 1960 to $122.3 million in 1974-1975. For the ASEAN nations as a group, the computed annual combined total cost for the regional rice reserve program without import adjustments range from $168.7 million in 1960 to $282.4 million in 1963. Over the 18-year period, the combined total costs exceed $250 million in 11 years.

Combined Cost for All Food Grain Reserves With Historical Trade

The total annual costs for the in-country all grain reserves are shown in Table 23. The totals are a direct summation of those in Tables 21 and 22, All Food Grains. In Indonesia, computed total costs vary from $30.0 million in 1965-1975 to $62.2 million in 1962. In Malaysia, they vary from $2.6 million in 1967-1971 to $7.6 million in 1974-1975. In the Philippines, they vary from $2.5 million in 1966-1969 to $15.6 million in 1971-1973. In Singapore, they vary from $1.0 million in 1961-1966 to $5.5 million in 1972-1973. In Thailand, they vary from $9.4 million in 1960-1961 to $64.0 million in 1974-1975. For ASEAN as a whole, the total annual costs for the in-country food grain reserves range from $63.9 million in 1968 to $118.0 million in 1974.

The computed total costs for the regional food grain reserves without import adjustments are shown in Table 26, All Food Grains. The total costs are a direct summation of the corresponding fixed and variable costs. The total costs vary from $76.3 million to $168.3 million for Indonesia, from $1.8 million to $5.9 million for Malaysia, from $5.2 million to $9.8 million for the Philippines from $1.0 million to $19.8 million for Singapore, and from $10.0 million to $110.3 million for Thailand. For the ASEAN regional food grain reserves as a whole, the computed annual total costs vary from $96.6 million in

TABLE 23. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(US $1000)

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

COMPUTED ANNUAL TOTAL COSTS FOR IN-COUNTRY RESERVES

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	58450	3699	5232	1512	9418	78311
2	1961	60254	3699	5232	1046	9418	79649
3	1962	62238	5412	5232	1046	23092	97020
4	1963	49889	5412	5232	1046	35449	97028
5	1964	49889	5272	5232	1046	31814	93253
6	1965	30084	5272	5232	1046	25756	67390
7	1966	30084	5272	2529	1046	48437	87368
8	1967	30084	2616	2529	5141	30217	70587
9	1968	30084	2616	2529	5232	23413	63874
10	1969	30084	2616	2529	5232	54029	94490
11	1970	30084	2616	4766	5321	55924	98711
12	1971	30084	2616	15605	5412	40826	94543
13	1972	30084	6765	15605	5503	40826	98783
14	1973	30084	7396	15605	5503	40826	99414
15	1974	30084	7576	13601	2660	64042	117963
16	1975	30084	7576	9920	2660	64042	114282
17	1976	37633	6458	9920	3406	44004	101421
18	1977	54782	6458	9920	3406	30956	105522

SOURCE:
FIGURES IN TABLE 21 PLUS FIGURES IN TABLE 22.

TABLE 26. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL TOTAL COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	76310	1804	5232	2164	14684	100194
2	1961	77663	1804	5232	1885	10024	96608
3	1962	168314	4059	5232	1046	10024	188675
4	1963	168314	4059	5232	1512	10024	189141
5	1964	168314	4059	5232	2071	10024	189700
6	1965	148089	4059	5232	2397	10024	169801
7	1966	140307	4059	9845	2491	29224	185926
8	1967	81777	3267	9845	2118	29224	126231
9	1968	88581	5923	9845	2025	28246	134620
10	1969	88581	5923	9845	6314	34727	145390
11	1970	88581	5923	9845	12899	46453	163701
12	1971	88581	5923	8354	13710	46453	163021
13	1972	88581	5923	8354	19753	46453	169064
14	1973	88581	5504	8354	19753	46453	168645
15	1974	88581	2941	8354	18076	110315	228267
16	1975	88581	2941	8354	11971	110315	222162
17	1976	88581	2941	8354	11971	110315	222162
18	1977	88581	2941	8354	11971	94797	206644

SOURCE:
IGURES IN TABLE 24 PLUS FIGURES IN TABLE 25.

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1961 to $228.3 million in 1974.

The computed annual total costs for the combined all food grain reserve program for the ASEAN countries without import adjustments are shown in Table 27, All Food Grains. The totals represent the sum of the totals for in-country reserves from Table 23 and the totals for the regional reserves from Table 26. The combined total costs for Indonesia range from $111.9 million in 1967 to $230.6 million in 1962; those for Malaysia range from $5.5 million in 1960-1961 to $12.9 million in 1973; those the the Philippines range from $10.5 million in 1960-1965 to $24.0 million in 1971-1973; those for Singapore range from $2.1 million in 1962 to $25.3 million in 1972-1973; and those for Thailand range from $19.4 million in 1961 to $174.4 million in 1974-1975. For the ASEAN nations as a group, the computed annual combined total cost for the food grain reserve program without import adjustments range from $176.3 million in 1961 to $346.2 million in 1974. Over the 18-year historical period, the combined total costs exceed $300 million in the last four years.

TABLE 27. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL TOTAL COSTS FOR COMBINED RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	134760	5503	10464	3676	24102	178505
2	1961	137917	5503	10464	2931	19442	176257
3	1962	230552	9471	10464	2092	33116	285695
4	1963	218203	9471	10464	2558	45473	286169
5	1964	218203	9331	10464	3117	41838	282953
6	1965	178173	9331	10464	3443	35780	237191
7	1966	170391	9331	12374	3537	77661	273294
8	1967	111861	5883	12374	7259	59441	196818
9	1968	118665	8539	12374	7257	51659	198494
10	1969	118665	8539	12374	11546	83756	239880
11	1970	118665	8539	14611	18220	102377	262412
12	1971	113665	8539	23959	19122	87279	257564
13	1972	118665	12688	23959	25256	87279	267847
14	1973	118665	12900	23959	25256	87279	268059
15	1974	118665	10517	21955	20736	174357	346230
16	1975	118665	10517	18274	14631	174357	336444
17	1976	126214	9399	18274	15377	154319	323583
18	1977	143363	9399	18274	15377	125753	312166

SOURCE:
FIGURES IN TABLE 23 PLUS FIGURES IN TABLE 26.

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SECTION 7

COMPUTED COSTS OF ASEAN RESERVES WITH STABILIZING INTERNATIONAL TRADE

The methodology and unit costs used to compute the costs of security reserves after stabilizing trade for the ASEAN countries over the 1960-1977 historical period are the same as those used to compute the costs of reserves without adjustments to imports (exports) (see Section 6). The only differences in the methodology are that (1) estimated costs are included for making the stabilizing trade adjustments and (2) the unit fixed and variable costs for maintaining the reserve are applied to the reserve requirements after the trade adjustments have been made.

Costs of Stablizing Adjustments in International Trade

The estimated costs for annual adjustments in rice imports and/or exports by the ASEAN countries are shown in the set of Tables 30 for rice and for all grains. These costs are computed by multiplying the indicated annual net import (export) adjustment from Table 15 by $57.69 MT. It is assumed that the market premium required for both positive and negative adjustments would have averaged $25.00 MT, rough rice equivalent. Furthermore, since counter-adjustments often are required to adjustments made the previous year, it is assumed that gross adjustments of 1.5 MT are required per MT of net adjustments as shown in Table 15. Multiplication of $25.00 MT by this factor of 1.5 provides a base of $37.50 MT; conversion to milled rice equivalent provides the aggregate factor of $57.69 used for the computations.

The computed costs of import (export) adjustments for rice vary sharply from one year to the next because of the varying requirements for the adjustments

TABLE 30. RICE ONLY
COMPUTED ANNUAL COSTS FOR IMPORT/EXPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	25384	0	0	58	10730	36172
2	1961	18634	577	0	58	10153	29422
3	1962	19557	58	0	635	7038	27288
4	1963	9288	288	0	231	7096	16903
5	1964	11134	115	0	346	1615	13210
6	1965	13673	1038	0	577	4154	19442
7	1966	25903	404	7615	692	20191	54805
8	1967	32191	2077	3808	1038	1269	40383
9	1968	22845	2538	1904	519	13673	41479
10	1969	1500	635	981	115	25268	28499
11	1970	750	115	2365	1327	15922	20479
12	1971	404	404	5481	2481	5250	17020
13	1972	173	1558	3577	3115	3058	11481
14	1973	115	923	231	1038	4384	6691
15	1974	58	2135	750	2077	5884	10904
16	1975	0	1096	519	3000	2250	6865
17	1976	3231	2250	231	981	12000	18693
18	1977	2250	577	115	577	17769	21288

SOURCE:
TABLE 15 X $57.69/MT. IGNORING MINUS SIGNS: BASED ON EXTRA COST FOR WHOLE GRAIN OF $25/MT AND 1.5 MT TOTAL ADJUSTMENT PER MT NET ADJUSTMENT.

TABLE 30. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL COSTS FOR IMPORT/EXPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	24403	635	0	404	9230	34672
2	1961	13211	288	0	692	8250	22441
3	1962	24057	1096	0	635	7346	33634
4	1963	9980	692	0	462	7384	18518
5	1964	12634	462	0	404	2019	15519
6	1965	18461	115	0	346	5019	23941
7	1966	20365	58	7904	58	18634	47019
8	1967	31383	2077	3923	1846	692	39921
9	1968	25268	4327	1961	2250	15749	49555
10	1969	8423	1096	981	1615	22672	34787
11	1970	4211	519	1904	2769	12634	22037
12	1971	2077	288	4961	1038	11307	19671
13	1972	1038	2308	2019	1731	3692	10788
14	1973	519	1500	1038	1096	1846	5999
15	1974	288	1385	750	3346	31441	37210
16	1975	115	981	3173	4904	16615	25788
17	1976	4615	1154	692	865	23711	28037
18	1977	12980	115	346	923	19730	34094

SOURCE:
TABLE 15 X $57.69/MT, IGNORING MINUS SIGNS; BASED ON EXTRA COST FOR WHOLE GRAIN OF $25/MT AND 1.5 MT TOTAL ADJUSTMENT PER MT NET ADJUSTMENT.

(Table 30, Rice Only). For Indonesia these costs vary from zero in 1975 to $32.2 million in 1967; for Malaysia they vary from zero in 1960 to $2.5 million in 1968; for the Philippines they vary from zero in 1960-1965 to $7.6 million in 1966; for Singapore they vary from $58,000 in 1960-1961 to $3.1 million in 1972; and for Thailand they vary from $1.3 million in 1967 to $25.3 million in 1969. For the ASEAN countries combined, the computed costs of import (export) adjustments for rice vary from a low of about $6.7 million in 1973 to a high of about $54.8 million in 1966.

The computed costs of import (export) adjustments for all food grains also vary from one year to the next depending upon the adjustments required (Table 30, All Food Grains). For Indonesia these costs vary from $115,000 in 1975 to $31.4 million in 1967; for Malaysia they vary from $58,000 in 1966 to $4.3 million in 1968; for the Philippines they vary from zero in 1960-1965 to $7.9 million in 1966; for Singapore they vary from $58,000 in 1966 to $4.9 million in 1975; for Thailand they vary from $692,000 in 1967 to $31.4 million in 1974. For the ASEAN countries combined, the computed costs of import (export) adjustments for all food grains vary from a low of about $6.0 million in 1973 to a high of about $50 million in 1968.

Combined Costs for Rice Reserves With Stabilizing Trade

The total annual costs for the in-country rice reserves, after trade adjustments, are shown in Table 33. The figures represent a direct summation of those in Tables 31 and 32. In Indonesia the computed total costs vary from a low of $26.3 million in 1966-1967 to a high of $54.4 million in 1962. In Malaysia they vary from $1.7 million in 1968 to $6.1 million in 1974, and in the Philippines from $2.2 million in 1966 to $12.5 million in 1971. The total annual costs for in-country reserves in Singapore vary from $1.1 million in 1966 to $3.9 million in 1971-1972, and in Thailand from $9.1 million in 1960 to $48.7 million in

1974. For ASEAN as a whole, the total annual costs for the in-country rice reserves range from $51.5 million in 1965 to $96.4 million in 1974.

The computed annual total costs for the regional rice reserves are shown in Table 36. The total costs are a direct summation of the corresponding fixed and variable costs. The total costs vary from $42.4 million to $69.4 million for Indonesia, from $1.6 million to $2.2 million for Malaysia, from $3.3 million to $4.6 million for the Philippines, from $1.5 million to $5.1 million for Singapore, and from $17.8 million to $18.2 million for Thailand. For the ASEAN regional rice reserves as a whole, the computed annual total costs vary from $68.8 million in 1960-1961 to $95.8 million in 1962-1965.

The computed annual total costs for the combined rice reserve program for the ASEAN countries after adjustments to historical imports are shown in Table 37. The totals represent the sum of the cost of import adjustments from Table 30, the totals for in-country reserves from Table 33 and the totals for the regional reserves from Table 36. The combined total costs for Indonesia range from $74.5 million in 1975 to $143.3 million in 1962; those for Malaysia range from $3.6 million in 1970 to $9.9 million in 1974; those for the Philippines range from $9.2 million in 1960-1965 to $21.3 million in 1971; those for Singapore range from $3.1 million in 1969 to $12.1 million in 1972; those for Thailand range from $32.9 million in 1964 to $91.0 million in 1969. For the ASEAN nations as a group, the computed annual combined total cost for the regional rice reserve program with import adjustments range from $161.5 million in 1961 to $221.3 million in 1966. The combined total costs exceed $200 million in only two years over the 18-year period.

Combined Costs for All Food Grain Reserves With Stabilizing Trade

The total annual costs for the in-country food grain reserves after trade adjustments are shown in Table 33. The totals are a direct summation of those

TABLE 33. RICE ONLY
COMPUTED ANNUAL TOTAL COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	50872	2164	4601	1934	9148	68769
2	1961	45374	1745	4601	1938	9568	63226
3	1962	54391	2346	4601	1425	14833	77596
4	1963	40597	2113	4601	2255	15299	64865
5	1964	45397	2299	4601	1276	13529	67102
6	1965	29600	3608	4601	1742	11944	51495
7	1966	26291	3282	2224	1090	41041	73928
8	1967	26291	1930	5954	1323	24172	59670
9	1968	28714	1744	4416	1556	29997	66427
10	1969	27503	1977	5208	1463	47535	83686
11	1970	28108	1864	6765	3066	45811	85634
12	1971	27782	2350	12537	3879	40918	87466
13	1972	27922	3142	12165	3879	43388	90496
14	1973	27829	3095	12351	3040	44460	90775
15	1974	27875	6134	11512	2201	48708	96430
16	1975	27875	5248	11932	1875	46891	93821
17	1976	30532	4316	11745	2667	39015	88275
18	1977	29739	4782	11838	2294	32538	81191

SOURCE:
FIGURES IN TABLE 31 PLUS FIGURES IN TABLE 32.

TABLE 36. RICE ONLY
COMPUTED ANNUAL TOTAL COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	42394	2164	4601	1895	17769	68823
2	1961	42394	2164	4601	1895	17769	68823
3	1962	69363	2164	4601	1895	17769	95792
4	1963	69363	2164	4601	1895	17769	95792
5	1964	69363	2164	4601	1895	17769	95792
6	1965	69363	2164	4601	1895	17769	95792
7	1966	67546	2164	3622	1475	17769	92576
8	1967	46623	2164	3622	1475	17769	71653
9	1968	46623	1605	3622	1475	17769	71094
10	1969	46623	1605	3622	1475	18220	71545
11	1970	46623	1605	3622	1475	18220	71545
12	1971	46623	1605	3296	1895	18220	71639
13	1972	46623	1605	3296	5141	18220	74885
14	1973	46623	1605	3296	5141	18220	74885
15	1974	46623	1605	3296	5141	18220	74885
16	1975	46623	1605	3296	3883	18220	73627
17	1976	46623	1605	3296	3883	18220	73627
18	1977	46623	1605	3296	3883	18220	73627

SOURCE:
FIGURES IN TABLE 34 PLUS FIGURES IN TABLE 35.

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TABLE 37. RICE ONLY
COMPUTED ANNUAL TOTAL COSTS FOR COMBINED RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	118650	4328	9202	3937	37647	173764
2	1961	106402	4486	9202	3891	37490	161471
3	1962	143311	4568	9202	3955	39640	200676
4	1963	119248	4565	9202	4381	40164	177560
5	1964	125894	4578	9202	3517	32913	176104
6	1965	112636	6810	9202	4214	33867	166729
7	1966	119740	5850	13461	3257	79001	221309
8	1967	105105	6171	13384	3836	43210	171706
9	1968	98182	5887	9942	3550	61439	179000
10	1969	75626	4217	9811	3053	91023	183730
11	1970	75481	3604	12752	5863	79953	177658
12	1971	74809	4359	21314	6255	67388	176125
13	1972	74718	6305	19038	12135	64666	176862
14	1973	74567	5623	15878	9219	67064	172351
15	1974	74556	9874	15558	9419	72812	182219
16	1975	74498	7949	15747	8758	67361	174313
17	1976	80386	8171	15272	7531	69235	180595
18	1977	78612	6964	15249	8754	68527	176106

SOURCE:
TABLE 33 + TABLE 36 + TABLE 30.

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in Tables 31 and 32, All Food Grains. In Indonesia computed total costs vary from $30.1 million in 1965 and 1967 to $62.2 million in 1962. In Malaysia they vary from $2.2 million in 1968 to $6.6 million in 1974. In the Philippines they vary from $2.5 million in 1966 to $12.4 million in 1971. In Singapore they vary from $1.0 million in 1964-1966 to $5.5 million in 1972. In Thailand they vary from $12.1 million in 1960 to $64.0 million in 1974. For ASEAN as a whole, the total annual costs for the in-country food grain reserve range from $55.3 million in 1965 to $122.9 million in 1974.

The computed total costs for the regional food grain reserves with import adjustments are shown in Table 36, All Food Grains. The total costs are a direct summation of the corresponding fixed and variable costs. The total costs vary from $38.2 million to $71.9 million for Indonesia, from $1.5 million to $1.8 million for Malaysia, from $3.5 million to $5.2 million (1960-65) for the Philippines, from $2.0 million to $6.9 million for Singapore, and from $19.5 million to $37.6 million for Thailand. For the ASEAN regional food grain reserves as a whole, the computed annual total costs vary from $66.8 million in 1960-1961 to $100.6 million in 1962-1964.

The computed annual total cost for the combined all food grain reserve program for the ASEAN countries after import adjustments are shown in Table 37, All Food Grains. The totals represent the sum of import adjustment costs from Table 30, the totals for in-country reserves from Table 33 and the totals for the regional reserves from Table 36. The combined total costs for Indonesia range from $82.7 million in 1975 to $158.2 million in 1962; those for Malaysia range from $4.6 million in 1961 to $9.5 million in 1974; those for the Philippines range from $9.8 million in 1969 to $20.8 million in 1971; those for Singapore range from $3.1 million in 1966 to $14.1 million in 1972; those for Thailand range from $38.4 million in 1964 to $133.1 million in 1974. For the ASEAN nations as a group, the computed annual combined total cost for the food grain reserve

program with import adjustments range from $160.9 million in 1961 to $252.9 million in 1974. The combined total costs exceed $200 million in eight years over the 18-year historical period.

TABLE 33. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL TOTAL COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	58450	2706	5232	1838	12074	80300
2	1961	49409	2473	5232	1652	12866	71632
3	1962	62238	4510	5232	1326	18458	91764
4	1963	41827	3951	5232	1232	18878	71120
5	1964	52033	4184	5232	1046	16874	79369
6	1965	30084	4091	5232	1046	14870	55323
7	1966	38752	4137	2529	1046	43567	90031
8	1967	30084	2366	6134	2977	25905	67466
9	1968	43691	2160	4549	3517	30845	84782
10	1969	36888	3065	5342	5232	44920	95447
11	1970	40289	2646	6041	5321	41751	96048
12	1971	38612	2879	12357	4949	35786	94583
13	1972	39451	4510	10726	5503	38769	98959
14	1973	39031	4044	11565	4617	37277	96534
15	1974	39264	6585	10167	2800	64042	122858
16	1975	39171	5793	9049	2660	50621	107294
17	1976	42992	5606	9608	4105	47313	109624
18	1977	49656	5699	9328	3359	34684	102726

SOURCE:
FIGURES IN TABLE 31 PLUS FIGURES IN TABLE 32.

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TABLE 36. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL TOTAL COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	38155	1804	5232	2164	19484	66839
2	1961	38155	1804	5232	2164	19484	66839
3	1962	71889	1804	5232	2164	19484	100573
4	1963	71889	1804	5232	2164	19484	100573
5	1964	71889	1804	5232	2118	19484	100527
6	1965	68720	1804	5232	2071	19484	97311
7	1966	68720	1804	3461	2025	19484	95494
8	1967	43370	1804	3461	2025	19484	70144
9	1968	43370	1524	3461	2025	19484	69864
10	1969	43370	1524	3461	2118	19484	69957
11	1970	43370	1524	3461	4330	19484	72169
12	1971	43370	1524	3461	4330	19484	72169
13	1972	43370	1524	3461	6856	19484	74695
14	1973	43370	1524	3461	6856	19484	74695
15	1974	43370	1524	3461	6856	37613	92824
16	1975	43370	1524	3461	4852	37613	90820
17	1976	43370	1524	3461	4852	37613	90820
18	1977	43370	1524	3461	4852	37613	90820

SOURCE:
FIGURES IN TABLE 34 PLUS FIGURES IN TABLE 35.

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TABLE 37. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL TOTAL COSTS FOR COMBINED RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	121008	5145	10464	4406	40788	181811
2	1961	100775	4565	10464	4508	40600	160912
3	1962	158184	7410	10464	4125	45768	225971
4	1963	123696	6447	10464	3858	45746	190211
5	1964	136556	6450	10464	3568	38377	195415
6	1965	117265	6010	10464	3463	39373	176575
7	1966	127837	5999	13894	3129	81685	232544
8	1967	104837	6247	13516	6848	46081	177531
9	1968	112329	8051	9971	7792	66078	204201
10	1969	88681	5685	9784	8965	87076	200191
11	1970	87870	4689	11406	12420	73869	190254
12	1971	84059	4691	20779	10317	66577	186423
13	1972	83859	8542	16206	14090	61945	184442
14	1973	82920	7058	16064	12569	58607	177228
15	1974	82922	9494	14376	13002	133096	252892
16	1975	82656	8298	15083	12416	104849	223902
17	1976	90977	6284	13761	9822	105637	228481
18	1977	106006	7338	13135	9134	92027	227640

SOURCE:
TABLE 33 + TABLE 36 + TABLE 30.

SECTION 8

COMPARATIVE COSTS OF ALTERNATIVE SECURITY RESERVE PROGRAMS

This section presents a summary of the differences in estimated total annual costs for alternative ASEAN food reserve programs as they might have operated over the 1960-1977 period. Estimated benefits have not been developed for any of the alternatives, but since all of the alternatives tested produce the same level of stability in food supplies, they can be compared for cost effectiveness. The comparison is based solely on the methodology and assumed unit costs described in the previous sections of the report. The relevant factors in the methodology and assumptions may be summarized as follows:

A. All Alternatives

1. Goal: Stability in food grain supplies within ±3 percent of the long term trend in total annual requirements within each country.

2. Means: Food grain reserves in each country as the first line of defense, supported by ASEAN regional reserves as required to achieve the stability goal in all years for each country.

3. Constraints on In-Country Reserve Levels: Year-end stocks of no less than zero and no more than the standard error of estimate above trend in total food requirements for each country.

4. Constraints on Regional Reserve Levels: Year-end stocks for the regional reserve as a whole of no less than zero; no upper bound on the regional reserves.

5. Annual Fixed Cost: Total per metric ton costs of $18.80 for storage facilities and $3.00 for administration, applied to the total capacity required (in rough rice equivalent) at the end of each year.

6. Annual Variable Storage Cost: Total per metric ton costs of

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$15.30 for inventory carrying cost and $8.00 for operation, applied to the reserve inventory (in rough rice equivalent) at the end of each year.

7. Handling Costs In and Out of Reserves: Taken at zero; that is, facilities for storing the reserves are located such that the reserves require aggregate transportation and handling no greater than would be true without the reserves.

B. Rice Reserve Alternatives: Stability goal and means applied to rice supplies only; supplies of wheat and corn remain the same as actually existed over the historical period.

C. All Food Grain Reserves: Stability goals and means applied to total food grain supplies (in rice equivalent); within the historical range existing in each ASEAN country, the alternative food grains taken as perfect substitutes in terms of their milled rice equivalent.

D. Alternatives Involving Import (Export) Substitution: One-half of the needed adjustment to meet the stability goal taken as effective the current year, with the other half effective the following year; cost of import adjustments taken as $37.50/MT, rough rice equivalent, for net adjustments, or approximately $25.00/MT for gross adjustments.

Combined total cost comparisons are made under two sets of alternatives. The first is a comparison of reserve programs without adjustments in annual imports (exports) as they have occurred historically in each country versus reserve programs after such adjustments. This comparison is made for (1) reserves of rice only and (2) reserves of all food grains. The second set of comparisons is that of reserves of all food grains versus reserves of rice only. The final comparison is made for (a) no import adjustments and (b) stabilizing import (export) adjustments.

All Food Grains Versus Rice Only, With Historical Imports

The computed additional costs for reserves to stabilize all food grain supplies compared to reserves to stabilize supplies of rice only under the alternative of no import (export) adjustments are shown in Table 28. The

added costs are obtained by subtracting the costs in Table 27, Rice from those in Table 27, All Food Grains. For ASEAN as a whole, the added costs are negative in 1961, 1965, and 1970-73, but increasing positive values after 1973, reaching about $72.7 million in 1977.

The pattern in computed added costs for all food grain reserves varies from country to country. For Indonesia, the added costs are significantly negative in 1961 and 1965, and slightly negative from 1967-75, but represent large positive differences in 1962, 1966, and 1977. In contrast, those for Malaysia are proportionately large positive amounts throughout the period. Those for the Philippines decline from $1.3 million to about $400,000 through 1966-69, are negative in 1970, and then positive through the rest of the period. Those for Singapore remain negative the first four years, increase to a peak of about $12.8 million in 1970 and exhibit a slight declining trend thereafter. The added costs for Thailand are negative for 1961-65 and 1969-73, but large positive values thereafter, peaking at $52.0 million in 1974-75.

All Food Grains Versus Rice Only, with Import Adjustments

The comparable cost comparison under the alternative of import (export) adjustments is summarized in Table 38. The added costs shown are the difference in computed total costs from Table 37, All Food Grains and Table 37, Rice Only. For ASEAN as a whole, the added costs for a total food grain reserve are positive in all but the second year. Over the 18-year period, annual additional costs for ASEAN average about $22 million.

The pattern in additional costs for the all food grain reserve program under this alternative also varies by country. For Indonesia, added costs are variable over the first eight years, but remain between roughly $8 million and $14 million thereafter, except for the last year when they peak at $27.4

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TABLE 28. COMPUTED ADDITIONAL COST
ALL FOOD GRAIN RESERVE PROGRAM COMPARED TO RICE RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	1806	1175	1262	-294	5852	9801
2	1961	-13530	2060	1262	-1039	-4446	-15693
3	1962	7396	5469	1262	-853	-3360	9854
4	1963	1338	5469	1262	-1272	-3020	3777
5	1964	5532	5236	1262	546	-3579	8997
6	1965	-7656	2477	1262	872	-4698	-7743
7	1966	10612	2477	377	639	6854	20959
8	1967	-992	2057	377	3756	4478	9676
9	1968	-246	2943	377	3102	1915	8091
10	1969	-246	2663	377	7391	-9111	1074
11	1970	-246	2663	-1116	12773	-17047	-2973
12	1971	-246	1871	5983	11004	-20588	-1976
13	1972	-246	3576	7951	9020	-20588	-287
14	1973	-246	3803	7951	9020	-25202	-4674
15	1974	-246	1768	7392	7016	52047	67977
16	1975	-246	1768	3711	4919	52047	62199
17	1976	2037	3400	3711	5665	49577	64390
18	1977	18161	3400	3711	5572	41841	72685

SOURCE:
TABLE 27 (ALL GRAINS) MINUS TABLE 27 (RICE).

TABLE 38. COMPUTED ADDITIONAL COST
ALL FOOD GRAIN RESERVE PROGRAM COMPARED TO RICE RESERVE PROGRAM

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	2358	817	1262	469	3141	8047
2	1961	-5627	79	1262	617	3110	-559
3	1962	14873	2842	1262	170	6148	25295
4	1963	4448	1882	1262	-523	5582	12651
5	1964	10662	1872	1262	51	5464	19311
6	1965	4629	-800	1262	-751	5506	9846
7	1966	8097	149	433	-128	2684	11235
8	1967	-268	76	134	3012	2871	5825
9	1968	14147	2144	29	4242	4639	25201
10	1969	13055	1468	-27	5912	-3947	16461
11	1970	12389	1065	-1346	6552	-6084	12596
12	1971	9250	332	-535	2062	-811	10298
13	1972	9141	2037	-2832	1955	-2721	7580
14	1973	8353	1445	186	3350	-8457	4877
15	1974	8366	-380	-1180	3583	60284	70673
16	1975	8158	349	-64	3658	37486	49589
17	1976	10591	113	-1511	2291	36402	47886
18	1977	27394	374	-2114	2380	23500	51534

SOURCE:
TABLE 37 (ALL GRAINS) MINUS TABLE 37 (RICE).

million. Those for Malaysia vary throughout the period ranging from -$800,000 in 1965 to $+2.8 million in 1962. Those for the Philippines show a decreasing trend, and average about zero over the period. Those for Singapore show a relatively sharp increasing trend through 1970 and then drop to relatively stable levels thereafter. The added costs for Thailand remain relatively stable around the average of roughly $5 million per year through 1968, then turn negative through 1973, and finally peak at about $60 million in 1974.

Rice Reserves With and Without Import Adjustments

The computed savings in total costs for rice reserves by country and year using stabilizing import (export) adjustments versus no such adjustments for ASEAN over the period 1960-1977 are shown in units of $1,000 in Table 29, Rice Only. The figures are obtained by subtracting those in Table 37 from those in Table 27. Negative figures in Table 29 indicate country-year cells for which the computed total costs are greater with import adjustments than without them. It will be noted that for ASEAN as a whole, the computed annual savings range from roughly -$5 million in 1960 to $105 million in 1963. The total annual savings average about $66.4 million over the 18-year historical period -- a significant saving indeed.

The pattern in computed cost saving under the two alternatives varies somewhat from country to country. The saving for Indonesia is substantial, being positive in all years, and ranging as high as $97.6 million in 1963. The savings for Malaysia, the Philippines, and Singapore are not so pronounced. For Malaysia the computed savings are negative in nine years and zero in one, and range from about -$2.3 million (1967) to $3.5 million (1973). For the

TABLE 29. RICE ONLY
COMPUTED COST SAVING FOR RESERVE PROGRAM WITH IMPORT ADJUSTMENTS

COMPARED TO RESERVE PROGRAM WITH HISTORICAL IMPORTS, ASEAN, 1960-1977

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	14304	0	0	33	-19397	-5060
2	1961	45045	-1043	0	79	-13602	30479
3	1962	79845	-566	0	-1010	-3144	5125
4	1963	97617	-563	0	-551	8329	104832
5	1964	86777	-463	0	-946	12504	97852
6	1965	73193	44	0	-1643	6611	78205
7	1966	40039	1004	-1464	-359	-8194	31026
8	1967	7748	-2345	-1367	-333	11753	15436
9	1968	20729	-291	2055	605	-11695	11403
10	1969	43285	1659	2186	1102	6844	55076
11	1970	43430	2272	2975	-421	39471	87727
12	1971	44102	2309	-3338	-137	40479	83415
13	1972	44193	2807	-3030	4101	43201	91272
14	1973	44344	3474	130	7017	45417	100382
15	1974	44355	-1125	-995	4301	49498	96034
16	1975	44413	800	-1184	954	54949	99932
17	1976	43791	-2172	-709	2181	35507	78598
18	1977	46590	-965	-686	3051	15385	63375

SOURCE:
FIGURES IN TABLE 27 MINUS FIGURES IN TABLE 37.

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Philippines they are negative in eight years and zero in six more, ranging from about -$3.3 million (1971) to $3.0 million (1970). The Philippines represent the only ASEAN country for which the total savings over the 18-year period are negative, averaging -$302,600 per year. For Singapore they are negative in eight of the 18 years, and range from about -$1.6 million (1965) to $7.0 million (1973). For Thailand rice export adjustments would have resulted in substantial savings in the total cost of the reserves. The computed savings are negative in five years, but large positive amounts in the remaining 13, ranging from about -$19.4 million in 1960 to $54.9 million in 1975.

Food Grain Reserves With and Without Import Adjustments

The comparable computed savings in total costs of food grain reserves by using import (export) adjustments are shown in Table 29, All Food Grains. The savings are computed in the same manner as those for rice reserves, using the total cost tables for all food grains under the two alternatives. The savings for ASEAN as a whole are negative in only two years and range to as much as about $112.5 million in 1975, averaging $56.5 million over the 18-year period.

The patterns in computed savings under the two alternatives vary by country, however. Those for Indonesia are large, being positive in all years and ranging to a high of about $94.5 million (1963). Those for Malaysia also are large relative to the total food requirements of that country, being negative in one year only (1967) and ranging up to about $5.8 million in 1973. The computed savings for Singapore are negative for all but two of the first nine years but relatively large positive amounts for the second half of the period, and reach a peak of about $12.7 million in 1973. Those for the

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TABLE 29. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED COST SAVING FOR RESERVE PROGRAM WITH IMPORT ADJUSTMENTS

COMPARED TO RESERVE PROGRAM WITH HISTORICAL IMPORTS, ASEAN, 1960-1977

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	13752	358	0	-730	-16666	-3306
2	1961	37142	938	0	-1577	-21158	15345
3	1962	72368	2061	0	-2033	-12672	59724
4	1963	94507	3024	0	-1300	-273	95958
5	1964	81647	2881	0	-451	3461	87538
6	1965	60908	3321	0	-20	-3593	60616
7	1966	42554	3332	-1520	408	-4024	40750
8	1967	7024	-364	-1144	411	13360	19287
9	1968	6336	508	2403	-535	-14419	-5707
10	1969	29984	2854	2590	2581	1680	39689
11	1970	30795	3850	3205	5800	28508	72158
12	1971	34606	3848	3180	6805	20702	71141
13	1972	34806	4346	7753	11166	25334	83405
14	1973	35745	5832	7895	12667	28672	90831
15	1974	35743	1023	7577	7734	41261	93338
16	1975	36009	2219	2591	2215	69508	112542
17	1976	35237	1115	4513	5555	48682	95102
18	1977	37357	2061	5139	6243	33726	84526

SOURCE:
FIGURES IN TABLE 27 MINUS FIGURES IN TABLE 37.

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Philippines are negative in two years and zero in six, but average out to +$2.5 million over the 18-year period. Those for Thailand are negative in seven of the earlier years, but are large positive amounts from 1969 forward, peaking at about $69.5 million in 1975. These findings indicate clearly the superiority of the alternatives involving stabilizing trade from the standpoint of cost-effectiveness. The indicated advantage has increased through time, and cost-savings have become more evenly spread among the five individual nations of ASEAN.

ANNEX I

METHODOLOGY FOR TESTING ALTERNATIVE SECURITY RESERVE PROGRAMS

Based Upon Historical Supply and Utilization Patterns

Using Specialized Subroutines
of the KSU Master Projection Computer Program

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October 1979

METHODOLOGY FOR TESTING ALTERNATIVE SECURITY RESERVE PROGRAMS

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METHODOLOGY FOR TESTING ALTERNATIVE SECURITY RESERVE PROGRAMS

Based Upon Historical Supply and Utilization Patterns

PHASE ONE. DETERMINING THE NEED FOR RESERVES BY COUNTRY AND REGION

Step 1A. Develop supply-utilization balance sheets by crop year for each major grain in each country such that the total supply quantity, Q, equals the total quantity utilized, U:

(1A) $Q_{ijk} = U_{ijk}$, for crop year (i), specific grain (j), and country (k).

For each ijk, total supply quantity, Q, is the sum of the quantities available from each source:

(1B) $Q = Q1 + Q2 + Q3$, where
- Q1 ≡ beginning inventory at the start of the crop year
- Q2 ≡ domestic production during the crop year
- Q3 ≡ net imports during the crop year (if exports of the grain of concern exceed imports, Q3 is negative).

Likewise, for each ijk, total quantity utilized, U, is the sum of the quantities absorbed by each use:

(1C) $U = U1 + U2 + U3 + U4$, where
- U1 ≡ on-farm disappearance (seed, loss, animal feed)
- U2 ≡ total consumption for food
- U3 ≡ total industrial utilization
- U4 ≡ ending inventory at the close of the crop year

The quantities available from each specific source and those utilized in each specific use from Equations 1B and 1C are substituted into Equation 1A to form the basic supply-utilization equation. Thus, for each ijk:

(1) $Q1 + Q2 + Q3 = U1 + U2 + U3 + U4$

Step 1B. Convert the balance sheets from Step 1A to a common denominator, g, (for example, milled rice equivalent), by applying appropriate conversion factors for each ijk. Thus, Equation 1A becomes $Q_{igk} = U_{igk}$, and comparable translation is made for Equation 1.

The results of this step are exemplified by the accompanying Table 1 for each of the ASEAN countries by individual food grain (in milled rice equivalent) for the crop years 1960-1977. The conversion factors to milled rice equivalent are shown by the footnotes to these tables.

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Step 1C. For cases where the concern is for reserves of total food grains, sum across the g's for each ik combination from Step 1B to obtain the equivalent quantities of total food grains, f, in terms of the common denominator, such as milled rice. Thus, Equation 1A becomes $Q_{ifk} = U_{ifk}$, and comparable summation is made for Equation 1. The results are exemplified by Table 1, all Food Grains, for each of the ASEAN countries.

For cases where other types of grain reserves may be of interest, (total feed grain reserves, total oilseed reserves, total domestic utilization reserves, etc), corresponding summations are made for such uses other than solely for human food. (Only food grain reserves were analyzed in this study).

Step 2. For the specific type of utilization of concern reorder Equation 1 to focus on the historical quantities available. For example, where the concern is food supply quantities Equation is reordered for each ijk, igk, or ifk as follows:

(2) $U2 = Q1 + Q2 + Q3 - U1 - U3 - U4$

This permits combining the individual countries (k) or the individual grains (j or g) into the same table for the U2 (as illustrated by the accompanying Table 2 for rice, and for all food grains), and preparing totals for region or various food grains (as the ASEAN totals in the accompanying Table 2).

Step 3. Convert the total quantities for U2 (or other utilization of concern) to the equivalent quantities available per capita over the historical period in each country. The corresponding per capita quantities in Equations 1 and 2 can be designated by the lower case q and u, respectively, and obtained by dividing these total equations through by the appropriate total human population figures, H_{ik}. Thus, for each ijk, igk, and ifk, the corresponding per capita quantities are defined by:

(3) $q1 + q2 + q3 = u1 + u2 + u3 + u4$, and

(4) $u2 = q1 + q2 + q3 - u1 - u3 - u4$.

The results from Equation 4 are shown by the historical quantities in the accompanying Table 4.

Step 4. Fit statistical time trends to the historical per capita quantities of the u_{igk} (or q_{igk}) of concern, using suitable regression equations. Thus, over the relevant historical period, a set of trend estimates, $\hat{q}$ and $\hat{u}$, is developed for each quantity in Equations 3 and 4 which is of interest. Linear trend estimates often are suitable for the per capita quantities, but in individual cases logarithmic or exponential equations may be needed.

The trend estimates are fitted by the method of least squares to the historical quantites, estimating the per capita quantity as a function of time, i. The linear estimating equation is simply:

(5) $\hat{q}_i = a + b_i$

Other common time trend equations include the natural logarithmic functions.

(6A) $\log_e \hat{q}_i = \log_e a + \log_e b_i$,

and exponential functions,

(6B) $\hat{q}_i = a + b(i)^X$, where X is some power greater or less than 1.0.

In lieu of time trends, more complex multi-variable estimating equations may be used to reflect such factors as anticipated changes in relative real prices of alternative food grains, and changes in the anticipated rate of growth in real per capita incomes. Even though the concern in this analysis is not with the estimates, per se, but rather in the pattern of deviations from the estimates, still the more complex estimators may yield more accurate results in some cases. If more complex estimators have been developed for other kinds of economic planning, then their use also for this purpose is recommended. Otherwise, the simple time trend estimators should suffice.

This step is illustrated by the accompanying computer plots from Table 4 historical and projected data, and by the tabular data in Table 5.

Step 5. Determine for each crop year the deviations from trends in available per capita quantities. Thus,

(7) $\dot{q}_{ijk} = \hat{q}_{ijk} - q_{ijk}$, and $\dot{u}_{ijk} = \hat{u}_{ijk} - u_{ijk}$, where

q and u ≡ observed quantities
$\hat{q}$ and $\hat{u}$ ≡ estimated quantities
$\dot{q}$ and $\dot{u}$ ≡ deviations from trend, plus or minus; ijk subscript identifies the crop year, the grain and the country, as before.

This step is illustrated by the accompanying Table 7.

Step 6. Convert the per capita deviations from the above step to the corresponding total tonnages for each country by applying the appropriate total population figures. Thus,

(8) $\dot{Q}_{ijk} = \dot{q}_{ijk} * H_{ik}$, and $\dot{U}_{ijk} = \dot{u}_{ijk} * H_{ik}$

The results of this step are illustrated in Table 8.

Step 7. Compute the corresponding deviations which are in excess of that acceptable were a security reserve program in operation. Thus,

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(9) $\ddot{Q}_{ijk} = \dot{Q}_{ijk} - \acute{Q}_{ijk}$, and $\ddot{U}_{ijk} = \dot{U}_{ijk} - \acute{U}_{ijk}$, where

$\ddot{Q}$ and $\ddot{U}$ $\equiv$ excess deviations needed annual transactions with reserves
$\dot{Q}$ and $\dot{U}$ $\equiv$ observed deviations (from Step 6)
$\acute{Q}$ and $\acute{U}$ $\equiv$ acceptable deviation levels, as determined exogenously.

Note: Given the trend and deviation patterns, the wider the range of acceptable deviation from trend, the lower the security reserve requirement, and vice versa.

Step 8. Define the need for annual transactions with security reserves as the tonnages, $\ddot{Q}$ and $\ddot{U}$, for each basic grain in each country each year. If such potential transactions are designated as RT, then Equation 2 (above) can be restated as:

(10) $U2 = Q1 + Q2 + Q3 - U1 - U3 - U4 - RT$, where

$RT \equiv \ddot{Q}$, or $RT \equiv \ddot{U}$

In years when additional supplies are needed for consumption, withdrawals are made from the reserves (RT is negative), so that the sign for the last term in Equation 10 becomes +; in years when current supplies are greater than needed for consumption, additions are made to the reserves (RT is positive); in years when total supply quantities are in balance with total utilization requirements no transactions are made with the reserves (RT is zero).

The results of this step are shown in units of 1000 MT, milled rice equivalent, in Table 10.

PHASE TWO. TESTING PERFORMANCE OF ALTERNATIVE SECURITY RESERVE SCHEMES HAD THEY BEEN OPERATIONAL OVER THE HISTORICAL PERIOD

Step 9. Determine reserve stock levels and net reserve transactions for economic and acceptable levels of security reserves for food grains within each country over the historical test-period. For each ijk, establish realistic bounds on in-country reserve levels, and compute the possible reserve transactions subject to these bounds, as follows:

(11) $RT1 = RT$, provided $L1 \leq RB1 \geq M1$, where

$RT_{ijk} \equiv$ total reserve transactions, as above
$RT1_{ijk} \equiv$ transactions with in-country reserves
$RB1_{ijk} \equiv$ balance in in-country reserves

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$L1_{ijk} \equiv$ lower limit for in-country reserve levels

$M1_{ijk} \equiv$ maximum limit for in-country reserve levels

Furthermore,

(12) $RB1_i = RB1_{i-1} + RT1_i$

This is a simultaneous computation, with RB1 a function of RT1, and RT1, subject to constraints on RB1. The results of this step are illustrated by the accompanying Tables 11 and 12 under the sub-alternative with L1 taken at zero and M1 taken at the standard error of estimate applied to the trend in total food requirement for each country.

Step 10. Determine the indicated residual transactions with regional reserves by each country in order to meet the targeted stability level in that country. Following Equation 11, this is done for each ijk subject to bounds on the regional reserves as follows:

(13) $RT2 = RT - RT1$, provided $\sum_k L2 \leq RB2 \geq \sum_k M2$, where

RT and RT1 are identified as above

$RT2_{ijk} \equiv$ transactions with regional reserves

$RB2_{ijk} \equiv$ balance in regional reserves

L2 and M2 $\equiv$ represent the limits on stock levels in regional reserves.

Likewise, following Equation 12

(14) $RB2_i = RB2_{i-1} + RT2_i$

The results of this step are illustrated by the accompanying Tables 13 and 14 under the sub-alternative for which $\sum_k L2 = 0$, and $\sum_k M2 = 2.0$ million MT.

Step 11. If residual needs for further reserve transactions to meet targeted levels stability still remain from the above step, the analysis can be extended to a still higher level of world-wide reserves, RT3 and RB3, following the procedures outlined above. Thus, corresponding to Equations 13 and 14 are:

(13') $RT3 = RT - (RT1 + RT2)$, provided $\sum_k L3 \leq RB3 \geq \sum_k M3$, and

(14') $RB3_i = RB3_{i-1} + RT3_i$.

These steps can be repeated for as many alternative configurations, targeted stability levels and constraint levels for reserve stocks as may be needed to support planning decisions by officials in each country and region.

It will be noted that for the ASEAN case, under the alternatives considered, RT3 is zero for all i, except 1968. Where j = rice only, withdrawals of 175,000 MT (milled rice equivalent) from world reserves would have been needed that year. Where j = all food grains, the withdrawals from world reserves would need to have been only 73,000 MT (see Tables 14).

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Step 12. Determine the potential adjustments in international trade to stabilize supply quantities in each country, using the relevant historical data from the above steps as base. This requires realistic determination of (1) the date within the crop year by which accurate estimates of domestic production, $Q1_i$, can be known, and (2) the time lag required for completing delivery of adjusted transactions in international trade. These two factors determine the fraction of the indicated adjustment which can be achieved during the same crop year, F1 and the fraction that will not be effective until the following crop year, F2.

Given this information, the potential adjustments in international trade are computed from the excess deviations in the historical quantities of grains in each country, $\ddot{Q}_{ijk}$ from Equation 10 (see accompanying Table 10). For each ijk, the net quantity adjustment in international trade, A, has two components, (1) the effective adjustment for the current crop year, $A1_i = F1 * \ddot{Q}_i$ plus the carry-over adjustment from the previous crop year, $A2_i = F2 * \ddot{Q}_{i-1}$. This time lag gives rise to the possibility of additional trade adjustments to offset last year's adjustment, so that the simple adjustment equation:

(15A) $A_i = F1 * \ddot{Q}_i + F2 * \ddot{Q}_{i-1}$, becomes

(15B) $A_i = F1 * (\ddot{Q}_i + A2_{i-1}) + F2 * (\ddot{Q}_{i-1} + A2_{i-2})$, or

(15) $A_i = F1 * \ddot{Q}_i + (\ddot{Q}_{i-1} * F2) + F2 * \ddot{Q}_{i-1} + (\ddot{Q}_{i-2} * F2)$

Starting with the $\ddot{Q}_{ijk}$ from Table 10, the results from application of Equation 15 are shown in the accompanying Table 15 for the case where F1 = 0.5 (and F2 = 0.5). As F1 approaches 1.0 (F2 → 0.0), trade adjustments (Table 15) approach excess deviations (Table 10), except with opposite sign. As F2 approaches 0.0 (F2 → 1.0), trade adjustments may exhibit far greater frequency and amplitude than the excess deviations they are designed to overcome. The adjustments indicated in Table 15 clearly fall between these extremes, exhibiting characteristics more common of year-to-year changes in international trade by most countries (note the patterns in year-to-year trade volumes in Table 1, for example).

Step 13. Define the need for transactions with security reserves after adjustments in international trade by each country. Thus, Equation 10 from Step 8 becomes:

(16) $U2 = Q1 + Q2 + Q3 + A - U1 - U3 - U4 - AT$,
$AT = \ddot{Q} - A$, where

A ≡ net adjustment in international trade as specified by Equation 15

AT ≡ annual transactions with security reserves after trade adjustments.

Note that if AT = 0 through time, then there is no need for food security reserves if full advantage is taken of potential adjustments in interna-

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tional trade by each country.

For the ASEAN case illustrated by the accompanying Table 16, the need for security reserves is dampened somewhat by the trade adjustments, but by no means is this need fully met by the adjustments.

Step 14. Determine the required stock levels and net reserve transactions for each country after trade adjustments. This step parallels Step 9 so that for each ijk Equations 11 and 12 become:

(17) $AT1 = AT$, provided $L1 \leq AB1 \geq M1$, given

(18) $AB1_i = AB1_{i-1} + AT1_i$, and where

$AT \equiv$ as identified in Step 13

$AT1 \equiv$ transactions with in-country reserves after trade adjustments

$AB1 \equiv$ balance in-country reserves after trade adjustments

$L1$ and $M1 \equiv$ limits on stock levels for in-country reserves, as in Step 9.

The results from this step are illustrated by the accompanying Tables 17 and 18 under the sub-alternative with L1 taken at zero and M1 taken at the STDE applied to the trend in the total food requirement, as is the case for Tables 11 and 12.

Step 15. Determine the indicated residual transactions with regional reserves after trade adjustments by each country in order to meet the targeted stability levels in that country. Following Equation 13 this is done for each ijk subject to bounds on the regional reserves as follows:

(19) $AT2 = AT - AT1$, provided $\sum_k L2 \leq AB2 \geq \sum_k M2$, given

(20) $AB2_i = AB2_{i-1} + AT2_i$, and where

AT and $AT1$ are identified as in Step 14

$AT2_{ijk} \equiv$ transactions with regional reserves after trade adjustments

$AB2_{ijk} \equiv$ balance in regional reserves after trade adjustments

$L2$ and $M2 \equiv$ represent the limits on stock levels in regional reserves, as in Step 10.

The results from this step are illustrated by the accompanying Tables 19 and 20 under the sub-alternative for which $\sum_k L2 = 0$ and $\sum_k M2 = 1.1$ million MT as in Tables 13 and 14.

Step 16. As in the case of Step 11, if residual needs for further reserve transactions to meet targeted levels of stability still remain from Step 15, comparable analysis can be extended to a still higher level of world-wide reserves (after international trade adjustments), AT3 and AB3, following the procedures outlined in

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Step 15. Corresponding to Equations 19 and 20 are:

(19') $AT3 = AT - (AT1 + AT2)$, provided $\sum_k L3 \leq AB3 \geq \sum_k M3$, and given

(20') $AB3_i = AB3_{i-1} + AT3_i$.

No examples are shown for ASEAN because all requirements were met by the combination of in-country and regional reserves (AT3 = zero for all ijk).

PHASE THREE. MEASURING COST-EFFECTIVENESS OF THE ALTERNATIVE SCHEMES

Step 17. Compute the annual fixed costs for maintaining the required grain storage capacity for in-country security reserves. If this capacity is assumed to be committed for security reserves and not available for alternative use, the annual fixed cost is defined for each ijk as,

(21) $FC1 = RC1 * K1 * fc1$, where

- FC1 is the total annual fixed cost of in-country storage facilities for security reserves.
- K1 is the appropriate constant for converting from milled rice equivalent to the form in which the grain would be stored for the reserve.
- fc1 is the annual fixed cost per metric ton for the in-country storage facilities.

The required storage capacity is determined directly from the in-country reserve balances given from Equation 12 by the following:

(12') $RC1_i = RB1_i$ or $RB1_{i-1}$, whichever is greater.

The results for ASEAN are shown in Table 12'.

The per unit total annual fixed costs for maintaining in-country reserve storage are given by the following:

(21') $fc1 = fca + fcd + fcc + fcm + fco$, where

- fca is the annual per ton costs for administrating the program, taken at $3.00 for ASEAN.
- fcd is the annual per ton facility depreciation expense, taken at $5.00 ($2.50 Bldgs + $2.50 Equip) for ASEAN.
- fcc is the annual per ton charge for capital invested in the storage facilities, taken at $7.50 ($125/2x.12) for ASEAN.
- fcm is the annual per ton repair and maintainence cost for the storage facilities, taken at $2.50 [($150 x .02 + 100 x .02)/2] for ASEAN.
- fco is the annual fixed cost per ton for other expenses of the storage facilities, taken at $3.80 for ASEAN.

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The estimated total annual fixed costs for in-country reserve storage facilities based on Equation 21 are shown for ASEAN in Table 21. In this case the multiplier, K1, is taken at 2.0, assuming all rice in the food security reserve is stored in the form of rough rice.

Step 18. Compute the annual variable cost for maintaining the required grain inventory for in-country security reserves. If such inventory is held at strategic locations so that no extra handling nor transportation is required, the annual variable cost for each ijk is defined as,

(22) VC1 = RB1 * K1 * vc1, where

- RB1 is as defined by Equation 12, and shown in Table 12
- K1 is as specified for Equation 21, above
- vc1 is the annual variable cost per metric ton for maintaining the in-country reserve inventories. This per ton cost is given by the following:

(22') vc1 = vcc + vcm + vco + vcs, where

- vcc is the annual per ton carrying charge for grain in security reserves, taken at $15.30 ($150 x 10.2%) for ASEAN.
- vcm is the annual per ton cost for quality maintenance, taken at $4.00 for ASEAN.
- vco is the annual per ton cost for operating expense, taken at $3.00 for ASEAN.
- vcs is the annual per ton cost for grain shrinkage, taken at $1.00 for ASEAN.

The estimated total annual variable costs for in-country reserve inventories based on Equation 22 are shown for ASEAN in Table 22. The K1 multiplier is taken at 2.0 for the ASEAN case. Note that VC1 is zero for all ijk, in which in-country reserve levels (RB1) are zero (see Equation 22 and Table 12).

Step 19. Sum the annual fixed cost and the annual variable cost for the estimated annual total cost of in-country reserves. This is done by straight summation for each ijk as indicated by Equation 23.

(23) TC1 = FC1 + VC1

The results for ASEAN are shown by Table 23.

Step 20. Repeat Steps 17 through 19 for the regional reserves. Annual fixed costs for regional storage facilities are given by Equation 24.

(24) FC2 = RC1 * K1 * fc2, where

- fc2 is defined in the same manner as fc1 in Equation 21'.
- K1 is defined as in Equation 21.
- RC1, the required regional storage capacity, is determined directly from the regional reserve balances given by Equation 14 as follows:

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(14') $RC2_i = RB2_i$ or $RB2_{i-1}$, whichever is greater. The results for ASEAN are shown in Table 14'.

Total fixed costs for regional reserves for ASEAN are shown by Table 24, based on the same values for fc and K1 as in Table 21.

Annual variable costs for regional reserve inventories are defined for each ijk by Equation 25.

(25) VC2 = RB2 * K1 * vc2, where
- vc2 is defined in the same manner as vc1 by Equation 22'.
- K1 is defined as in Equation 21.
- RB2 is defined by Equation 14 and shown in Table 14. Negative balances by individual participating nations are charged at the same rate as corresponding positive balances in the regional reserves.

Total variable costs for ASEAN regional reserves are shown in Table 25. The figures are based on the same values for K1 and vc as those in Table 22.

Annual total costs for regional reserves are obtained by summation as indicated by Equation 26.

(26) TC2 = FC2 + VC2

The results for ASEAN are shown by Table 26.

Step 21. Determine the combined total costs for the regional reserve program. This is done by summing the total costs for in-country reserves and the total costs for regional reserves for each ijk.

(27) CTC = TC1 + TC2

The results for ASEAN are shown by Table 27.

Step 22. Compare the relative total costs of alternative security reserve programs to measure the cost-effectiveness of the alternatives. The comparison varies depending upon the kinds of alternatives under analysis. Following are common examples.

The additional cost of more complete programs is obtained by subtracting the combined total costs of the two cases. Thus, for each ijk,

(28) $ATC = CTC_c - CTC_s$, where
- ATC is the additional total cost.
- CTC_c is the combined total cost from Equation 27 for the more complete case.
- CTC_s is the combined total cost from Equation 27 for the more simple case.

The results from Equation 28 for ASEAN food reserves of all food

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grains compared to ASEAN food reserves of rice only are shown in Table 28.

The magnitude of cost savings between two alternatives capable of producing the same level of benefits is obtained by subtracting the combined total costs for the two alternatives. Thus, for each ijk,

(29) $STC = CTC_2 - CTC_1$, where

- STC is the saving in total cost.
- CTC_2 is the combined total cost for the second best alternative.
- CTC_1 is the combined total cost for the best alternative.

The cost savings from Equation 29 for ASEAN food reserves based on adjustments in international trade compared to such reserves without adjustments in international trade are shown in Table 29.

Step 23. Compute the costs of using adjustments in imports and/or exports to help stabilize food grain supplies in each country. This is done by applying the average total per ton extra cost for the adjustments in international trade to the calculated volumes of trade adjustment. Thus, for each ijk,

(30) CAT = AT * cat, where

- CAT is the total additional cost for net adjustment in international trade.
- AT is the net plus or minus adjustment in tonnage of grain imported (see Equation 15 and Table 15).
- cat is the average total additional cost per metric ton for making the adjustment in international trade transactions. For the ASEAN case, cat is taken at \$57.69 [(\$25.00 x 1.5)/.65], assuming extra cost for trade adjustments of \$25/MT, total adjustment of 1.5 MT per MT net adjustment, and average rice milling rate of 65 percent.

The resulting computed total annual cost for adjustments in international trade to help stabilize domestic grain supplies in each ASEAN country are shown in Table 30.

Step 24. Repeat Steps 17 through 19 for the costs of in-country reserves after net import adjustments. Following Equation 21, annual fixed costs for in-country reserve storage facilities are given by Equation 31.

(31) FCA1 = RCA1 * K1 * fc1, where

- FCA1 is the total annual fixed cost for the needed in-country reserve storage facilities after import adjustments.
- K1 and fc1 are the same as defined in Equation 21.
- RCA1 is the required storage capacity for in-country reserves, and is computed directly from the in-country reserve balances given in Equation 18 as

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follows:

(18') $RCA1_i = AB1_i$ or $AB1_{i-1}$, whichever is greater; the results for ASEAN are shown in Table 18'.

The resulting computed total fixed costs for in-country reserve capacity with import adjustments for ASEAN are shown in Table 31.

Following Equation 22, the annual variable costs for in-country reserves after import adjustments are given by the following:

(32) VCA1 = AB1 * K1 * vc1, where AB1 is as defined in Equation 18 and K1 and vc1 are as defined for Equation 22.

The results for ASEAN are shown in Table 32.

Annual total costs for in-country reserves with import adjustments are computed by straight summation. For each ijk,

(33) TCA1 = FCA1 + VCA1

These results for ASEAN are shown in Table 33.

Step 25. Repeat Steps 17 through 19 for the costs of regional reserves after net import adjustments. Following Equation 21, annual fixed costs for regional storage facilities after import adjustments are given by Equation 34.

(34) FCA2 = RCA2 * K1 * fc2, where
K1 and fc2 are comparable to the corresponding variables in Equation 21.
RCA2 is the required regional storage capacity with import adjustments, as given by the equation,

(20') $RCA2_i = AB2_i$ or $AB2_{i-1}$, whichever is greater; the results for ASEAN are shown in Table 20'.

The resulting fixed costs for ASEAN regional reserves after net import adjustments are shown in Table 34.

Following Equation 22, annual variable costs for needed regional reserve stocks after import adjustments are computed as follows:

(35) VCA2 = AB2 * K1 * vc2, where AB2 is as defined in Equation 20 and K1 and vc2 are as defined in Equation 22. The ASEAN results are shown in Table 35.

Following Equation 23, annual total costs for regional reserves after net import adjustments are computed by summation. For each ijk,

(36) TCA2 = FCA2 + VCA2

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These results for ASEAN are shown in Table 36.

Step 26. Determine the combined total costs for the regional reserve program with net import adjustments to help stabilize supplies in each member country. This is done by summing the total costs for adjustments in international trade, total costs for in-country reserves and total costs for regional reserves with the trade adjustments. Thus, for each ijk,

(37) $CTCA = CAT + TCA1 + TCA2$

The results for ASEAN are shown in Table 37.

Step 27. Compare the costs of alternative regional reserve programs after net import adjustments to measure relative cost-effectiveness.

Following the equations in Step 22, alternative comparisons can be made. For example, to compare the after-trade-adjustment cost of a more complete program with one which is less complete, the following equation is used:

(38) $ATCA = CTCA_c - CTCA_s$, where

$ATCA$ is the additional total cost.
$CTCA_c$ is the combined total cost from Equation 37 for the more complete program.
$CTCA_s$ is the combined total cost from Equation 37 for the more simple case.

The results from Equation 38 for ASEAN food reserves of all food grains compared to ASEAN food reserves of rice only are shown in Table 38.

APPENDIX

USE OF THE MPJ COMPUTER PROGRAM FOR THE ANALYSIS

The Master Projection (MPJ) Computer Program is one of a series of fully-operational computer programs developed by Kansas State University and published by the Food and Feed Grain Institute under the world-wide technical assistance program of U.S. Agency for International Development (AID/ta-C-1162). The program is written in Fortran and is available through USAID offices, or from SEARCA in Los Baños, Philippines as well as from KSU in Manhattan, Kansas and AID/W. Earlier versions of MPJ and other programs in the system have been installed in many of the developing countries of Asia. Complete information on the program and its use is contained in "User's Guide to Computerized System for Feasible Agri-business Development" Special Report No. 2, Vol 2, Chap. 10, 1979 Edition. Food and Feed Grain Institute, Kansas State University, Manhattan, Kansas 66506.

Technical assistance and training on the use of the MPJ program for analyzing alternative food security reserve programs also are available. The same is true for related programs in the KSU package, including those for feasibility analysis, proforma financial statements, impact analysis and transportation linear programming. Comments and suggestions regarding the programs and their use are encouraged by the Food and Feed Grain Institute staff.

General Description of MPJ

The MPJ is a user-controlled program designed for economists, engineers and technicians with limited knowledge of computers and computer programming. It is a versatile tool capable of many kinds of analysis and tabular formatting. It can be used to fit least-squares trends to time series data, using exponential or

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logarithmic as well as linear models. Because it is easy to use for cell-by-cell addition, multiplication, subtraction, or division of tables, and for calculating border totals, it is often used to produce numbers needed for input to other programs. It's convenient plotting feature adds to it's versatility.

All of the tables and charts in this report were produced with the MPJ. Most of them require one or more of the standard subroutines which are also included in previous versions of the program. However, some make use of recently-added subroutines which are tailored for the analysis of food security reserves.

The versatility of MPJ makes it seem formable upon first exposure to it. In all, it receives user command instructions and/or data at 29 steps, with each step containing as many as 20 different commands. For any one use, most of these command points can be bypassed, so that with some practice MPJ becomes relatively easy to manipulate. However, successful use requires possession of the full user's guide, cited above. The brief information contained here serves to supplement the user's guide in the kind of analysis used for evaluation of alternative food security reserve programs.

Most of the crucial command instructions needed by MPJ for the analysis herein as read at four steps in the program -- Step 4, Step 4A, Step 4B, and Step 5. These commands are read as integer numbers. Some are used to define dimensions and parameters (such as the number of rows and columns for each table), but most follow the convention of yes = 1, no = 0. To activate a desired command, the user inserts a "1" in the proper space, otherwise it will not be activated (the computer reads a blank as "0"). In the instructions which follow, attention is called to the unique non-zero entries needed for each type of computer run. In Table A (below), each run is keyed to the Step and Equation number in the body of the methodology annex as well as to the corresponding output table number.

Kinds of MPJ Runs Used

Although the MPJ program is best known for its capability to fit trends and develop projections, no projections are developed in this analysis. The kinds of runs used may be classified as follows:

1. Y runs, in which the Y-table is defined as some combination of two or more X-tables. For example, the supply-utilization balance sheets for all food grains (in milled rice equivalent) are defined as the sum of comparable tables for rice, wheat, and corn.

   Such runs are accomplished by supplying information for each of the X tables in succession, followed by the command instructions for the Y table. Usually one commands the program to generate a data deck of the Y-table (as well as to print it) so that it can be used in subsequent steps.

2. NFIT runs, in which commands are given to fit time-trend regression and/or plot the results. These may be combined with NDEV runs to make tables of the deviations from trends rather than observed values.

3. ISTOCK runs, to compute year-by-year transactions with reserves subject to constraints on stock (cumulative total) levels. Special combinations of this feature are used to determine regional reserve transactions, import adjustments, and cumulative storage capacities.

4. NONEG runs, to compute output based on the absolute values of numbers in the input data.

5. LPLOT runs, used in connection with NPLOT to compress the Y-axis on the computer plots (otherwise it will be expanded to highlight the deviations from trend).

6. NOTL runs, where no column total is desired in the output-table (s).

7. NOPRT runs, where no output table is to be printed.

8. CONST runs, where Step 0 conversion tables are desired.

Various combinations of these eight basic runs are used for the complete analysis herein. The prorate (Step 15) option and other more complex options of MPJ are

not necessary. Original input data is required for Tables 1, 2, and 3. All the rest are produced, printed, and stored by MPJ at the user's command.

Specific Runs for Each Set of Tables

The accompanying Table A summarizes the specific runs with MPJ to produce the output tables. Except for Run 1 to produce the set of Tables 1 for each ASEAN country, each run is made twice, once for the rice only output and once for the all food grains output. The number and contents of the output tables are given in the first two columns. The methodology step and equation number are listed next, followed by the type of computer run.

The control cards by step in MPJ are listed in the last three columns of Table A, and refer to the key shown in the footnote to the table. Step 4 is the master control card, and contains varying commands for each run. Step 4A controlling the number and length of input periods is uniform for all runs, and is not listed in Table A. Step 4B controlling the plot option is used only in Runs 2 and 3. Step 5 contains features unique to buffer stock and security reserve analysis, and is used in many of the runs.

1. Determining the Need for Reserves

The need for food security reserves as determined from the historical patterns of food grain supply and utilization over the past 18 years, is analyzed in the first eight runs summarized in Table A. The computer runs used are as follows:

Run 1. Supply-utilization balance sheets by country by food grain, in milled rice equivalent.

These tables, shown in Annex II, represent the basic input data for the analysis. This run is used to print the final output for the X-tables (rice, wheat, and corn) and to calculate by addition the all food grains table, which is printed and a card deck punched in the same run. Five runs are made, one for each ASEAN country.

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Run 2. Available per capita food supplies in each country

This run is used to compute and plot the available per capita food supplies. One run is made for rice and another for all food grains. The X_1 table, total food use, is taken directly from column 6 of the corresponding Tables 1. The X_2 table, total human population, is prepared from original data, and NFIT and NPLOT are used to check the stability of total population trends. The Y table, per captia food supplies, is computed by division, printed and keypunched in this run.

Run 3. Year-to-year stability in per capita food supplies

This run is made from the output of the previous run and is used to fit, print, and plot the trend and deviations in available food supplies on a per capita basis.

Run 4. Year-to-year deviations in food supplies

This is a Y-table run to compute the annual deviations in total food supplies. The X_1 table is computed from the Table 4 deck and Table 7 title cards, using the NDEV option. The results are multiplied by the population deck (X_2) to compute, print and punch the Y table. The NOPRT option is used for X_2 since it was already printed in Run 2.

Run 5. Trend estimates of per capita food supplies

This also is a Y-table run used to compute, print, and punch the per capita trend estimates by adding the deviations (X_2) to the observed data (X_1). NOPRT is used with both X tables.

Run 6. Trend estimates of total food supplies

This run parallels Run 5, but is applied to total food supplies. It is used to compute, print, and punch the total trend estimates, and at the same time to compute, print, and punch the targeted maximum allowable year-to-year deviation from trend (taken at 3 percent of the trend in this study). As in Run 5, NOPRT is used with both X tables.

Run 7. Allowed year-to-year deviation in total food supplies

This run is used to produce the work table, Table 9'. As indicated by the footnote to the table, it sets the maximum deviation trend at $\pm$ 3 percent, or the observed historical deviation, whichever is smaller. It is accomplished with the ISTOCK and NRTR (needed reserve transaction) options, using the data decks for Table 8 and Table 9 with the title cards for Table 9'.

Run 7a. Needed reserve transactions for targeted stability

This is a Y-table run, subtracting the allowable deviations (Table 9') from the historical deviations (Table 8). Output Table 10 is computed, printed, and punched in this run.

Run 8. Maximum limits on security reserve balances for each country

This is a special run used to compute, print, and punch a work table of maximum limits on reserve balances, Table 11'. As shown

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by the footnote to this table, the limits are based on the least-squares trend analysis for each country, being set at the standard errors of estimate associated with Table 4, and applied to the total trend estimates in Table 6. The run is a Y-table run, multiplying Table 6 by the STDEs. A one-line X_2 table is prepared, and NP and RATE are used to instruct the MPJ to complete this multiplier table for use in computing Table 11'.

2. Testing the Performance of Alternative Food Reserve Programs

The performance of alternative food reserve programs is tested in Runs 9-16. Runs 9-11 are used to test the performance of programs using the volume of international trade as it has existed horizontally in each country. Runs 12-16 are used to test the performance of programs using adjustments in the volume of international trade to help stabilize available food supplies in each country.

Run 9. In-country reserves

This is a special Y-table run used to compute annual reserve transactions subject to constraints on reserve balances, and to compute the reserve balances. Table 11 is computed, printed, and punched as X, using the Table 10 and 11' decks plus the beginning stocks card with Table 11 title cards. It is accomplished by the ISTOCK option set equal to "1". Table 12 is computed, printed, and punched as the Y table, using Table 12 title cards, no additional data and the ISTOCK option set equal to "2".

Run 10. Residual need for regional reserves

This is a straight Y-table run for computing, printing, and punching the needed transactions with regional reserves in each country (Table 13). It is accomplished by subtracting the figures in Table 11 from those in Table 10, using NOPRT with both X tables.

Run 11. Cumulative balances in regional reserves

This is a special run for computing, printing, and punching Table 14. It is accomplished by using the Table 14 title cards with the Table 13 deck, exercising the ISTOCK and IREG options.

Run 12. Adjustments in international trade

This is a special run for computing, printing, and punching the possible adjustments in international trade by each country. It requires specification of the fraction of indicated adjustments in trade which can be accomplished during the same crop year in which the need is discovered, taken at 0.5 for the ASEAN case. It is accomplished by submitting two decks of Table 10 plus the beginning reserve card and the Table 15 title cards. The FACTO, ISTOCK and IMPORT options are exercised at Step 5 of MPJ.

Run 13. Needed reserve transactions after international trade adjustments

This is a straight Y-table run in which Table 15 is subtracted from Table 10 to compute, print, and punch Table 16, needed transactions with security reserves after net import adjustments. NOPRT is used with both X variables.

Run 14. In-country reserves after net import adjustments

This is a special Y-table run paralleling that of Run 9. Table 17 is computed, printed, and punched as X_1 using the Table 16 and Table 11' decks plus the beginning stocks card with Table 17 title cards, using ISTOCK equal to "1". Table 18 is computed, printed, and punched as the Y table using Table 18 title cards, no additional data and the ISTOCK option set equal to "2".

Run 15. Residual need for regional reserves after net import adjustments

This is a straight Y-table run paralleling that of Run 10. Table 19 is computed, printed, and punched as the cell-by-cell residuals between Table 16 and Table 17. The NOPRT option is used with both X tables.

Run 16. Cumulative balances in regional reserves after net import adjustments

This is a special run, paralleling Run 11, for computing, printing, and punching Table 20. It is accomplished using the Table 20 title cards with the Table 19 deck and exercising the ISTOCK and IREG options at Step 5 of MPJ.

3. Measuring Cost-Effectiveness of the Alternative Schemes

The cost-effectiveness of alternative food security reserves schemes is determined by computing the total cost of the required grain storage facilities and maintaining the needed inventories in the security reserves. Standardized per metric ton storage costs are used for the different alternatives under consideration so that the results are directly comparable. Schemes which generate identical benefits can be evaluated on the basis of direct comparisons of their total costs. Schemes which generate differing benefits can be evaluated on the basis of the additional costs required to produce the added benefits.

The cost-effectiveness of the alternatives are accomplished with the MPJ computer program in a series of 17 computer runs, extending from Run 17 to Run 34. Each of these is discussed in sequence.

Run 17. Fixed costs of in-country reserve grain storage facilities

This is a conversion table run in which total fixed costs are caluclated by applying a constant per ton factor to the annual storage capacity required in each country. The required storage capacity (Table 12') is calculated from the Table 12 deck, using the ISTOCK and NCAP options. In the same run Table 21 is calculated by multiplying Table 12' by $21.80 x 2 = $43.60, assuming two metric ton of storage capacity as rough rice for every one metric ton milled rice equivalent.

Run 18. Variable costs of in-country grain inventories in the security reserves

This is also a conversion table run. Total annual variable costs are calculated by applying a constant per ton factor to the annual inventories in the security reserves in each country (Table 12). The NOPRT option is used for this table, since the run is used only to calculate, print, and punch Table 22. The constant factor used for ASEAN is $23.30 x 2 = $46.60.

Run 19. Total annual costs for in-country grain security reserves

This is a straight Y-table run in which the fixed cost is added to the variable cost to compute, print, and punch the total annual costs for in-country grain reserves for Table 23. The NOPRT option is used for both X tables.

Run 20. Fixed costs of regional reserve grain storage facilities

This is a conversion table run paralleling that of Run 17. The Table 14 data deck is used to generate Table 14' under the ISTOCK-NCAP options and the costs in Table 24 are computed, printed, and punched, applying the $43.60 constant per ton fixed-cost factor.

Run 21. Variable costs of regional grain inventories in security reserves

This is a conversion table run paralleling that of Run 18, except for use of the NONEG option to ignore the minus signs in Table 14 (as indicated by the footnote to Table 25, negative balances by individual countries in the regional reserves are computed at the same rate as positive balances). The constant factor of $46.60 is used for calculating, printing, and punching Table 25 as a conversion table.

Run 22. Total annual costs for regional grain security reserves

This is a straight Y-table run paralleling Run 19. The NOPRT option is used for both X tables, since the run is used only to compute, print, and punch Table 26.

Run 23. Combined total annual costs for grain security reserves

This also is a straight Y-table run. It is used to compute, punch, and print Table 27 as the sum of the total costs of in-country reserves (Table 23) and the total cost of regional reserves (Table 26). The NOPRT option is used for both X tables.

Run 24. Added cost for reserves of all grains compared to reserves of rice only

This is a straight Y-table run used to compute, print, and punch the added costs (Table 28) as differences between Table 27 for all grains and Table 27 for rice only. The NOPORT option is

used for both X tables.

Run 25. Cost saving for reserve program with import adjustments

This is another straight Y-table run; it is used to compute, print, and punch the cost saving (Table 29) as the difference between Table 27 (with no import adjustments) and Table 37 (after import adjustments). The NOPRT option is used for both X tables.

Run 26. Computed costs of international trade adjustments

This is a conversion table run in which Table 15 with the NONEG option is multiplied by a constant per ton factor to compute, print, and punch the costs shown in Table 30. 1/ The per ton cost used for the ASEAN countries is $57.69/MT. This is based on an average extra cost for adjustments in international trade of $25.00/MT, an average milling rate for rice of 65 percent and an average gross adjustment of 1.5 MT per MT net adjustment achieved.

Run 27. Fixed costs of in-country reserve grain storage facilities after trade adjustments

This is a conversion table run paralleling Run 17. The required storage capacity (Table 18') is computed form the Table 18 deck and used with the constant factor of $43.60 per MT to compute, print, and punch Table 31.

Run 28. Variable costs of in-country reserve inventories after trade adjustments

This is a conversion table run paralleling Run 18. The constant factor of $46.60/MT is applied to Table 18 to compute, print, and punch Table 32.

Run 29. Total annual cost for in-country reserves after trade adjustments

This is a Y-table run paralleling Run 19. Tables 31 and 32 are added to compute, print, and punch Table 33.

Run 30. Fixed costs of regional reserve grain storage facilities after trade adjustments

This is a conversion table run paralleling Run 20. The Table 20 data deck is used with the INTOCK and NCAP options to generate the required capacities shown in Table 20'. The constant factor of $43.60 is applied to compute, print, and punch the fixed costs shown in Table 34.

Run 31. Variable costs of regional reserve inventories after trade adjustments

This is a conversion table run paralleling Run 21. Table 20 with the NONEG option is multiplied by the constant of $46.60/MT to compute, print, and punch the variable costs shown in Table 35.

Run 32. Total annual cost for regional reserves after trade adjustments

This is a Y-table run paralleling Run 22. Tables 34 and 35 are added to obtain, print, and punch Table 36.

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Run 33. Combined total annual costs for security reserves after trade adjustments

This is a Y-table run in which the combined total costs are obtained by adding the costs of trade adjustments from Table 30, the total annual cost for in-country reserves from Table 33, and the total annual costs for regional reserves from Table 36. The NOPRT option is used for all X tables, as the run is used to compute, print, and punch the combined cost shown in Table 37.

Run 34. Added cost for reserves of all grain compared to reserves of rice only

This is a Y-table run paralleling Run 24, used to compute, print, and punch Table 38 as the difference between Table 37 for all grains and Table 37 for rice.

1/ It is well to note here that the per ton charge need not be constant over time to employ the CONST option. The multiplier can be changed each year under this MPJ option if desired.

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TABLE A. SUMMARY OF MPJ COMPUTER RUNS FOR FOOD RESERVES

Table		Methodology		Computer Run		Control Cards by Step in MPJ*		
No.	Contents	Step	Function	No.	Type	Step 4	Step 4B	Step 5
1	Q/U Bal (Rice)	1	(1)	1. X_1	Final	2,4	0	0
1	Q/U Bal (Wheat)	1	(1)	X_2	Final	2,4	0	0
1	Q/U Bal (Corn)	1	(1)	X_3	Final	2,4	0	0
1	Q/U Bal (All)	1	(1)	Y	F/Deck	2,4,7	0	0
2	Food Use	2	(2)	2. X_1	Final	2	0	1
3	Population	3	data	X_2	NFIT	2,3	5	4
4	Use/Capita	3	(4)	Y	Deck	2,4,7	0	0
4	Use/Capita	4	(5)	3. Z	NFIT	4	5	4
7	Dev/Capita	5	(7)	4. X_1	T4/Deck	2,4,7	0	1,3,4
3	Population	3	data	X_2	NOPRT	2,5	0	0
8	Total Deviation	6	(8)	Y	F/Deck	2,7	0	0
4	Use/Capita	3	(4)	5. X_1	NOPRT	2,5	0	0
7	Dev/Capita	5	(7)	X_2	NOPRT	2,5	0	0
5	Est/Capita	4	(5)	Y	F/Deck	2,4,7	0	0
2	Food Use	2	(2)	6. X_1	NOPRT	2,5	0	0
8	Total Deviation	6	(8)	X_2	NOPRT	2,5	0	0
6	Total Est	7	(9)	Y	F/Deck	1,2,7,8	0	0
9	Target Dev	7	(9)	Y_c	F/Deck	-	-	-

*Summary Codes — Factor and Column by Control Step

Code No.	Step 4		Step 4B (14)	Step 5	
0	Standard-No projection		Blank	Standard-NCARDS, NEGNO	
1	Step 0		Plot 1 (19)	WCOEF	(9)
2	NFAC (IFORM)	(36/48)	Plot 2 (20)	FACTO	(17/25)
3	LPRJ	(40)	Plot 3 (21)	NDEV	(60)
4	NOTL	(44)	Plot 4 (22)	NFIT	(64)
5	NOPRT	(52)	Plot 5 (23)	ISTOCK(only)	(48)
6	RATE	(56)	Plot 6 (24)	ISTOCK/IREG	(52)
7	CARDM	(60)	Plot 7 (25)	ISTOCK/IMPORT	(56)
8	CARDT	(64)	Plot 8 (26)	ISTOCK/NRTR	(68)
9	NOMOD	(72)	Plot 9 (27)	ISTOCK/NCAP	(72)
10				LPLOT	(76)
11				NONEG	(80)

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Table		Methodology		Computer Run			Control Cards by Step in MPJ*		
No.	Contents	Step	Function	No.		Type	Step 4	Step 4B	Step 5
9'	Adj. Allowed	8	(10)	7.		ISTOCK T8, T9	7	0	8
8	Total Dev	6	(8)	7a.	X_1	NOPRT	2,5	0	0
9'	Adj. Allowed	8	(10)		X_2	NOPRT	2,5	0	0
10	NRTR	8	(10)		Y	F/Deck	2,7	0	0
6	Total Est	7	(9)	8.	X_1	NOPRT	2,5	0	0
	T4 STDE	not shown			X_2	NP	2,6	0	0
11'	Max RBI	not shown			Y	F/Deck	2,7	0	0
11	RT1	9	(11)	9.		ISTOCK T10,T11'	7	0	5 = 1
12	RB1	9	(12)		Y	ISTOCK	7	0	5 = 2
10	NRTR	8	(10)	10.	X_1	NOPRT	2,5	0	0
11	RT1	9	(11)		X_2	NOPRT	2,5	0	0
13	RT2	10	(13)		Y	F/Deck	2,7	0	0
14	RB2	10	(14)	11.		ISTOCK T13	7	0	6
15	Adj	12	(15)	12.		ISTOCK T10*	7	0	2,7
10	NRTR	8	(10)	13.	X_1	NOPRT	2,5	0	0
15	Adj	12	(15)		X_2	NOPRT	2,5	0	0
16	AT	13	(16)		Y	F/Deck	2,7	0	0
17	AT1	14	(17)	14.		ISTOCK T16,T11'	7	0	5 = 1
18	AB1	14	(18)		Y	ISTOCK	7	0	5 = 2
16	AT	13	(16)	15.	X_1	NOPRT	2,5	0	0
17	AT1	14	(17)		X_2	NOPRT	2,5	0	0
19	AT2	15	(19)		Y	F/Deck	2,7	0	0
20	AB2	15	(20)	16.		ISTOCK T19	7	0	6

* 2 decks + 1 blank card for this special imports adjustment run

Table		Methodology		Computer Run		Control Cards by Step in MPJ*		
No.	Contents	Step	Function	No.	Type	Step 4	Step 4B	Step 5
12'	RC1	17	(12')	17.	T12/Deck	1,7,8	0	9
21	FC1	17	(21)		CONST/F/Deck			
22	VC1	18	(22)	18.	T12/NOPRT	1,8	0	0
					CONST/F/Deck			
21	FC1	17	(21)	19. X_1	NOPRT	2,5	0	0
22	VC1	18	(22)	X_2	NOPRT	2,5	0	0
23	TC1	19	(23)	Y	F/Deck	2,7	0	0
14'	RC2	20	(14')	20.	T14/Deck	1,7,8	0	9
24	FC2		(24)		CONST/F/Deck			
25	VC2	20	(25)	21.	T14/NONEG	1,8	0	11
					CONST/F/Deck			
24	FC2	20	(24)	22. X_1	NOPRT	2,5	0	0
25	VC2		(25)	X_2	NOPRT	2,5	0	0
26	TC2		(26)	Y	F/Deck	2,7	0	0
23	TC1	19	(23)	23. X_1	NOPRT	2,5	0	0
26	TC2	20	(26)	X_2	NOPRT	2,5	0	0
27	CTC	21	(27)	Y	F/Deck	2,7	0	0
27	CTC_a	21	(27)	24. X_1	NOPRT	2,5	0	0
27	CTC_r	21	(27)	X_2	NOPRT	2,5	0	0
28	ATC	22	(28)	Y	F/Deck	2,7	0	0
27	CTC	21	(27)	25. X_1	NOPRT	2,5	0	0
37	CTCA	26	(37)	X_2	NOPRT	2,5	0	0
29	STC	22	(29)	Y	F/Deck	2,7	0	0
15	ADJ	12	(15)	26.	T15/NONEG	1,8	0	11
30	CAT	23	(30)		CONST/F/Deck			
18'	RCA1	24	(18')	27.	T18/Deck	1,7,8	0	9
31	FCA1	24	(31)		CONST/F/Deck			
32	VCA1	24	(32)	28.	T18/NOPRT	1,8	0	0
					CONST/F/Deck			
31	FCA1	24	(31)	29. X_1	NOPRT	2,5	0	0
32	VCA1		(32)	X_2	NOPRT	2,5	0	0
33	TCA1		(33)	Y	F/Deck	2,7	0	0

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Table		Methodology		Computer Run		Control Cards by Step in MPJ*		
No.	Contents	Step	Function	No.	Type	Step 4	Step 4B	Step 5
20'	RCA2	25	(20')	30.	T20/Deck	1,7,8	0	9
34	FCA2	25	(34)		CONST/F/Deck			
35	VCA2	25	(35)	31.	T20/NONEG	1,8	0	11
					CONST/F/Deck			
34	FCA2	25	(34)	32. X_1	NOPRT	2,5	0	0
35	VCA2		(35)	X_2	NOPRT	2,5	0	0
36	TCA2		(36)	Y	F/Deck	2,7	0	0
30	CAT	23	(30)	33. X_1	NOPRT	2,5	0	0
33	TCA1	24	(33)	X_2	NOPRT	2,5	0	0
36	TCA2	25	(36)	X_3	NOPRT	2,5	0	0
37	CTCA	26	(37)	Y	F/Deck	2,7	0	0
37	$CTCA_a$	26	(37)	34. X_1	NOPRT	2,5	0	0
37	$CTCA_r$	26	(37)	X_2	NOPRT	2,5	0	0
38	ATCA	27	(38)	Y	F/Deck	2,7	0	0

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ANNEX II

Annual Supply and Utilization of Rice, Wheat, and Corn by Nation, 1960-1977

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ANNEX II

Annual Supply and Utilization of Rice, Wheat and Corn by Nation, 1960-1977

Statistics compiled and published by the U.S. Department of Agriculture, Foreign Agricultural Service were used to develop balance sheets of total annual supply and utilization of food grains. The statistics are compiled by crop year, drawing on reports by each country. The source data are reconciled so that major discrepancies have been removed. Imports of wheat flour and other processed products are converted to whole grain equivalents. The reported figures for production, imports, stocks, and consumption for each country by grain cover the same calendar period. The crop-year calendar periods vary somewhat between countries, and between grains within countries, as indicated by the footnotes to the accompanying Tables 1.

For purposes of this analysis, all reported figures were converted to milled rice equivalent for comparability. The conversion rates from whole grains reflect the prevailing milling rates and end product utilization. As percentages of the whole grain tonnages the conversion rates to milled rice equivalent are as follows:

Country	Whole Grain		
	Rice	Wheat	Corn
Indonesia	68.00	75.62	61.04
Malaysia	65.00	75.62	61.04
Philippines	65.00	75.62	61.04
Singapore	65.00	75.62	61.04
Thailand	66.00	75.62	61.04

The same format is used in all supply and utilization balance sheets for each ASEAN country. It is illustrated by reference to the accompanying

Table 1 for Indonesia, Rice. The period and year are listed in the first two columns. The calendar year shown represents that in which the crop year begins, e.g. the 1960-61 crop year is shown as 1960. Gross domestic production is listed in column (1) and net imports in column (2). The change in ending stocks for the crop year is given in column (3). The total supply listed in column (4) is computed as total production + net imports - change in ending stocks.

The seed and loss figures reported in column (5) of Table 1 are computed at 10 percent of gross production. Food use listed in column (6) is reported total consumption minus column (5). The balance shown in column (7) is computed as total supply in column (4) minus seed and loss in column (5) minus food use in column (6). The figures in the balance column are usually zero for rice and wheat, the end products of which are used only for human food. The corn figures in this column represent utilization for poultry and livestock feeds and other non-food uses. The reader is reminded that all Table 1 figures, including those in column (7), are given in milled rice equivalent.

Indonesia

As is true of all ASEAN nations, rice is the dominant food grain in Indonesia. Rice represents about 87 percent of total food grain consumption, compared to about 3 percent for wheat and 10 percent for corn. The relative importance of wheat is increasing, but that of corn is decreasing, so that the dominance of rice in Indonesia diets is being maintained.

Even though domestic production continues to increase, Indonesia is still dependent on rice imports (Table 1, Indonesia, Rice). Since 1960, gross domestic production has increased by an average of 412,420 MT per year, and net imports by 43,790 MT per year. Rice imports continue to represent

about 8 percent of total food grain needs. Indonesia's total food need for rice is increasing at an average rate of 428,920 MT per year, and at this rate will reach 17 million MT by the 1980 crop year. About 1.45 million MT of the 1980 requirement will need to be imported.

Indonesia produces no milling wheat, but is becoming an increasingly important customer in world trade (Table 1, Indonesia, Wheat). In milled rice equivalent, net wheat imports are increasing at the average rate of 46,700 MT per year, and at this rate will reach 908,000 MT in 1980. This corresponds to 1,201,000 MT of wheat (908,000 + 0.7562. All of the wheat flour milled in Indonesia is used for human food.

Indonesia has been a relatively important corn producer, but the trends in both production and total utilization have been relatively flat (Table 1, Indonesia, Corn). Except in isolated years, net imports have not been significant. Human consumption has declined at an average annual rate of 4,820 MT per year, resulting in projected total consumption for the 1980 crop year of 1,394,000 MT. In contrast, utilization of corn for poultry and livestock feeding has increased at an average annual rate of 4,050 MT, indicating 1980 non-food utilization of 116,000 MT (milled rice equivalent) or 190,000 MT (corn equivalent).

Summation of Tables 1 for the individual food grains yields the combined food grain supply and utilizatin situation for Indonesia shown by Table 1, All Food Grains. In milled rice equivalent, gross domestic production is increasing at an average annual rate of 413,430 MT, but food consumption at the rate of 471,170 MT and non-food use at the rate of 4,050 MT. The discrepancy plus the requirements for seed and losses means an annual average increase in Indonesia's imports of 91,820 MT, and projected total imports for 1980 in milled rice equivalent of about 2.4 million MT.

TABLE 1
INDONESIA, RICE

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	10168	894	145	10917	1017	9900	0	10917
2	1961	9585	1054	165	10484	959	9525	0	10484
3	1962	10285	1325	-150	11460	1029	10431	0	11460
4	1963	9158	1043	35	10166	916	9250	0	10166
5	1964	9611	1010	35	10586	961	9625	0	10586
6	1965	10243	203	-55	10501	1024	9477	0	10501
7	1966	10752	309	140	10921	1075	9846	0	10921
8	1967	10402	354	-56	10811	1040	9771	0	10811
9	1968	11666	628	300	11994	1167	10827	0	11994
10	1969	12249	806	-75	13130	1225	11905	0	13130
11	1970	13140	773	230	13683	1314	12369	0	13683
12	1971	13724	524	30	14218	1372	12846	0	14218
13	1972	13183	1234	-225	14642	1318	13324	0	14642
14	1973	14607	1225	325	15507	1461	14046	0	15507
15	1974	15276	1148	365	16059	1528	14531	0	16059
16	1975	15185	670	-830	16665	1519	15166	0	16665
17	1976	15845	1526	-105	17476	1585	15891	0	17476
18	1977	15200	2500	-135	17885	1520	16365	0	17365
	YBAR	12237.72	940.89	4.94	13173.61	1223.89	11949.72	0.10	13173.61
	B	412.42	43.79	-13.95	470.16	41.24	428.92	0.00	470.16
	RSQ	0.9092	0.1976	0.0741	0.8867	0.9088	0.8832	0.0000	0.8867
	SYX	717.07	485.60	271.26	915.42	71.88	858.44	0.00	915.42
	SB	32.58	22.06	12.32	41.59	3.27	39.00	0.00	41.59

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MARCH 1978.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 68%. CROP YEAR APR-MAR.

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TABLE 1
INDONESIA, WHEAT

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	0	122	0	122	0	122	0	122
2	1961	0	113	0	113	0	113	0	113
3	1962	0	18	0	18	0	18	0	18
4	1963	0	76	0	76	0	76	0	76
5	1964	0	15	0	15	0	15	0	15
6	1965	0	15	0	15	0	15	0	15
7	1966	0	30	0	30	0	30	0	30
8	1967	0	129	0	129	0	144	0	129
9	1968	0	253	42	211	0	211	0	211
10	1969	0	518	90	428	0	428	0	428
11	1970	0	344	44	300	0	300	0	300
12	1971	0	368	-153	521	0	521	0	521
13	1972	0	538	30	541	0	541	0	541
14	1973	0	585	61	524	0	524	0	524
15	1974	0	582	-31	613	0	613	0	613
16	1975	0	631	8	623	0	623	0	623
17	1976	0	747	44	703	0	703	0	703
18	1977	0	758	-45	803	0	803	0	803
YBAR		0.10	324.56	5.04	321.39	0.10	322.22	0.10	321.39
B		0.00	46.70	-0.16	47.11	0.00	47.06	0.00	47.11
RSQ		0.0000	0.8500	0.0004	0.8589	0.0000	0.8610	0.0000	0.8589
SYX		0.00	107.96	52.64	105.08	0.00	104.05	0.00	105.08
SB		0.00	4.93	2.39	4.77	0.00	4.73	0.00	4.77

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1978 (1960-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 75.62%

TABLE 1
INDONESIA, CORN

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	1502	0	0	1502	150	1352	0	1502
2	1961	1394	0	0	1394	139	1255	0	1394
3	1962	1980	0	0	1980	198	1782	0	1980
4	1963	1439	7	0	1446	144	1302	0	1446
5	1964	2301	2	0	2303	230	2073	0	2303
6	1965	1444	3	0	1447	144	1276	27	1447
7	1966	2269	3	0	2272	227	1971	74	2272
8	1967	1446	2	0	1448	145	1235	68	1446
9	1968	1933	0	0	1933	193	1672	68	1933
10	1969	1401	0	111	1511	140	1025	346	1511
11	1970	1724	0	23	1701	172	1379	150	1701
12	1971	1591	1	4	1588	159	1334	95	1588
13	1972	1231	48	-135	1414	123	1249	42	1414
14	1973	1777	43	199	1621	178	1312	131	1621
15	1974	1838	0	286	1552	184	1228	140	1552
16	1975	1772	0	92	1680	177	1472	31	1680
17	1976	1572	42	-54	1668	157	1506	5	1668
18	1977	1850	4	-86	1940	185	1755	0	1940
	YBAR	1692.39	8.66	24.49	1688.89	169.17	1454.33	65.42	1688.89
	B	1.01	1.33	3.21	-0.65	0.11	-4.82	4.05	-0.65
	RSQ	0.0003	0.1834	0.0311	0.0002	0.0004	0.0082	0.0616	0.0002
	SYX	310.10	15.42	98.58	291.88	31.04	291.33	87.04	291.88
	SB	14.09	0.70	4.48	13.26	1.41	13.24	3.95	13.26

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 61.04%.

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TABLE 1
INDONESIA, ALL FOOD GRAINS

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	11670	1016	145	12541	1167	11374	0	12541
2	1961	10979	1177	165	11991	1098	10893	0	11991
3	1962	12265	1043	-150	13458	1227	12231	0	13458
4	1963	10597	1126	35	11688	1060	10628	0	11688
5	1964	11912	1027	35	12904	1191	11713	0	12904
6	1965	11667	221	-55	11963	1168	10768	27	11963
7	1966	13021	342	140	13223	1302	11847	74	13223
8	1967	11848	485	-56	12388	1185	11150	68	12388
9	1968	13599	881	342	14138	1360	12710	68	14138
10	1969	13649	1324	126	15069	1365	13358	346	15069
11	1970	14864	1117	297	15684	1486	14048	150	15684
12	1971	15315	893	-119	16327	1531	14701	55	16327
13	1972	14414	1820	-330	16597	1441	15114	42	16597
14	1973	15384	1853	585	17652	1639	15882	131	17652
15	1974	17114	1730	620	18224	1712	16372	140	18224
16	1975	16957	1301	-730	18988	1696	17261	31	18988
17	1976	17417	2315	-115	19847	1742	18100	5	19847
18	1977	17050	3262	-316	20628	1705	18923	0	20628
	YBAR	13930.11	1274.06	34.39	15183.89	1393.06	13726.28	65.42	15183.89
	B	413.43	91.82	-10.91	516.62	41.35	471.17	4.05	516.62
	RSQ	0.3963	0.4530	0.0321	0.8390	0.3961	0.8759	0.0616	0.8890
	SYX	773.69	555.22	329.46	1004.64	77.50	975.78	87.04	1004.64
	SB	35.15	25.22	14.97	45.64	3.52	44.33	3.95	45.64

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6.

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Malaysia

Malaysian consumers depend upon rice for about three-fourths of their total food grain requirements. Based on the 18-year means from column (6) of Tables 1 for Malaysia, rice has represented 77 percent of total food grain consumption, compared to 19 percent for wheat and 4 percent for corn. The current portions are 75 percent rice products, 19 percent wheat products, and 6 percent corn proudcts.

In contrast to Indonesia, Malaysia's long term trend in domestic production of rice has been increasing more rapidly than consumption, providing a gradual downward trend in net imports (Table 1, Malaysia, Rice). Gross production has increased at an annual average rate of 42,440 MT, while net imports have decreased at the average rate of 14,780 MT per year. At the historical average rates, the 1980 food consumption requirement of 1,324,000 MT can be met by net imports on only 74,000 MT, milled rice equivalent.

As with the other ASEAN countries, Malaysia produces no milling wheat, but has been steadily increasing net imports (Table 1, Malaysia, Wheat). At the 18-year average rate of increase of 6,360 MT, Malaysia's imports for the 1980 crop year will reach 328,000 MT (milled rice equivalent) or 433,000 MT (wheat equivalent).

Malaysia also depends exclusively on imports for meeting her requirements for corn (Table 1, Malaysia, Corn). Imports have increased at an annual average rate of 7,410 MT, serving average annual increases for food use of 7,570 MT. At this rate, total corn import requirements for 1980 will reach 193,000 MT (milled rice equivalent) or 316,000 MT (corn equivalent).

Malaysia's total grain requirement for food use is increasing at an average annual rate of 37,930 MT, indicating a projected requirement by 1980 of 1,834,000 MT (Table 1, Malaysia, All Food Grains). This projected requirement together with that of 27,000 MT for non-food uses will necessitate total net imports in 1980 of 594,315 MT (milled rice equivalent). The combined food grain imports show virtually no trend, the downward trend in rice imports being offset by upward trends in wheat and corn imports.

TABLE 1
MALAYSIA. RICE

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET. 1960-1977

(1000 METRIC TONS. MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	501	380	0	881	50	814	17	881
2	1961	548	341	25	864	55	789	20	864
3	1962	615	317	-51	982	62	898	22	982
4	1963	658	399	116	941	66	865	10	941
5	1964	601	414	11	1004	60	937	7	1004
6	1965	688	305	-102	1095	69	992	34	1095
7	1966	677	253	-152	1082	68	982	32	1082
8	1967	669	291	0	960	67	863	10	960
9	1968	792	247	50	989	79	908	2	989
10	1969	880	245	51	1074	88	980	6	1074
11	1970	929	306	102	1133	93	1035	5	1133
12	1971	1004	164	-51	1219	100	1116	3	1219
13	1972	1017	128	-152	1297	102	1172	23	1297
14	1973	1124	185	0	1309	112	1172	25	1309
15	1974	1183	234	20	1397	118	1265	14	1397
16	1975	1116	85	-92	1293	112	1156	25	1293
17	1976	1136	131	20	1247	114	1118	15	1247
18	1977	1119	225	9	1335	112	1203	20	1335
	YBAR	847.61	258.33	-10.87	1116.78	84.83	1015.83	16.11	1116.78
	B	42.44	-14.78	-1.19	28.06	4.24	24.64	-0.01	28.86
	RSQ	0.9395	0.6861	0.0069	0.8410	0.9411	0.8316	0.0000	0.8410
	SYX	59.25	55.00	78.29	69.07	5.34	61.02	10.01	69.07
	SB	2.69	2.50	3.56	3.14	0.27	2.77	0.45	3.14

SOURCE:
PRODUCTION. IMPORTS. STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR. USDA. MARCH 1978.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 654. CROP YEAR JAN-DEC.

TABLE 1
MALAYSIA. WHEAT

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET. 1960-1977

(1000 METRIC TONS. MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	0	219	1	218	0	212	6	218
2	1961	0	209	1	208	0	200	8	208
3	1962	0	218	1	217	0	206	11	217
4	1963	0	240	1	239	0	239	0	239
5	1964	0	188	0	188	0	188	0	188
6	1965	0	186	21	165	0	165	0	165
7	1966	0	249	6	243	0	242	1	243
8	1967	0	240	-16	256	0	256	0	256
9	1968	0	203	0	203	0	203	0	208
10	1969	0	273	-5	278	0	278	0	278
11	1970	0	232	1	231	0	231	0	231
12	1971	0	250	3	247	0	240	7	247
13	1972	0	264	3	281	0	281	0	281
14	1973	0	293	7	286	0	280	6	286
15	1974	0	278	-2	280	0	272	8	280
16	1975	0	254	-22	276	0	265	11	276
17	1976	0	324	19	305	0	287	18	305
18	1977	0	329	8	321	0	299	22	321
YBAR		0.10	248.28	1.51	246.78	0.10	241.33	5.49	247.06
R		0.00	6.36	0.02	6.33	0.00	5.72	0.61	6.33
RSQ		0.0000	0.6460	0.0002	0.6431	0.0000	0.6192	0.2386	0.6510
SYX		0.00	25.91	10.31	25.97	0.00	24.69	6.00	25.50
SB		0.00	1.18	0.47	1.18	0.00	1.12	0.27	1.16

SOURCE:
PRODUCTION. IMPORTS. STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR. USDA. MAY 1976 (1960-72). NOV 1978 (1973-77).
(5) AT 10% OF COL. 1: (6) REPORTED CONSUMPTION LESS COL. 5: (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 75.62%. CROP YEAR JULY-JUNE.

TABLE 1
MALAYSIA. CORN

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	4	79	0	83	0	78	5	83
2	1961	4	106	0	110	0	103	7	110
3	1962	5	101	2	104	0	99	5	104
4	1963	5	58	0	63	0	63	0	63
5	1964	5	27	1	31	0	31	0	31
6	1965	5	32	-1	38	0	37	1	38
7	1966	4	39	0	43	0	43	0	43
8	1967	5	42	0	47	0	47	0	47
9	1968	5	63	1	67	0	67	0	67
10	1969	5	76	0	81	0	81	0	81
11	1970	4	103	6	101	0	101	0	101
12	1971	3	120	-1	124	0	124	0	124
13	1972	2	143	0	145	0	145	0	145
14	1973	2	129	-1	132	0	132	0	132
15	1974	3	133	0	136	0	136	0	136
16	1975	16	195	18	193	2	191	0	193
17	1976	4	177	0	181	0	180	1	181
18	1977	4	183	-5	192	0	192	0	192
	YBAR	4.72	100.33	1.16	103.94	0.21	102.78	1.13	103.94
	B	0.07	7.41	0.13	7.34	0.03	7.57	-0.25	7.34
	RSQ	0.0144	0.5623	0.0209	0.5657	0.0923	0.6036	0.3904	0.5657
	SYX	3.06	35.95	4.76	35.41	0.44	33.77	1.73	35.41
	SB	0.14	1.63	0.22	1.61	0.02	1.53	0.08	1.61

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1976 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 61.044. CROP YEAR JULY-JUNE.

TABLE 1
MALAYSIA. ALL FOOD GRAINS

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET. 1960-1977

(1000 METRIC TONS. MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	505	678	1	1182	50	1104	28	1182
2	1961	552	656	26	1182	55	1092	35	1182
3	1962	620	636	-48	1303	62	1203	38	1303
4	1963	663	697	117	1243	66	1167	10	1243
5	1964	606	629	12	1223	60	1156	7	1223
6	1965	693	523	-82	1298	69	1194	35	1298
7	1966	681	541	-146	1368	68	1267	33	1368
8	1967	674	573	-16	1263	67	1186	10	1263
9	1968	797	513	51	1259	79	1178	2	1264
10	1969	885	534	46	1433	88	1339	6	1433
11	1970	933	641	109	1465	93	1367	5	1465
12	1971	1007	534	-49	1590	100	1480	10	1590
13	1972	1019	555	-149	1723	102	1598	23	1723
14	1973	1126	607	6	1727	112	1584	31	1727
15	1974	1186	645	16	1813	118	1673	22	1813
16	1975	1132	534	-96	1762	114	1612	36	1762
17	1976	1140	632	39	1733	114	1585	34	1733
18	1977	1123	737	12	1848	112	1694	42	1848
	YBAR	852.33	606.94	-8.28	1467.50	84.94	1359.94	22.61	1467.78
	B	42.51	-1.01	-1.03	42.54	4.27	37.93	0.35	42.54
	RSC	0.9407	0.0069	0.0053	0.8819	0.9416	0.8871	0.0183	0.8835
	SYX	58.72	66.82	77.38	85.67	5.85	74.46	13.94	85.00
	SB	2.67	3.04	3.52	3.89	0.27	3.38	0.63	3.86

SOURCE:
PRODUCTION. IMPORTS. STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR. USDA.
(5) AT 10% OF COL. 1: (6) REPORTED CONSUMPTION LESS COL. 5: (7) COL. 4 LESS COLS. 5 AND 6.

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Philippines

Rice provides more than 70 percent of total food grain requirements in the Philippines. Based on the 18-year means from column (6) of Tables 1, Philippines, rice represented 73 percent, wheat 10 percent, and corn 17 percent of total food grain requirements. If past trends continue, the 1980 food grain requirements will include rice, 70 percent; wheat 10 percent; and corn 20 percent.

The Philippines has achieved self-sufficiency in rice production (Table 1, Philippines, Rice). Gross production has increased at the average annual rate of 100,930 MT while food consumption has increased at the average annual rate of only 80,420 MT. Year-to-year net imports have fluctuated widely, but show an annual average decrease of 3,610 MT (milled rice equivalent). Philippines rice consumption is projected to reach 3,929,000 MT for the 1980 crop year.

The Philippines produces no milling wheat, and has increased net imports at an annual average rate of 12,350 MT in order to meet growing domestic requirements (Table 1, Philippines, Wheat). At this growth rate, the 1980 import requirement will be 572,000 MT (milled rice equivalent), or 756,000 MT (wheat equivalent).

Continued increases in domestic corn production in the Philippines have more than offset the growing requirements for food use, but not the steady increase in total domestic requirement including non-food uses (Table 1, Philippines, Corn). Net production (after seed and loss) has increased at the average annual rate of 57,250 MT, food consumption at the rate of 61,220 MT and non-food utilization at the rate of 3,950 MT. Imports

have increased at the annual average rate of 5,620 MT, and for 1980 are projected to reach 100,000 MT (milled rice equivalent) or 165,000 MT (corn equivalent).

The Philippines' food use of all food grains in milled rice equivalent is projected to reach 6,279,000 MT by 1980 (Table 1, Philippines, All Food Grains). This projected requirement together with that of 76,000 MT for non-food use will require 1980 imports of 807,000 MT in addition to the projected gross production of 6,320,000 MT (in milled rice equivalent).

TABLE 1
PHILIPPINES, RICE

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	2408	9	-98	2515	241	2274	0	2515
2	1961	2542	186	140	2868	254	2334	0	2588
3	1962	2579	40	-71	2690	258	2432	0	2690
4	1963	2498	273	58	2713	250	2463	0	2713
5	1964	2595	513	305	2803	260	2543	0	2803
6	1965	2647	299	53	2893	265	2628	0	2893
7	1966	2661	214	222	2653	266	2367	20	2653
8	1967	2964	182	-82	3228	296	2811	121	3228
9	1968	2889	0	-348	3237	289	2921	27	3237
10	1969	3401	0	68	3333	340	2993	0	3333
11	1970	3472	20	-42	3534	347	3187	0	3534
12	1971	3310	601	211	3700	331	3369	0	3700
13	1972	2865	294	-471	3630	287	3343	0	3630
14	1973	3630	316	286	3662	363	3299	0	3662
15	1974	3673	209	278	3604	367	3237	0	3604
16	1975	3757	62	79	3760	358	3402	0	3760
17	1976	3938	29	97	3870	394	3476	0	3870
18	1977	4320	-79	311	3980	432	3548	0	3980
	YBAR	3119.39	180.01	55.33	3244.06	311.00	2923.72	9.42	3244.06
	B	100.93	-3.61	7.55	89.77	9.85	80.42	-0.50	89.77
	RSQ	0.8670	0.0113	0.0346	0.9360	0.8573	0.9245	0.0087	0.9360
	SYX	217.54	186.07	219.66	129.12	22.11	126.46	29.65	129.12
	SB	9.88	8.45	9.98	5.87	1.00	5.75	1.35	5.87

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MARCH 1978. CROP YEAR JULY-JUNE.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 65% (1960-73) AND 61% (1974-

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TABLE 1
PHILIPPINES. WHEAT

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	0	304	7	297	0	297	0	297
2	1961	0	298	17	281	0	281	0	281
3	1962	0	297	2	295	0	295	0	295
4	1963	0	386	23	363	0	363	0	363
5	1964	0	346	-18	364	0	364	0	364
6	1965	0	380	11	369	0	369	0	369
7	1966	0	374	-51	425	0	425	0	425
8	1967	0	494	10	484	0	484	0	484
9	1968	0	444	-3	447	0	448	0	448
10	1969	0	423	11	412	0	412	0	412
11	1970	0	430	-3	433	0	433	0	433
12	1971	0	521	30	491	0	491	0	491
13	1972	0	464	-13	477	0	477	0	477
14	1973	0	396	-30	426	0	426	0	426
15	1974	0	380	-3	383	0	383	0	383
16	1975	0	416	12	404	0	404	0	404
17	1976	0	586	75	511	0	511	0	511
18	1977	0	575	8	567	0	567	0	567
YBAR		0.10	417.44	4.72	412.72	0.10	412.78	0.10	412.78
B		0.00	12.35	0.86	11.49	0.00	11.49	0.00	11.49
RSO		0.0000	0.5876	0.0311	0.6207	0.0000	0.6202	0.0000	0.6202
SYX		0.00	56.93	26.45	49.42	0.00	49.47	0.00	49.47
SB		0.00	2.59	1.20	2.25	0.00	2.25	0.00	2.25

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1976 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 75.62%. CROP YEAR JULY-JUNE.

TABLE 1
PHILIPPINES. CORN

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	739	0	4	735	74	661	0	735
2	1961	773	0	30	743	77	666	0	743
3	1962	777	1	-1	779	78	700	1	779
4	1963	789	0	-3	792	79	713	0	792
5	1964	803	1	6	798	80	717	1	798
6	1965	842	2	23	821	84	737	0	821
7	1966	909	27	82	858	91	767	0	858
8	1967	988	4	60	932	99	807	26	932
9	1968	1058	0	12	1046	106	926	14	1046
10	1969	1226	15	73	1168	123	1030	15	1168
11	1970	1224	15	-9	1248	122	1110	16	1248
12	1971	1229	45	11	1263	123	1139	1	1263
13	1972	1118	71	-102	1291	112	1179	0	1291
14	1973	1397	55	36	1416	140	1276	0	1416
15	1974	1568	97	-231	1696	157	1387	352	1396
16	1975	1689	33	211	1511	169	1342	0	1511
17	1976	1735	98	20	1813	174	1639	0	1813
18	1977	1742	82	-68	1892	174	1718	0	1892
	YBAR	1144.78	30.36	8.56	1166.78	114.56	1028.56	23.72	1166.78
	B	63.63	5.62	-2.30	71.54	6.38	61.22	3.95	71.54
	RSQ	0.9229	0.7117	0.0197	0.8970	0.9229	0.9257	0.0656	0.8970
	SYX	101.17	19.70	89.52	133.41	10.14	95.44	82.00	133.41
	SB	4.60	0.89	4.07	6.06	0.46	4.34	3.73	6.06

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 61.04%. CROP YEAR JULY-JUNE.

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TABLE 1
PHILIPPINES, ALL FOOD GRAINS

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	3147	313	-87	3547	315	3232	0	3547
2	1961	3315	484	187	3612	331	3281	0	3612
3	1962	3356	338	-70	3764	336	3427	1	3764
4	1963	3287	659	78	3868	329	3539	0	3868
5	1964	3398	863	293	3965	340	3624	1	3965
6	1965	3489	681	67	4083	349	3734	0	4083
7	1966	3570	615	253	3936	357	3559	20	3936
8	1967	3952	680	-12	4644	395	4102	147	4644
9	1968	3947	444	-339	4730	395	4295	41	4731
10	1969	4627	438	152	4913	463	4435	15	4913
11	1970	4696	465	-54	5215	469	4730	16	5215
12	1971	4539	1167	252	5454	454	4999	1	5454
13	1972	3983	829	-586	5398	399	4999	0	5398
14	1973	5027	769	292	5504	503	5001	0	5504
15	1974	5241	686	44	5683	524	5007	352	5683
16	1975	5446	531	302	5675	527	5148	0	5675
17	1976	5673	713	192	6194	568	5626	0	6194
18	1977	6062	628	251	6439	606	5833	0	6439
	YBAR	4264.16	627.78	68.61	4823.55	425.56	4365.05	33.05	4823.61
	B	164.57	14.37	6.11	172.80	16.22	153.13	3.44	172.80
	RSQ	0.6998	0.1366	0.0190	0.9637	0.3989	0.9621	0.0447	0.9687
	SYX	302.18	196.72	241.66	170.80	29.94	167.20	67.56	170.79
	SB	13.73	9.03	10.98	7.76	1.36	7.60	3.56	7.76

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6.

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Singapore

Over the 18-year historical period, Singapore has shifted food grain consumption patterns more than the other countries of ASEAN. Based on 18-year averages, the total food grain requirement included rice 67 percent, wheat 31 percent, and corn 2 percent. The 1980 projections indicate the total requirement of 324,000 MT (milled rice equivalent) will include rice 58 percent, wheat 38 percent, and corn 4 percent. Singapore's total food grain requirement is met by net imports.

Rice consumption in Singapore has shown a slight downward trend of about 400 MT per year, indicating projected total consumption of 186,000 MT for 1980 (Table 1, Singapore, Rice). Rice imports show a downward trend averaging 11,640 MT per year, and rice exports a downward trend of 10,380 MT per year. Ignoring changes in ending stocks, net imports for 1980 will need to be 186,000 MT (milled rice equivalent) or 286,000 MT (rough rice equivalent).

In contrast to the rice situation, Singapore's food utilization, imports, and exports of wheat all show upward trends (Table 1, Singapore, Wheat). Total utilization, and therefore net imports, is increasing at the average rate of 3,600 MT per year. Projections at this rate indicate 1980 net imports of 138,000 MT (milled rice equivalent) or 182,000 MT (wheat equivalent).

Singapore's net corn imports have been increasing significantly, especially since 1970 (Table 1, Singapore, Corn). Most of the increase is needed to serve the growing non-food demand. Projected utilization for 1980 includes 14,000 MT for food use and 239,000 MT for non-food uses. The

indicated total 1980 net import requirement is 253,000 MT (milled rice equivalent), or 415,000 MT (corn equivalent).

In milled rice equivalent, Singapore's total food requirement for grain is increasing at the annual average rate of 3,910 MT, indicating a total requirement of 338,000 MT for the 1980 crop year (Table 1, Singapore, All Food Grains). This total requirement plus that of 239,000 MT for non-food uses will need to be met by imports.

TABLE 1
SINGAPORE, RICE

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) IMPORTS	(2) EXPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	335	143	0	192	0	192	0	192
2	1961	350	188	-30	192	0	192	0	192
3	1962	440	223	55	162	0	162	0	162
4	1963	270	109	-56	217	0	217	0	217
5	1964	291	99	31	161	0	161	0	161
6	1965	262	107	-37	192	0	192	0	192
7	1966	256	79	22	155	0	155	0	155
8	1967	286	73	36	177	0	177	0	177
9	1968	237	48	-26	215	0	215	0	215
10	1969	294	47	58	189	0	189	0	189
11	1970	316	47	12	247	0	247	0	247
12	1971	358	71	28	259	0	259	0	259
13	1972	235	44	-96	287	0	287	0	287
14	1973	144	15	-62	191	0	191	0	191
15	1974	114	19	-34	129	0	129	0	129
16	1975	188	6	37	95	0	95	0	95
17	1976	200	10	8	182	0	182	0	182
18	1977	150	10	-50	190	0	190	0	190
	YBAR	262.11	74.33	-2.88	190.67	0.10	190.67	0.10	190.67
	B	-11.64	-10.38	-0.80	-0.40	0.00	-0.40	0.00	-0.40
	RSQ	0.5581	0.7996	0.0089	0.0022	0.0000	0.0022	0.0000	0.0022
	SYX	56.99	26.60	50.08	46.46	0.00	46.46	0.00	46.46
	SB	2.59	1.30	2.26	2.11	0.00	2.11	0.00	2.11

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MARCH 1978. CROP YEAR JAN-DEC.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 65%.

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TABLE 1
SINGAPORE, WHEAT

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) IMPORTS	(2) EXPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	81	51	0	30	0	30	0	30
2	1961	95	60	0	35	0	35	0	35
3	1962	118	48	0	70	0	70	0	70
4	1963	101	71	0	30	0	30	0	30
5	1964	167	77	0	90	0	90	0	90
6	1965	154	92	0	62	0	62	0	62
7	1966	175	64	0	111	0	111	0	111
8	1967	210	29	0	181	0	181	0	181
9	1968	157	29	0	128	0	128	0	128
10	1969	222	66	0	156	0	156	0	156
11	1970	206	79	0	127	0	127	0	127
12	1971	96	46	0	50	0	50	0	50
13	1972	158	73	0	85	0	85	0	85
14	1973	187	76	0	111	0	111	0	111
15	1974	143	76	0	67	0	67	0	67
16	1975	146	76	0	70	0	70	0	70
17	1976	228	76	0	152	0	152	0	152
18	1977	189	76	0	113	0	113	0	113
YBAR		157.50	64.83	0.10	92.67	0.10	92.67	0.10	92.67
B		4.63	1.08	0.00	3.60	0.00	3.60	0.00	3.60
RSQ		0.3038	0.1099	0.0000	0.1813	0.0000	0.1813	0.0000	0.1813
SYX		36.97	16.95	0.00	42.04	0.00	42.04	0.00	42.04
SB		1.77	0.77	0.00	1.91	0.00	1.91	0.00	1.91

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1964-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 75.624. CROP YEAR JULY-JUNE.

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TABLE 1
SINGAPORE. CORN

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET. 1960-1977

(1000 METRIC TONS. MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) IMPORTS	(2) EXPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	0	0	0	0	0	0	0	0
2	1961	0	0	0	0	0	0	0	0
3	1962	0	0	0	0	0	0	0	0
4	1963	0	0	0	0	0	0	0	0
5	1964	0	0	0	0	0	0	0	0
6	1965	8	0	0	8	0	8	0	8
7	1966	6	0	0	6	0	6	0	6
8	1967	2	0	0	2	0	2	0	2
9	1968	1	0	0	1	0	1	0	1
10	1969	6	0	0	6	0	6	0	6
11	1970	5	0	0	5	0	5	0	5
12	1971	10	0	0	10	0	10	0	10
13	1972	136	0	0	136	0	10	126	136
14	1973	148	0	0	148	0	9	139	148
15	1974	211	0	0	211	0	10	201	211
16	1975	220	0	0	220	0	10	210	220
17	1976	220	0	0	220	0	10	210	220
18	1977	220	0	0	220	0	10	210	220
	YBAR	66.31	0.10	0.10	66.31	0.10	5.42	60.96	66.31
	B	14.94	0.00	0.00	14.94	0.00	0.70	14.23	14.94
	RSQ	0.7149	0.0000	0.0000	0.7149	0.0000	0.7536	0.6955	0.7149
	SYX	51.91	0.00	0.00	51.91	0.00	2.22	51.80	51.91
	SB	2.36	0.00	0.00	2.36	0.00	0.10	2.35	2.36

SOURCE:
PRODUCTION. IMPORTS. STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR. USDA. MAY 1976 (1964-72). NOV 1976 (1973-77).
(5) AT 10% OF COL. 1: (6) REPORTED CONSUMPTION LESS COL. 5: (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 61.04%. CROP YEAR JULY-JUNE.

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TABLE 1
SINGAPORE, ALL FOOD GRAINS

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) IMPORTS	(2) EXPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	416	194	0	222	0	222	0	222
2	1961	445	246	-30	227	0	227	0	227
3	1962	558	271	55	232	0	232	0	232
4	1963	371	180	-56	247	0	247	0	247
5	1964	458	176	31	251	0	251	0	251
6	1965	424	199	-37	262	0	262	0	262
7	1966	437	143	22	272	0	272	0	272
8	1967	500	102	36	360	0	360	0	360
9	1968	395	77	-26	344	0	344	0	344
10	1969	522	113	58	351	0	351	0	351
11	1970	517	126	12	379	0	379	0	379
12	1971	466	119	28	319	0	319	0	319
13	1972	529	117	-96	508	0	382	126	508
14	1973	479	91	-62	450	0	311	139	450
15	1974	468	95	-34	407	0	206	201	407
16	1975	554	82	87	365	0	175	210	365
17	1976	646	88	8	554	0	344	210	554
18	1977	559	86	-50	523	0	313	210	523
	YBAR	485.89	139.17	-2.88	349.61	0.10	288.72	60.96	349.61
	B	7.99	-9.30	-0.86	18.15	0.00	3.91	14.23	18.15
	RSQ	0.3787	0.7093	0.0089	0.8283	0.0000	0.1068	0.0955	0.8283
	SYX	56.26	32.75	50.06	45.46	0.00	62.21	51.30	45.46
	SB	2.56	1.49	2.28	2.07	0.00	2.83	2.35	2.07

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6.

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Thailand

In contrast to other ASEAN nations, Thailand is a major exporter of both rice and corn, with annual exports in milled rice equivalent averaging more than 1.5 million MT of rice and 750,000 MT of corn.

Rice is more dominant in Thai diets than is true of any other ASEAN country. Based on the means from column (6) of Tables 1, food grain consumption included rice 98 percent, wheat 1 percent and corn 1 percent. Even with relative trends toward shifts against rice, the projected 1980 food grain consumption includes rice 97 percent, wheat 1 percent and corn 2 percent.

Production, domestic consumption and net exports of rice by Thailand all show significant long-term upward trends (Table 1, Thailand, Rice). Domestic consumption has increased at an average annual rate of 184,860 MT, indicating total consumption of 8,400,000 MT by the 1980 crop year. Production (in milled rice equivalent) has increased at the average rate of 201,400 MT per year, indicating a total of 10,938,000 MT for 1980. Net exports have increased an average of 11,680 MT per year, indicating exports of 1,647,000 by the 1980 crop year. However, Thai rice exports have exhibited considerable year-to-year variability.

Thailand does not produce milling wheat, and consumption of wheat products has remained at minimal levels (Table 1, Thailand, Wheat). In milled rice equivalent, total food use of wheat has increased at the average annual rate of 3,870 MT, and is projected to reach 98,000 MT by 1980. In wheat equivalent, this will require 1980 imports of 129,000 MT.

As with Thai rice, domestic production, net exports and domestic consumption (both for food and for non-food uses) of Thai corn all show

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significant upward trends (Table 1, Thailand, Corn). In rice equivalent, Thailand's corn production has increased at an average annual rate of 81,390 MT and net exports at an average annual rate of 48,890 MT. Food consumption has increased at an average rate of 11,560 MT per year and non-food utilization at an average rate of 10,890 MT per year. The corresponding 1980 projections indicate production of 1,983,000 MT, exports of 1,365,000 MT, food use of 211,000 MT and non-food utilization of 193,000 MT. In corn equivalent, Thailand's projected net corn exports for 1980 are 2,236,000 MT.

The total food grain situation for Thailand is summarized in Table 1, Thailand, All Food Grains. Projected 1980 total domestic food consumption is 8,717,000 MT (milled rice equivalent). Projected production for the same year totals 12,921,000 MT, and projected net exports are 2,910,000 MT (in milled rice equivalent).

TABLE 1
THAILAND, RICE

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	6275	-1576	0	4699	624	4075	0	4695
2	1961	6330	-1271	0	5059	633	4426	0	5059
3	1962	7433	-1418	0	6015	743	5272	0	6015
4	1963	8033	-1896	0	6137	803	5334	0	6137
5	1964	7656	-1895	0	5761	767	4994	0	5761
6	1965	7368	-1508	0	5860	737	5123	0	5860
7	1966	8910	-1483	66	7361	891	6470	0	7361
8	1967	7391	-1066	343	5980	739	5241	0	5980
9	1968	8191	-1023	694	6474	819	5655	0	6474
10	1969	8851	-1064	-176	7963	885	7078	0	7963
11	1970	8956	-1576	-289	7669	896	6773	0	7669
12	1971	9071	-2112	-54	7013	907	6106	0	7013
13	1972	8065	-849	-459	7675	807	6868	0	7675
14	1973	9471	-1046	212	8213	947	7266	0	8213
15	1974	9570	-993	63	8514	957	7557	0	8514
16	1975	10032	-1870	-273	8435	1003	7432	0	8435
17	1976	10402	-2885	-486	8035	1040	6965	0	8035
18	1977	9570	-1500	0	8070	957	7113	0	8070
	YBAR	8420.83	-1501.83	-20.02	6939.05	841.94	6097.11	0.10	6939.05
	B	201.40	-11.68	-15.33	205.05	20.19	184.86	0.00	205.05
	RSQ	0.8043	0.0154	0.0885	0.8214	0.8046	0.8094	0.0000	0.8214
	SYX	546.61	514.70	270.68	526.11	54.76	493.64	0.00	526.11
	SB	24.83	23.38	12.30	23.90	2.49	22.43	0.00	23.90

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MARCH 1976.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 66%. CROP YEAR JAN-DEC.

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TABLE 1
THAILAND, WHEAT

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	0	24	0	24	0	24	0	24
2	1961	0	26	0	26	0	26	0	26
3	1962	0	24	0	24	0	24	0	24
4	1963	0	28	0	28	0	26	2	28
5	1964	0	29	0	29	0	28	1	29
6	1965	0	36	2	34	0	34	0	34
7	1966	0	45	4	41	0	41	0	41
8	1967	0	50	3	47	0	46	1	47
9	1968	0	48	0	48	0	48	0	48
10	1969	0	54	4	50	0	49	1	50
11	1970	0	50	-1	51	0	48	3	51
12	1971	0	60	1	59	0	59	0	59
13	1972	0	56	-7	63	0	63	0	63
14	1973	0	70	8	62	0	62	0	62
15	1974	0	51	-10	61	0	61	0	61
16	1975	0	72	8	64	0	64	0	64
17	1976	0	88	8	80	0	79	1	80
18	1977	0	113	4	109	0	109	0	109
YBAR		0.10	51.33	1.37	50.00	0.10	49.50	0.57	50.00
B		0.00	4.04	0.17	3.86	0.00	3.87	-0.01	3.86
RSQ		0.0000	0.8307	0.0363	0.8709	0.0000	0.8665	0.0034	0.8709
SYX		0.00	10.32	4.72	8.18	0.00	8.36	0.84	8.18
SB		0.00	0.46	0.21	0.37	0.00	0.38	0.04	0.37

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 75.62%. CROP YEAR JULY-JUNE.

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TABLE 1
THAILAND, CORN

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	332	-285	9	38	33	5	0	38
2	1961	365	-323	-4	44	37	7	0	44
3	1962	406	-396	-44	54	41	7	6	54
4	1963	524	-507	-51	68	52	9	7	68
5	1964	570	-492	8	70	57	9	4	70
6	1965	623	-622	-35	66	62	12	12	66
7	1966	685	-648	-57	94	69	12	13	94
8	1967	803	-667	28	108	80	18	10	108
9	1968	920	-708	69	143	92	36	15	143
10	1969	1038	-825	12	201	104	57	40	201
11	1970	1183	-914	34	235	118	70	47	235
12	1971	1404	-1159	-56	301	140	89	72	301
13	1972	806	-570	-12	248	81	98	69	248
14	1973	1434	-1170	-74	338	143	110	85	338
15	1974	1495	-1079	12	435	150	122	133	405
16	1975	1863	-1313	66	484	186	128	170	484
17	1976	1679	-1208	-56	529	168	259	142	529
18	1977	1751	-681	-10	476	125	154	197	476
	YBAR	965.61	-753.72	-11.83	217.89	96.56	66.76	55.79	217.89
	B	81.39	-48.69	0.75	29.97	8.13	11.56	10.09	29.97
	RSQ	0.8408	0.6681	0.0076	0.9135	0.8422	0.7919	0.3503	0.9135
	SYX	194.89	169.59	47.40	50.74	19.37	32.61	27.12	50.74
	SB	8.85	8.61	2.15	2.31	0.88	1.48	1.23	2.31

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA, MAY 1976 (1960-72), NOV 1978 (1973-77).
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6. CONVERTED AT 61.644. CROP YEAR JULY-JUNE.

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TABLE 1
THAILAND, ALL FOOD GRAINS

FOOD GRAIN SUPPLY AND UTILIZATION BALANCE SHEET, 1960-1977

(100) METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	(1) PRODUCTION	(2) IMPORTS	(3) CHANGE IN STOCKS	(4) TOTAL SUPPLY	(5) SEED AND LOSS	(6) FOOD USE	(7) BALANCE	(8) TOTAL UTILIZATION
1	1960	6607	-1837	9	4761	657	4104	0	4761
2	1961	6695	-1568	-4	5129	670	4459	0	5129
3	1962	7839	-1790	-44	6093	784	5303	6	6093
4	1963	8557	-2375	-51	6233	855	5369	9	6233
5	1964	8226	-2358	6	5860	824	5031	5	5860
6	1965	7991	-2094	-83	5980	799	5169	12	5980
7	1966	9595	-2086	13	7496	960	6523	13	7496
8	1967	8194	-1685	374	6135	819	5305	11	6135
9	1968	9111	-1683	703	6665	911	5739	15	6665
10	1969	9889	-1635	-160	8214	989	7184	41	8214
11	1970	10139	-2440	-256	7955	1014	6891	50	7955
12	1971	10475	-3211	-109	7373	1047	6254	72	7373
13	1972	8871	-1363	-478	7986	888	7029	69	7986
14	1973	10905	-2146	146	8613	1090	7438	65	8613
15	1974	11065	-2021	65	8980	1107	7740	133	8980
16	1975	11895	-3111	-199	8983	1189	7624	170	8983
17	1976	12081	-4005	-538	8614	1208	7303	143	8614
18	1977	10821	-2068	-6	8655	1082	7376	197	8655
YBAR		9386.44	-2204.22	-30.56	7206.94	938.50	6213.39	57.29	7206.94
B		282.79	-56.53	-14.40	238.38	28.32	200.29	10.68	238.86
RSQ		0.8443	0.2102	0.0716	0.8668	0.8448	0.8403	0.8323	0.8668
SYX		668.24	602.95	285.34	515.29	66.82	480.53	26.88	515.29
SB		30.36	27.39	12.96	23.41	3.04	21.83	1.22	23.41

SOURCE:
PRODUCTION, IMPORTS, STOCKS AND UTILIZATION FROM FOREIGN AGRICULTURE CIRCULAR, USDA.
(5) AT 10% OF COL. 1; (6) REPORTED CONSUMPTION LESS COL. 5; (7) COL. 4 LESS COLS. 5 AND 6.

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ANNEX III

ASEAN Population Trends, 1960-1977

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ASEAN Population Trends, 1960-1977

The methodology employed in this study requires consistent estimates of mid-year figures for total human population in each country. The population figures are used as the divisor to obtain the available food supplies on a per capita basis each year; such supplies are the basis for measuring the need for food reserves to insure a stable supply of food in each of the nations concerned.

The figures shown in the accompanying Table 3 are taken from the latest available United Nations Demographic Yearbook. Most of the earlier estimates from this source have been adjusted for under-enumeration in older census reports.

Statistical trends were fitted to the figures reported by the source, using least squares regression with natural logarithm models. The resulting statistical parameters are shown in the lower section of Table 3. The R^2 values are greater than 0.995 for each of the nations except Singapore, for which the R^2 value is 0.98. Average annual growth rates in total population have ranged from 1.93 percent for Singapore to 2.98 percent in Thailand and 2.99 percent in the Philippines; the annual growth rate since 1960 for ASEAN as a whole has been about 2.7 percent.

As further check for "out-of-line" estimates for individual years, the results were plotted using the "NPLOT" option of the Master Projection Program (see Annex I). Results from the plots for each country are reproduced herein. Most of the observed vales and estimates are identical within the accuracy of the computer plot. This is true of all years for Indonesia, for all but 1968 for the Philippines, and of all but 1967, 1972, and 1975 for Thailand.

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As shown by the charts, additional minor deviations are indicated for Malaysia and for Singapore. However, even these are mostly the result of rounding errors in the plot routine when plotting logarithm functions to arithmetric scale. None of the deviations in the population estimates are believed troublesome to the kind of analysis used in this study.

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TABLE 3
TOTAL POPULATION BY COUNTRY, ASEAN, 1960-1977

(MID-YEAR ESTIMATES)

(1000 PERSONS)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	93911	7908	26971	1636	25736	157162
2	1961	95986	8171	27850	1697	27568	161278
3	1962	98155	8446	28792	1752	28420	165565
4	1963	100432	8709	29750	1803	29301	170001
5	1964	102863	8956	30750	1854	30218	174641
6	1965	105332	9209	31770	1904	31175	179388
7	1966	107891	9470	32730	1945	32149	184185
8	1967	110610	9710	33710	1980	33155	189165
9	1968	113490	9940	34730	2010	34199	194369
10	1969	116440	10150	35770	2040	35273	199673
11	1970	119470	10390	36850	2070	36370	205150
12	1971	122610	10700	37900	2110	37490	210810
13	1972	125840	11000	38990	2150	38590	216570
14	1973	129150	11310	40120	2190	39690	222460
15	1974	132550	11650	41300	2220	40780	228500
16	1975	136040	11968	42520	2250	41870	234648
17	1976	139620	12295	43750	2280	42960	240905
18	1977	143280	12595	45030	2310	44150	247375
LOG	YBAR	11.6556	9.2149	10.4657	7.6014	10.4514	
	SLN	0.0251	0.0263	0.0299	0.0173	0.0298	
	RSQ	0.9950	0.9989	0.9975	0.9835	0.9968	
	SYY	0.0098	0.0050	0.0052	0.0150	0.0095	
	SB	0.0004	0.0002	0.0004	0.0037	0.0004	

SOURCE:
DEMOGRAPHIC YEARBOOK 1977, UNITED NATIONS 1976. (ALSO DEMOGRAPHIC YEARBOOK 1970, 1973-76): REFLECTS ADJUSTMENTS FOR UNDERENUMERATION

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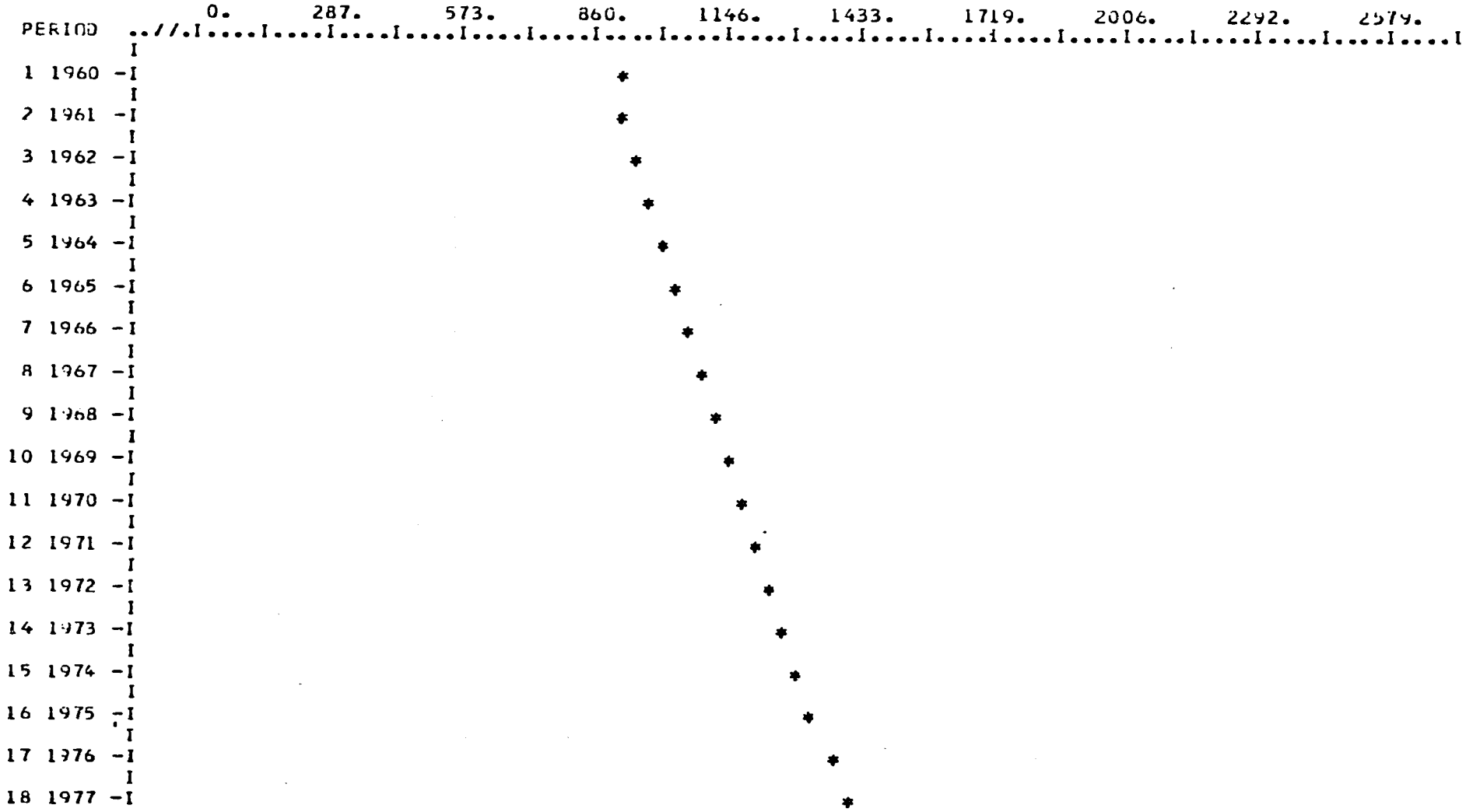
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 3

INDONESIA UNIT IS 1000 PERSONS X 100 (RSQ = 0.9950)

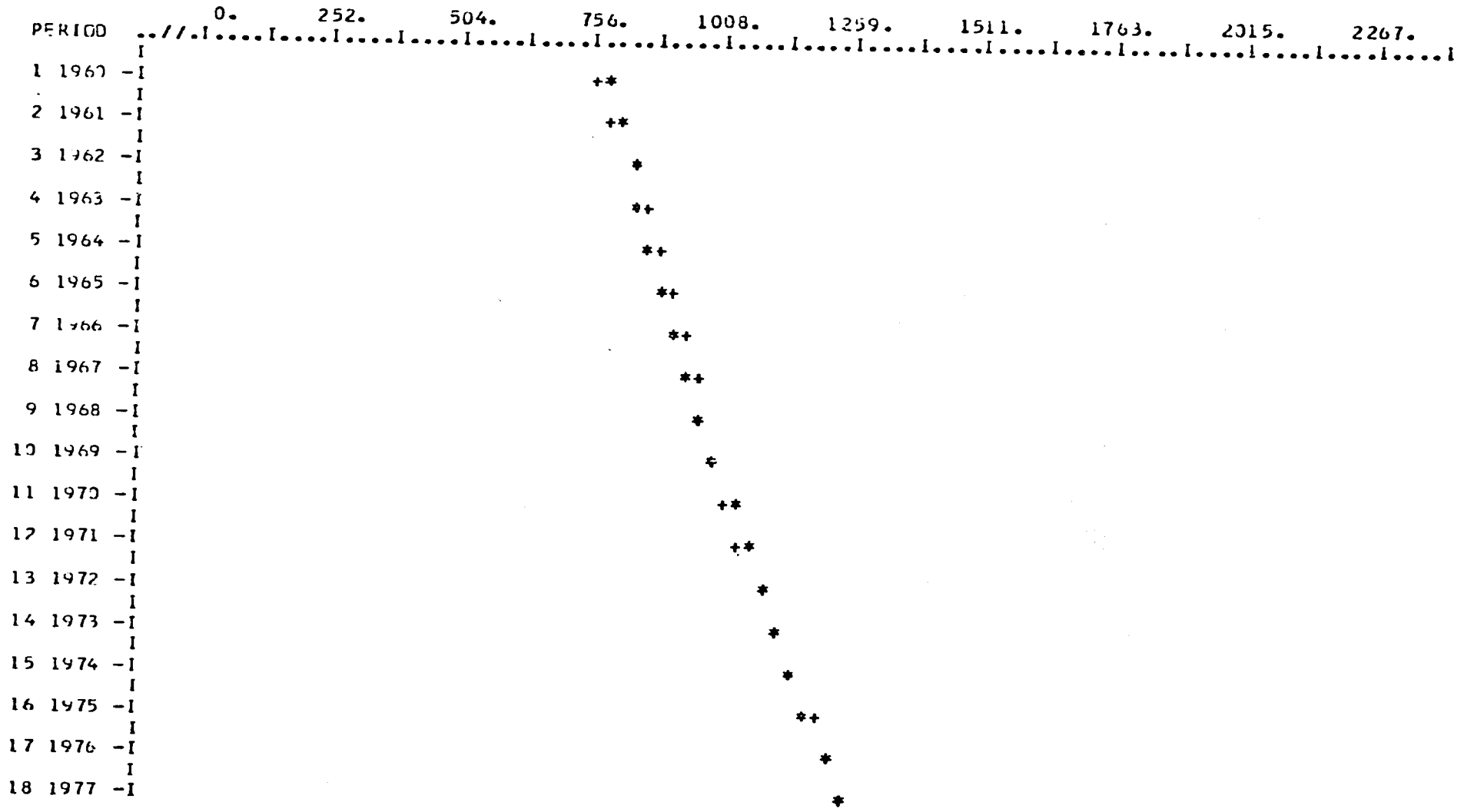


PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 3

MALAYSIA

UNIT IS 1000 PERSONS X 10 (RSQ = 0.9989)



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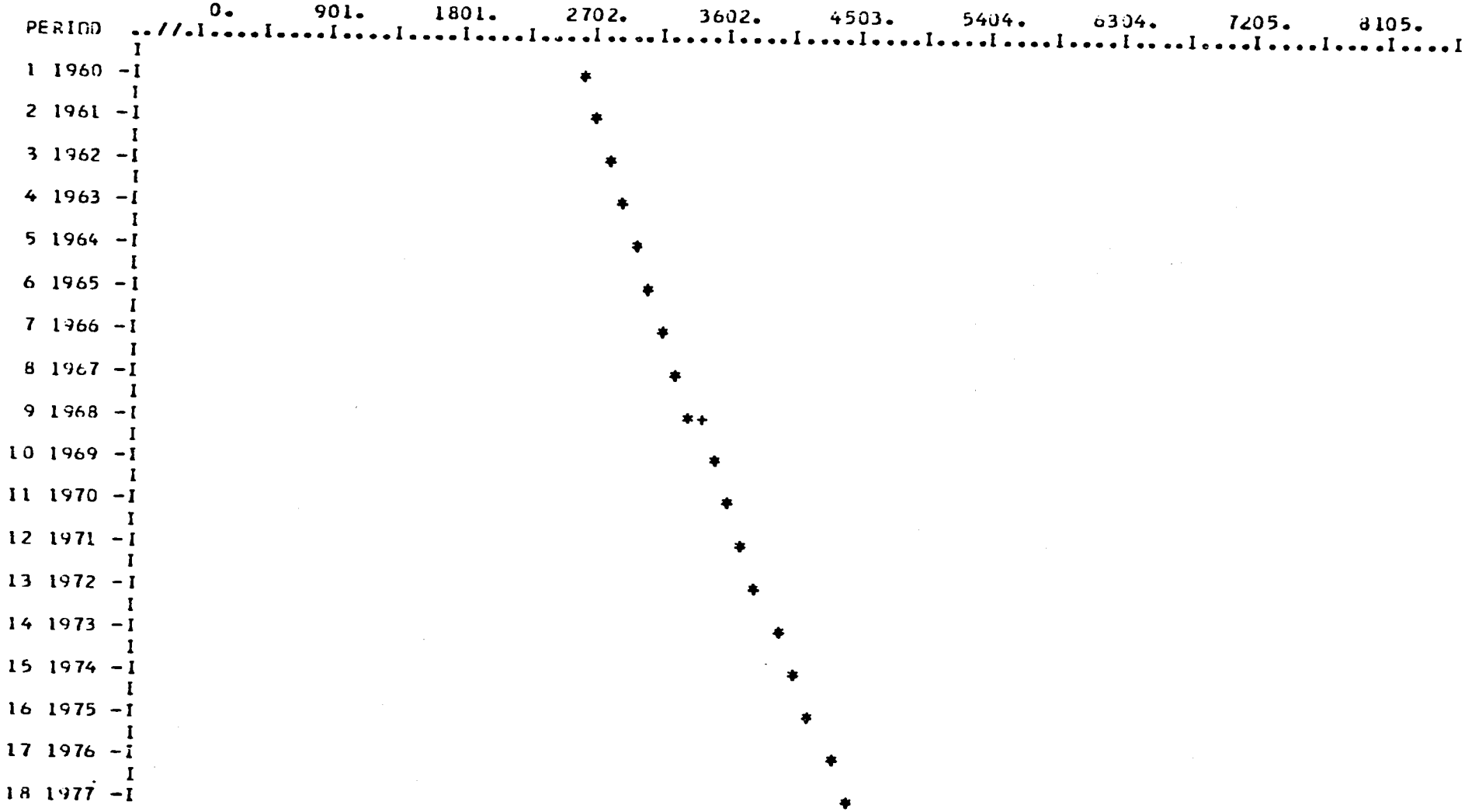
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 3

PHILIPPINES UNIT IS 1000 PERSONS X 10 (RSQ = 0.9975)



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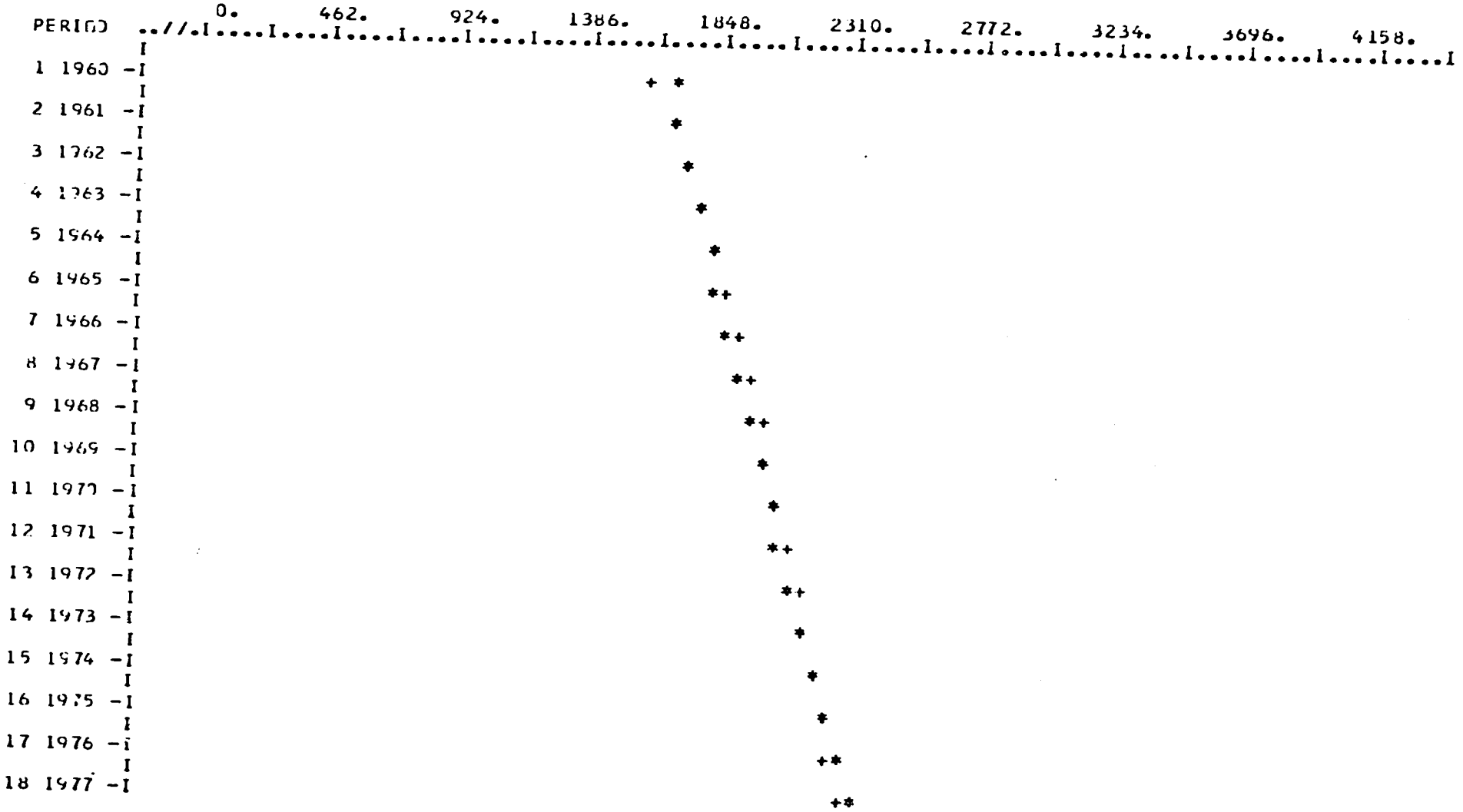
PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 3

SINGAPORE

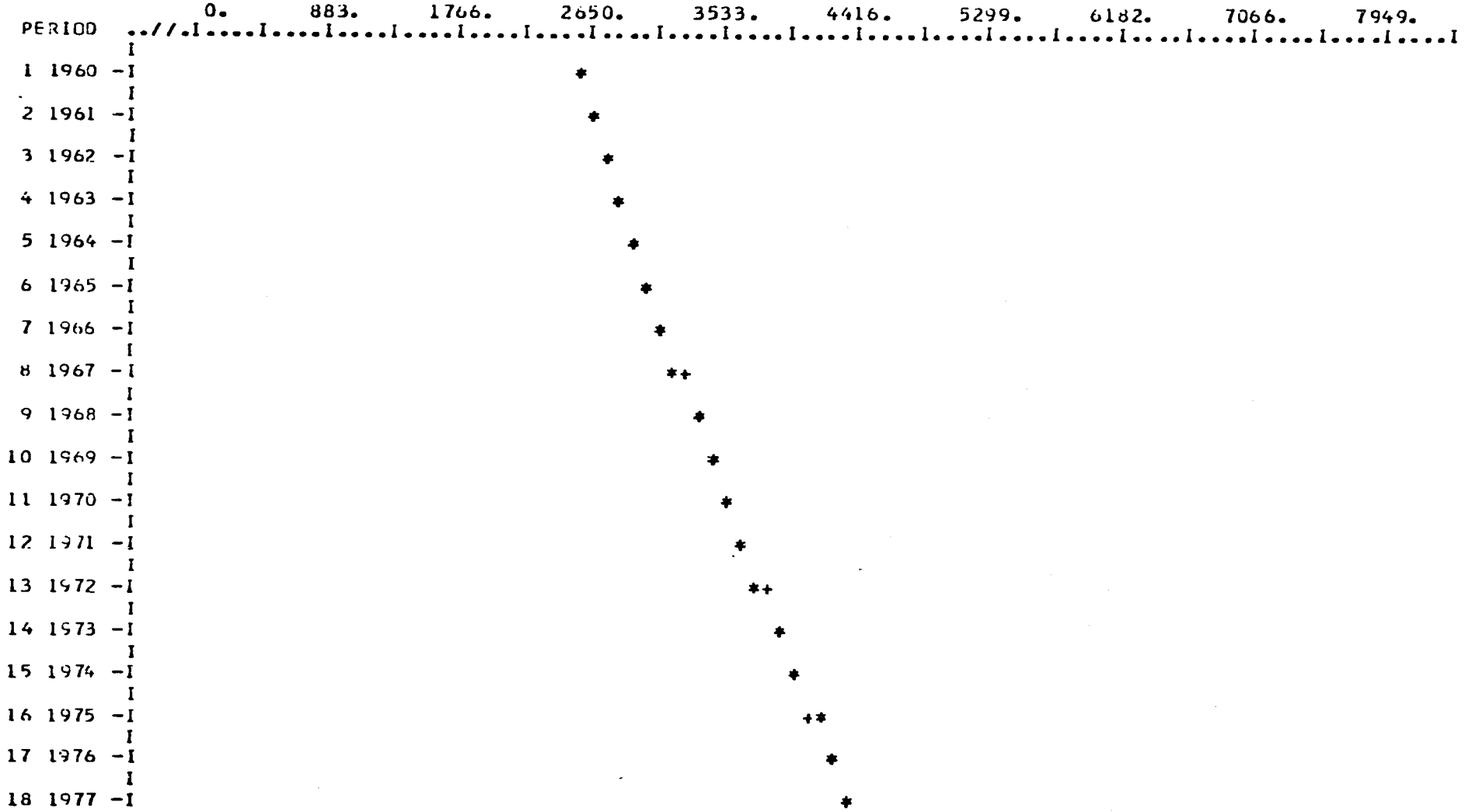
UNIT IS 1000 PERSONS X 1 (RSQ = 0.9805)



PLOT OF OBSERVED AND ESTIMATED DATA

TABLE 3

THAILAND UNIT IS 1000 PERSONS X 10 (RSQ = 0.9966)



ANNEX IV

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Note: Tables for "All Food Grains" appear immediately following the corresponding table for "Rice Only".

TABLE 6. RICE ONLY
ESTIMATED DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	8757	808	2261	184	4584	16594
2	1961	9049	853	2331	188	4735	17136
3	1962	9355	860	2434	190	4890	17699
4	1963	9675	884	2480	192	5050	18281
5	1964	10015	906	2556	194	5217	18892
6	1965	10364	931	2638	196	5391	19520
7	1966	10727	955	2712	198	5570	20160
8	1967	11111	977	2786	196	5754	20826
9	1968	11517	998	2867	195	5945	21522
10	1969	11936	1017	2947	193	6142	22235
11	1970	12370	1039	3030	192	6344	22975
12	1971	12821	1067	3110	192	6550	23740
13	1972	13288	1095	3193	191	6754	24521
14	1973	13770	1123	3279	190	6956	25320
15	1974	14269	1154	3369	189	7161	26142
16	1975	14785	1183	3461	187	7365	26981
17	1976	15318	1213	3554	185	7569	27839
18	1977	15367	1239	3651	183	7794	28734

SOURCE:
FIGURES IN TABLE 5 MULTIPLIED BY FIGURES IN TABLE 3.

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TABLE 6. ALL FOOD GRAINS (RICE, WHEAT, CORN)
ESTIMATED DOMESTIC CONSUMPTION BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	10221	1051	3146	243	4560	19221
2	1961	10542	1067	3268	251	4727	19875
3	1962	10878	1125	3397	258	4900	20558
4	1963	11230	1161	3531	265	5080	21267
5	1964	11604	1195	3670	271	5267	22007
6	1965	11987	1230	3813	277	5463	22770
7	1966	12386	1266	3950	282	5664	23548
8	1967	12808	1299	4091	286	5872	24356
9	1968	13254	1331	4238	290	6089	25202
10	1969	13714	1361	4389	293	6314	26071
11	1970	14190	1394	4546	296	6544	26970
12	1971	14685	1437	4701	300	6781	27904
13	1972	15197	1479	4863	305	7016	28860
14	1973	15725	1522	5031	309	7253	29840
15	1974	16271	1569	5206	312	7491	30849
16	1975	16834	1613	5389	315	7730	31881
17	1976	17416	1659	5574	318	7972	32939
18	1977	18015	1701	5767	321	8236	34040

SOURCE:
FIGURES IN TABLE 7 MULTIPLIED BY FIGURES IN TABLE 3.

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TABLE 9. RICE ONLY
COMPUTED ATTAINABLE VARIATION IN SUPPLY BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	263	24	68	6	138	499
2	1961	271	25	70	6	142	514
3	1962	281	26	72	6	147	532
4	1963	290	27	74	6	151	548
5	1964	300	27	77	6	157	567
6	1965	311	28	79	6	162	586
7	1966	322	29	81	6	167	605
8	1967	333	29	84	6	173	625
9	1968	346	30	86	6	179	646
10	1969	358	31	88	6	184	667
11	1970	371	31	91	6	190	689
12	1971	385	32	93	6	196	712
13	1972	399	33	96	6	203	737
14	1973	413	34	98	6	209	760
15	1974	428	35	101	6	215	785
16	1975	444	35	104	6	221	811
17	1976	460	36	107	6	227	836
18	1977	476	37	110	6	234	862

SOURCE:
FIGURES IN TABLE 5 MULTIPLIED BY FIGURES IN TABLE 3.

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TABLE 9. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ALLOWABLE VARIATION IN SUPPLY BY COUNTRY, ASEAN, 1960-1977

(1000 METRIC TONS, MILLED RICE EQUIVALENT)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	307	32	94	7	137	577
2	1961	316	33	98	8	142	597
3	1962	326	34	102	8	147	617
4	1963	337	35	106	8	152	638
5	1964	348	36	110	8	158	660
6	1965	360	37	114	8	164	683
7	1966	372	38	118	8	170	706
8	1967	384	39	123	9	176	731
9	1968	398	40	127	9	183	757
10	1969	411	41	132	9	189	782
11	1970	426	42	136	9	196	809
12	1971	441	43	141	9	203	837
13	1972	456	44	146	9	210	865
14	1973	472	46	151	9	218	896
15	1974	488	47	156	9	225	925
16	1975	505	48	162	9	232	956
17	1976	522	50	167	10	239	988
18	1977	540	51	173	10	247	1021

SOURCE:
FIGURES IN TABLE 7 MULTIPLIED BY FIGURES IN TABLE 3.

TABLE 9'. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

ADJUSTED ALLOWABLE VARIATION FOR 3 PERCENT SUPPLY STABILITY

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	263	6	13	6	-138
2	1961	271	-25	3	4	-142
3	1962	281	26	28	-6	147
4	1963	-290	-19	-17	6	151
5	1964	-300	27	-15	-6	-157
6	1965	-311	28	-10	-4	-162
7	1966	-322	27	-81	-6	167
8	1967	-333	-29	23	-6	-173
9	1968	-346	-30	54	6	-178
10	1969	-31	-31	46	-4	184
11	1970	-1	-4	91	6	190
12	1971	25	32	93	6	-196
13	1972	36	33	96	6	114
14	1973	276	34	20	1	209
15	1974	262	35	-101	-6	215
16	1975	381	-27	-59	-6	67
17	1976	460	-36	-76	-3	-227
18	1977	476	-36	-103	5	-234

SOURCE:
SMALLER OF THE ABSOLUTE VALUE IN TABLE 8 AND TABLE 9, WITH THE DIFFERENCE GIVEN THE SIGN FROM TABLE 8.

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TABLE 9'. ALL FOOD GRAINS (RICE, WHEAT,CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

ADJUSTED ALLOWABLE VARIATION FOR 3 PERCENT SUPPLY STABILITY

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	307	32	86	-7	-137
2	1961	316	5	13	-8	-142
3	1962	326	34	30	-8	147
4	1963	-337	6	8	-6	152
5	1964	109	-36	-46	-8	-158
6	1965	-360	-36	-79	-8	-164
7	1966	-372	1	-118	-8	170
8	1967	-384	-39	11	9	-176
9	1968	-398	-40	57	9	-183
10	1969	-356	-22	46	9	189
11	1970	-142	-27	136	9	196
12	1971	16	43	141	9	-203
13	1972	-83	44	136	9	13
14	1973	157	46	-30	2	185
15	1974	101	47	-156	-9	225
16	1975	427	-1	-162	-9	-106
17	1976	522	-50	52	10	-239
18	1977	540	-7	66	-8	-247

SOURCE:
SMALLER OF THE ABSOLUTE VALUE IN TABLE 8 AND TABLE 9, WITH THE DIFFERENCE GIVEN THE SIGN FROM TABLE 8.

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TABLE 11'. RICE ONLY
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

MAXIMUM STOCKS BASED ON STDE APPLIED TO SUPPLY TREND, 1960-1977

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	564	48	101	42	394
2	1961	583	49	104	43	407
3	1962	603	51	108	43	420
4	1963	624	52	111	43	434
5	1964	645	54	115	44	448
6	1965	668	55	118	44	463
7	1966	691	56	121	44	478
8	1967	716	58	125	44	494
9	1968	742	59	128	44	511
10	1969	769	60	132	44	527
11	1970	797	61	136	43	545
12	1971	826	63	139	43	563
13	1972	856	65	143	43	580
14	1973	887	66	147	43	598
15	1974	920	68	151	43	615
16	1975	953	70	155	42	633
17	1976	987	72	159	42	650
18	1977	1023	73	163	41	669

SOURCE:
STDE (%): 6.445 5.897 4.477 22.657 8.588
STANDARD ERRORS OF ESTIMATE (TABLE 4) APPLIED TO FIGURES IN TABLE 6.

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TABLE 11'. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(1000 METRIC TONS, MILLED RICE EQUIVALENT)

MAXIMUM STOCKS BASED ON STDE APPLIED TO SUPPLY TREND, 1960-1977

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND
1	1960	648	56	116	48	432
2	1961	668	58	120	50	448
3	1962	690	60	125	51	465
4	1963	712	62	130	53	482
5	1964	736	64	135	54	499
6	1965	760	66	140	55	518
7	1966	785	68	145	56	537
8	1967	812	70	151	57	557
9	1968	840	72	156	58	577
10	1969	870	73	162	58	599
11	1970	900	75	167	59	620
12	1971	931	77	173	60	643
13	1972	964	79	179	61	665
14	1973	997	82	185	62	688
15	1974	1032	84	192	62	710
16	1975	1067	87	198	63	733
17	1976	1104	89	205	63	756
18	1977	1142	91	212	64	781
SOURCE:						
STDE (%):		6.341	5.375	3.683	19.931	9.481

STANDARD ERRORS OF ESTIMATE (TABLE 4) APPLIED TO FIGURES IN TABLE 6.

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TABLE 21. RICE ONLY
COMPUTED ANNUAL FIXED COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	24590	1046	2224	1003	8589	37452
2	1961	25419	1046	2224	1003	8589	38281
3	1962	26291	1046	2224	1003	10246	40810
4	1963	26291	1046	2224	1003	16045	46609
5	1964	26291	1046	2224	1003	16045	46609
6	1965	26291	2267	2224	1003	16045	47830
7	1966	26291	2267	2224	1003	20841	52626
8	1967	26291	2267	2224	1003	20841	52626
9	1968	26291	2267	2224	1003	20841	52626
10	1969	26291	2267	2224	1003	22977	54762
11	1970	26291	2267	2878	1875	23762	57073
12	1971	26291	2267	6060	1875	23762	60255
13	1972	26291	2660	6235	1875	23762	60823
14	1973	26291	2878	6235	1875	23762	61041
15	1974	26291	2965	6235	1875	25157	62523
16	1975	26291	2965	6235	1875	25157	62523
17	1976	26291	2955	6235	1875	25157	62523
18	1977	26291	2965	6235	1875	25157	62523

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 12' TIMES PER TON FIXED COSTS OF $18.00 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

TABLE 21. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(US $1000)

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

COMPUTED ANNUAL FIXED COSTS FOR IN-COUNTRY RESERVES

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	28253	1788	2529	1046	9418	43034
2	1961	29125	1788	2529	1046	9418	43906
3	1962	30084	2616	2529	1046	11162	47437
4	1963	30084	2616	2529	1046	17135	53410
5	1964	30084	2616	2529	1046	17135	53410
6	1965	30084	2616	2529	1046	17135	53410
7	1966	30084	2616	2529	1046	23413	59688
8	1967	30084	2616	2529	2485	23413	61127
9	1968	30084	2616	2529	2529	23413	61171
10	1969	30084	2616	2529	2529	26116	63874
11	1970	30084	2616	2529	2572	27032	64833
12	1971	30084	2616	7543	2616	27032	69891
13	1972	30084	3270	7543	2660	27032	70589
14	1973	30084	3575	7543	2660	27032	70894
15	1974	30084	3662	7543	2660	30956	74905
16	1975	30084	3662	7543	2660	30956	74905
17	1976	30084	3662	7543	2660	30956	74905
18	1977	30084	3662	7543	2660	30956	74905

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 12' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

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TABLE 22. RICE ONLY
COMPUTED ANNUAL VARIABLE COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	26282	1118	2377	1072	0	30849
2	1961	27168	233	2377	1072	0	30850
3	1962	28100	792	2377	47	10951	42267
4	1963	21800	792	2377	932	17149	43059
5	1964	17615	885	2377	0	14073	34950
6	1965	0	2423	2377	0	9134	13934
7	1966	0	2423	0	0	22275	24698
8	1967	0	0	0	0	6431	6431
9	1968	0	0	0	652	1212	1864
10	1969	0	0	0	652	24558	25210
11	1970	0	0	3076	2004	25397	30477
12	1971	0	792	6477	2004	13840	23113
13	1972	0	2843	6664	2004	13840	25351
14	1973	0	3076	6664	2004	18454	30198
15	1974	0	3169	5219	0	26888	35276
16	1975	0	3169	5219	0	26888	35276
17	1976	5266	419	5219	0	9320	20224
18	1977	6291	419	5219	93	0	12022

SOURCE:
STORAGE VOLUMES FROM TABLE 12 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION: SEE TABLE 8, KSU SPECIAL REPORT #61.

TABLE 22. ALL FOOD GRAINS (RICE, WHEAT, CORN)
(US $1000)

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

COMPUTED ANNUAL VARIABLE COSTS FOR IN-COUNTRY RESERVES

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	30197	1911	2703	466	0	35277
2	1961	31129	1911	2703	0	0	35743
3	1962	32154	2796	2703	0	11930	49583
4	1963	19805	2796	2703	0	18314	43618
5	1964	19805	2656	2703	0	14679	39843
6	1965	0	2656	2703	0	8621	13980
7	1966	0	2656	0	0	25024	27680
8	1967	0	0	0	2656	6804	9460
9	1968	0	0	0	2703	0	2703
10	1969	0	0	0	2703	27913	30616
11	1970	0	0	2237	2749	28892	33878
12	1971	0	0	8062	2796	13794	24652
13	1972	0	3495	8062	2843	13794	28194
14	1973	0	3821	8062	2843	13794	28520
15	1974	0	3914	6058	0	33086	43058
16	1975	0	3914	2377	0	33086	39377
17	1976	7549	2796	2377	746	13048	26516
18	1977	24698	2796	2377	746	0	30617

SOURCE:
STORAGE VOLUMES FROM TABLE 14A TIMES PER MT VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

TABLE 24. RICE ONLY
COMPUTED ANNUAL FIXED COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	39676	1046	2224	916	8589	52451
2	1961	47786	1046	2224	916	8589	60561
3	1962	81576	1046	2224	916	8589	94351
4	1963	81576	1046	2224	916	8589	94351
5	1964	81576	1046	2224	916	8589	94351
6	1965	81576	1046	2224	916	8589	94351
7	1966	81576	1046	2224	916	13385	99147
8	1967	81576	1046	2224	916	13385	99147
9	1968	81576	1046	2224	916	13385	99147
10	1969	81576	1046	2224	916	24329	110091
11	1970	81576	1046	2224	916	33964	119726
12	1971	81576	1046	2224	2049	33964	120859
13	1972	81576	1046	2224	5973	33964	124783
14	1973	81576	1046	2224	5973	33964	124783
15	1974	81576	1264	2224	5973	33964	125001
16	1975	81576	1264	2224	5973	33964	125001
17	1976	81576	1264	2224	5973	33964	125001
18	1977	81576	1264	2224	5973	33964	125001

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 14' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

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TABLE 24. ALL FOOD GRAINS (RICE, WHEAT, CORN)
BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

COMPUTED ANNUAL FIXED COSTS FOR REGIONAL RESERVES

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	36386	872	2529	1046	9418	50751
2	1961	37540	872	2529	1046	9418	51405
3	1962	81358	1962	2529	1046	9418	96313
4	1963	81358	1962	2529	1046	9418	96313
5	1964	81358	1962	2529	1046	9418	96313
6	1965	81358	1962	2529	1046	9418	96313
7	1966	81358	1962	2529	1046	14126	101021
8	1967	81358	1962	2529	1046	14126	101021
9	1968	81358	1962	2529	1046	14126	101021
10	1969	81358	1962	2529	3052	15786	105687
11	1970	81358	1962	2529	6235	22454	114538
12	1971	81358	1962	2529	6627	22454	114930
13	1972	81358	1962	2529	9548	22454	117851
14	1973	81358	1962	2529	9548	22454	117851
15	1974	81358	1962	2529	9548	53323	148720
16	1975	81358	1962	2529	9548	53323	148720
17	1976	81358	1962	2529	9548	53323	148720
18	1977	81358	1962	2529	9548	53323	148720

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 14' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

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TABLE 25. RICE ONLY
COMPUTED ANNUAL VARIABLE COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	42406	1118	2377	979	1072	47952
2	1961	51074	1118	2377	979	6710	62258
3	1962	87189	1118	2377	979	6710	98373
4	1963	87189	1118	2377	979	6710	98373
5	1964	87189	1118	2377	652	6710	98046
6	1965	77962	1118	2377	652	6710	88819
7	1966	51912	1118	7549	979	14306	75864
8	1967	4986	513	7549	1584	14306	28938
9	1968	11044	2283	7549	1584	14306	36766
10	1969	11044	2563	7549	1584	26003	48743
11	1970	11044	2563	7549	652	36301	58109
12	1971	11044	2563	3215	2190	36301	55313
13	1972	11044	2563	885	6384	36301	57177
14	1973	11044	2097	885	6384	36301	56711
15	1974	11044	1351	885	5872	36301	55453
16	1975	11044	1351	885	1864	36301	51445
17	1976	11044	1351	885	1864	36301	51445
18	1977	11044	1351	885	1864	24791	39935

SOURCE:
STORAGE VOLUMES FROM TABLE 14 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (NEGATIVE BALANCES AT SAME RATE PER MT).

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TABLE 25. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL VARIABLE COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, USING HISTORICAL IMPORTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	39424	932	2703	1118	5266	49443
2	1961	40123	932	2703	839	606	45203
3	1962	86956	2097	2703	0	606	92362
4	1963	86956	2097	2703	406	606	92828
5	1964	86956	2097	2703	1025	606	93387
6	1965	66731	2097	2703	1351	606	73488
7	1966	58949	2097	7316	1445	15098	84905
8	1967	419	1305	7316	1072	15098	25210
9	1968	7223	3961	7316	979	14120	33599
10	1969	7223	3961	7316	3262	17941	39703
11	1970	7223	3961	7316	6664	23999	49163
12	1971	7223	3961	5825	7063	23999	48091
13	1972	7223	3961	5825	10205	23999	51213
14	1973	7223	3542	5825	10205	23999	50794
15	1974	7223	979	5825	6528	56992	79547
16	1975	7223	979	5825	2423	56992	73442
17	1976	7223	979	5825	2423	56992	73442
18	1977	7223	979	5825	2423	41474	57924

SOURCE:
STORAGE VOLUMES FROM TABLE 14 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (NEGATIVE BALANCES AT SAME RATE PER MT).

TABLE 31. RICE ONLY
COMPUTED ANNUAL FIXED COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	24590	1046	2224	959	8589	37408
2	1961	24590	1046	2224	959	8589	37408
3	1962	26291	1134	2224	959	8589	39197
4	1963	26291	1134	2224	1090	8589	39328
5	1964	26291	1134	2224	1090	8589	39328
6	1965	26291	1744	2224	1090	8589	39938
7	1966	26291	1744	2224	1090	19838	51187
8	1967	26291	1744	2878	1090	19838	51841
9	1968	26291	1744	2878	1090	19838	51841
10	1969	26291	1744	2878	1090	22977	54980
11	1970	26291	1744	3270	1482	22977	55764
12	1971	26291	1744	6060	1875	22977	58947
13	1972	26291	1744	6060	1875	22977	58947
14	1973	26291	1744	6060	1875	22977	58947
15	1974	26291	2965	6060	1875	23544	60735
16	1975	26291	2965	6060	1875	23544	60735
17	1976	26291	2965	6060	1875	23544	60735
18	1977	26291	2965	6060	1875	23544	60735

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 18' TIMES PER TON FIXED COSTS OF $16.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #61.

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TABLE 31. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL FIXED COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	28253	1308	2529	1046	9418	42554
2	1961	28253	1308	2529	1046	9418	42554
3	1962	30084	2180	2529	1046	9418	45257
4	1963	30084	2180	2529	1046	9418	45257
5	1964	30084	2180	2529	1046	9418	45257
6	1965	30084	2180	2529	1046	9418	45257
7	1966	30084	2180	2529	1046	21059	56898
8	1967	30084	2180	2965	1459	21059	57727
9	1968	30084	2180	2965	1700	21059	57988
10	1969	30084	2180	2965	2529	21713	59471
11	1970	30084	2180	2965	2572	21713	59514
12	1971	30084	2180	5973	2572	21713	62522
13	1972	30084	2180	5973	2660	21713	62610
14	1973	30084	2180	5973	2660	21713	62610
15	1974	30084	3183	5973	2660	30956	72856
16	1975	30084	3183	5973	2660	30956	72856
17	1976	30084	3183	5973	2660	30956	72856
18	1977	30084	3183	5973	2660	30956	72856

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 18' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

TABLE 32. RICE ONLY
COMPUTED ANNUAL VARIABLE COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	26282	1118	2377	1025	559	31361
2	1961	20784	699	2377	979	979	25818
3	1962	28100	1212	2377	466	6244	38399
4	1963	14306	979	2377	1165	6710	25537
5	1964	19106	1165	2377	186	4940	27774
6	1965	3309	1864	2377	652	3355	11557
7	1966	0	1538	0	0	21203	22741
8	1967	0	186	3076	233	4334	7829
9	1968	2423	0	1538	466	10159	14586
10	1969	1212	233	2330	373	24558	28706
11	1970	1817	140	3495	1584	22834	29870
12	1971	1491	606	6477	2004	17941	28519
13	1972	1631	1398	6105	2004	20411	31549
14	1973	1538	1351	6291	1165	21483	31828
15	1974	1584	3169	5452	326	25164	35695
16	1975	1584	2283	5872	0	23347	33086
17	1976	4241	1351	5685	792	15471	27540
18	1977	3448	1817	5778	419	3994	20456

SOURCE:
STORAGE VOLUMES FROM TABLE 18 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

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TABLE 32. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL VARIABLE COSTS FOR IN-COUNTRY RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	30197	1398	2703	792	2656	37746
2	1961	21156	1165	2703	606	3448	29078
3	1962	32154	2330	2703	280	9040	46507
4	1963	11743	1771	2703	186	9460	25863
5	1964	21949	2004	2703	0	7456	34112
6	1965	0	1911	2703	0	5452	10066
7	1966	8668	1957	0	0	22508	33133
8	1967	0	186	3169	1538	4846	9739
9	1968	13607	0	1584	1617	9786	26794
10	1969	6804	885	2377	2703	23207	35976
11	1970	10205	466	3076	2749	20038	36534
12	1971	8528	699	6384	2377	14073	32061
13	1972	9367	2330	4753	2843	17056	36349
14	1973	8947	1864	5592	1957	15564	33924
15	1974	9180	3432	4194	140	33086	50002
16	1975	9087	2610	3076	0	19665	34438
17	1976	12908	2423	3635	1445	16357	36768
18	1977	19572	2516	3355	699	3728	29870

SOURCE:
TORAGE VOLUMES FROM TABLE 18 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (SEE TABLE 8, KSU SPECIAL REPORT #61).

TABLE 34. RICE ONLY
COMPUTED ANNUAL FIXED COSTS FOR REGIONAL RESERVES
BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	20492	1046	2224	916	8589	33267
2	1961	20492	1046	2224	916	8589	33267
3	1962	33528	1046	2224	916	8589	46303
4	1963	33528	1046	2224	916	8589	46303
5	1964	33528	1046	2224	916	8589	46303
6	1965	33528	1046	2224	916	8589	46303
7	1966	33528	1046	2224	916	8589	46303
8	1967	33528	1046	2224	916	8589	46303
9	1968	33528	1046	2224	916	8589	46303
10	1969	33528	1046	2224	916	8807	46521
11	1970	33528	1046	2224	916	8807	46521
12	1971	33528	1046	2224	916	8807	46521
13	1972	33528	1046	2224	2485	8807	48090
14	1973	33528	1046	2224	2485	8807	48090
15	1974	33528	1046	2224	2485	8807	48090
16	1975	33528	1046	2224	2485	8807	48090
17	1976	33528	1046	2224	2485	8807	48090
18	1977	33528	1046	2224	2485	8807	48090

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 20' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

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TABLE 34. ALL FOOD GRAINS (RICE, WHEAT, CORN)
COMPUTED ANNUAL FIXED COSTS FOR REGIONAL RESERVES

BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	18443	872	2529	1046	9418	32308
2	1961	18443	872	2529	1046	9418	32308
3	1962	34749	872	2529	1046	9418	48614
4	1963	34749	872	2529	1046	9418	48614
5	1964	34749	872	2529	1046	9418	48614
6	1965	34749	872	2529	1046	9418	48614
7	1966	34749	872	2529	1046	9418	48614
8	1967	34749	872	2529	1046	9418	48614
9	1968	34749	872	2529	1046	9418	48614
10	1969	34749	872	2529	1046	9418	48614
11	1970	34749	872	2529	2093	9418	49661
12	1971	34749	872	2529	2093	9418	49661
13	1972	34749	872	2529	3314	9418	50882
14	1973	34749	872	2529	3314	9418	50882
15	1974	34749	872	2529	3314	18181	59645
16	1975	34749	872	2529	3314	18181	59645
17	1976	34749	872	2529	3314	18181	59645
18	1977	34749	872	2529	3314	18181	59645

SOURCE:
CAPACITY REQUIREMENTS FROM TABLE 20' TIMES PER TON FIXED COSTS OF $18.80 FOR STORAGE AND $3.00 FOR ADMINISTRATION (SEE TABLE 8, KSU SPECIAL REPORT #6).

TABLE 35. RICE ONLY
COMPUTED ANNUAL VARIABLE COSTS FOR REGIONAL RESERVES
BY ASEAN COUNTRY. 1960-1977. ASSUMING IMPORT ADJUSTMENTS

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	21902	1118	2377	979	9180	35556
2	1961	21902	1118	2377	979	9180	35556
3	1962	35835	1118	2377	979	9180	49489
4	1963	35835	1118	2377	979	9180	49489
5	1964	35835	1118	2377	979	9180	49489
6	1965	35835	1118	2377	979	9180	49489
7	1966	34018	1118	1398	559	9180	46273
8	1967	13095	1118	1398	559	9180	25350
9	1968	13095	559	1398	559	9180	24751
10	1969	13095	559	1396	559	9413	25024
11	1970	13095	559	1396	559	9413	25024
12	1971	13095	559	1072	979	9413	25118
13	1972	13095	559	1072	2656	9413	26795
14	1973	13095	559	1072	2656	9413	26795
15	1974	13095	559	1072	2656	9413	26795
16	1975	13095	559	1072	1398	9413	25537
17	1976	13095	559	1072	1398	9413	25537
18	1977	13095	559	1072	1398	9413	25537

SOURCE:
STORAGE VOLUMES FROM TABLE 20 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $6.00 FOR OPERATION (NEGATIVE BALANCES AT SAME RATE PER MT).

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TABLE 35. ALL FOOD GRAINS (RICE, WHEAT, CORN)
BY ASEAN COUNTRY, 1960-1977, ASSUMING IMPORT ADJUSTMENTS

COMPUTED ANNUAL VARIABLE COSTS FOR REGIONAL RESERVES

(US $1000)

PERIOD NO.	YEAR	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	ASEAN TOTAL
1	1960	19712	932	2703	1118	10066	34531
2	1961	19712	932	2703	1118	10066	34531
3	1962	37140	932	2703	1118	10066	51959
4	1963	37140	932	2703	1118	10066	51959
5	1964	37140	932	2703	1072	10066	51913
6	1965	33971	932	2703	1025	10066	48697
7	1966	33971	932	932	979	10066	46880
8	1967	8621	932	932	979	10066	21530
9	1968	8621	652	932	979	10066	21250
10	1969	8621	652	932	1072	10066	21343
11	1970	8621	652	932	2237	10066	22508
12	1971	8621	652	932	2237	10066	22508
13	1972	8621	652	932	3542	10066	23813
14	1973	8621	652	932	3542	10066	23813
15	1974	8621	652	932	3542	19432	33179
16	1975	8621	652	932	1538	19432	31175
17	1976	8621	652	932	1538	19432	31175
18	1977	8621	652	932	1538	19432	31175

SOURCE:
STORAGE VOLUMES FROM TABLE 20 TIMES PER TON VARIABLE COSTS OF $15.30 FOR INVENTORY AND $8.00 FOR OPERATION (SEE TABLE 8, KSU SPECIAL REPORT #61.

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