FDD FIELD REPORT 41

# PRODUCTION CAPACITY AND SUPPLY RESPONSE IN VIETNAM'S AGRICULTURE: AN APPLICATION OF AN ECONOMIC RESEARCH SERVICE PRODUCTION-DISTRIBUTION MODEL FOR VIETNAM

INTERNATIONAL DEVELOPMENT CENTER
ECONOMIC RESEARCH SERVICE
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in cooperation with
VIETNAM MINISTRY OF AGRICULTURE AND LAND DEVELOPMENT
and
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## ABSTRACT

Productive capacity of South Vietnam's agriculture was examined in terms of the quantity and mix of agricultural commodities needed to maximize national agricultural income. The analysis started with the existing resource base and was extended to other plausible resource use situations, with emphasis on expanding the land resource.

A linear programming model was tailored to the particular conditions and problems existing in South Vietnam. The model specifies resources and defines production relationships among resources, enterprises, and regions. It also explicitly reflects processing, marketing, transportation, and consumption phenomena and relationships.

For two of the major resource bases, various assumptions relative to commodity prices and other variables were altered to determine the likely impact on income, supply mix, investment requirements, trade balances, and other phenomena.

Various program alternatives related to South Vietnam's agricultural and economic development are implicitly suggested by the analysis. Information developed is being used by the Government of Vietnam in its 5-Year Economic Development Plan.



Key Words: South Vietnam, linear programming, economic analysis, projections, agricultural development, production, marketing, resource allocation, policy implications, and foreign trade.

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by

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Frontispiece--Production-marketing regions used in production-distribution model for South Vietnam.

# FOREWORD

This is the last of a series of reports based on studies of Vietnam's agriculture and its relationships to the general economy. These studies were conducted by USDA (U.S. Department of Agriculture) in cooperation with USAID (U.S. Agency for International Development) and the Vietnam Ministry of Agriculture and Land Development.

The first phase of the broad effort appraised the 5-Year Rural Economic Development Plan produced by Vietnam's Ministry of Agriculture, and recommended ways to strengthen the planning process. The report, VIETNAM's 5-YEAR RURAL ECONOMIC DEVELOPMENT PLAN--APPRAISALS AND RECOMMENDATIONS, was published in December 1971 by the USDA Economic Research Service (ERS) in cooperation with USAID.

The second phase involved the analysis of price-quantity relationships for all major agricultural commodities and the relationship of the agricultural sector to other parts of the economy. It developed a model for measuring the impact of alternative policy options on GNP, investments, savings, and other macroeconomic indicators. A summary of this work was published in January 1973 as VIETNAM'S AGRICULTURAL SITUATION AND NEAR-TERM PROSPECTS (ERS, FDD Field Report 26, by Rex Daly, et al.), with the detailed report following in June 1973 under the title of AGRICULTURE IN THE VIETNAM ECONOMY, A SYSTEM FOR ECONOMIC ANALYSIS (FDD Field Report 32).

The third phase, which produced the report which follows, was a study to determine optimal use of basic agricultural resources and marketing facilities, as well as the distribution patterns associated with optimal resource use. It developed a model to help decisionmakers systematically evaluate the net effects of alternative development policies. These results, coupled with the judgment and experience of the Vietnamese officials, will provide a valuable aid to policy and program formulation.

The fourth phase of the broad USDA/USAID effort related to the marketing process and changes needed to accommodate the movement of projected supplies. Data from these marketing studies were used in the linear programming model which was developed to help determine optimal resource use (discussed in detail in this report). The marketing work resulted in the following reports: FRUIT AND VEGETABLE MARKETING AND PROCESSING IN VIETNAM--POTENTIAL IMPROVEMENTS (James Pearson, FDD Field Report 15, July 1972); DEMAND AND COST CONSIDERATIONS AFFECTING OILSEED PROCESSING (Larry Summers and James Pearson, FDD Field Report 16, July 1972); THE POULTRY MARKETING SYSTEM OF SOUTH VIETNAM (Andrew Duymovic, FDD Field Report 17, July 1972); PROCESSING OF SUGARCANE AND RAW SUGAR IN VIETNAM, AND ECONOMIC APPRAISAL (James Pearson and Larry Summers, FDD Field Report 18, July 1972); GRAIN MARKETING IN SOUTH VIETNAM (Amos Jones and Floyd Niernberger, FDD Field Report 19, November 1972); SWINE MARKETING IN SOUTH VIETNAM (Duane Hacklander, FDD Field Report 20, August 1972); and TRANSPORTATION AND VIETNAM'S AGRICULTURE (Clarence Moore, FDD Field Report 38, October 1973).

A summary report (ECONOMIC CONSIDERATIONS IN THE DEVELOPMENT OF AGRICULTURE IN VIETNAM, FDD Field Report 29) was published in February 1974 to bring together results from the various studies in the series, and to illustrate the application of the national macroeconomic model in evaluating the alternative

resource uses examined in the linear programming model that is outlined in the report which follows.

The ERS research program was intended to: 1) bring together and analyze available economic information as a basis for the work of the new Directorate of Agricultural Economics as well as USAID personnel; 2) develop and test appropriate research techniques and procedures for continuing the informational base needed for planning; and 3) provide experience and training for the staff of the newly created Directorate of Agricultural Economics.

Many people have contributed to this overall effort. In this final report of the series, I feel it is appropriate to not only commend the team members, but to acknowledge assistance from the Saigon USAID Mission, the staff of the Vietnam Ministry of Agriculture and Land Development, USDA specialists working on other projects in Vietnam as well as colleagues in the United States, and the many others who in various ways supported the work. Only through cooperative efforts of many was this series of studies realized.

William A. Faught
Project Coordinator

# PREFACE

This study, incorporated within a formal model framework, addresses questions relating to the impact on Vietnam's agricultural economy of altering the resource base and of changing specified variables within particular resource situations. It does not attempt to project into the future on the basis of trends or historical production patterns. Rather, the analysis is in the context of "what if?"--what would be the expected effect of specified changes?

Since the analysis employs an optimizing technique, since it implies change, and since it is in a "what if?" context, there obviously are numerous explicit and implicit assumptions. The appendix elaborates the major assumptions and procedures used in the study. Some of these bear summarizing here. Among the major assumptions are:

1. That security will greatly improve and that the political and social climate will permit specified economic changes to occur;

2. That public and infrastructure developments implied by particular model solutions will be accomplished. These developments and their costs are not specified;

3. That internal capital requirements generated by particular solutions can by made available;

4. That the necessary distribution structure can be developed concurrent with production changes;

5. That labor will not be a limiting resource, particularly with improved security and a move toward relative peace;

6. That the small farm size structure (with relatively slight modification on new land) will be retained;

7. That the farm family will provide most of the required labor on farms other than rice farms;

8. That emphasis is on the land resource;

9. That consumption requirements for individual commodities can be shown by projecting traditional consumption rates forward on the basis of projected population increases; and

10. That adjustments, and their effects, occur at some point in the future. Most solutions are assumed to be as of the year 1980, generally long enough for most adjustments to occur. Some adjustments could occur over a shorter planning period, of course.

The model encompasses virtually the entire agricultural economy. It specifies resources and defines production relationships among resources, among enterprises, and among regions. It includes marketing and processing, transportation, consumption, pricing, and other relationships. Therefore, data and model formulation involved in one sense literally thousands of decisions and assumptions. While the major outline of assumptions and procedures has been presented in this report, it clearly is impossible to include every detail in narrative form. However, every single assumption used was reduced to quantitative terms. These materials have been converted to an intelligible format and provided to the USAID Mission, Saigon.

The model solutions that are presented in this report do not begin to exhaust the possible useful runs that could be made. Countless additional variables could be evaluated, and almost infinite variations of the runs that are reported here could be completed. A major thrust of this particular study involved an evaluation of the potential impact of various categories of land resources that might be added over the planning period. These resource situations could have been combined in many different ways. Solutions would have differed with different combinations. But the combinations used served the purpose of indicating relative differences, within a framework emphasizing broad directions and impacts. At some point, however, Government of Vietnam (GVN) will need to focus on particular development strategies. At such time, the particular combination of resources to be employed could be defined and numerous useful evaluations could be made regarding particular enterprises, particular prices, particular processing plants in specific locations, particular capital limitations, specific improvements in transportation, or other variables as desired. It would also be possible, of course, to evaluate the impact on the agricultural economy of superimposing other categories of resources, not considered in this study, simply by defining the resources and incorporating the appropriate date into the model. Another useful modification would be the incorporation of infrastructure costs related to changes in resource use. The model is highly flexible. Variables and coefficients can be added, deleted, or changed at will. Effects of changes are determined simply by making additional runs.

The model provides a vehicle or framework for evaluating economic alternatives. It could be used for this purpose in the future. It should not be sed blindly, however. For extensive and continued use into the future, many improvements would be needed in terms of data refinement, and in terms of developing information on enterprises and resources not included in this study. The data and relationships included in the model have withstood the test of reasonableness in the many runs made to this point. It must be remembered, however, that when this work was started, the data base was virtually nonexistent. It is possible for experienced analysts to work successfully with less than ideal data, particularly if they are intimately familiar with the data and details of the model. Occasionally, for example, a particular run simply will not be made because of the knowledge that the data are not adequate for the specific evaluation. Data quality becomes much more critical, however, with less experienced analysts farther removed from data and model development, and for the more detailed evaluations needed for focusing on some types of highly specific questions. With the framework developed, it would now be possible to refine and supplement the data set quickly and relatively easily. This should be done if the model is to used extensively in the future. There would always be a need to keep data current, of course.

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## SUMMARY

Returning abandoned cropland to the existing land resource base would help Vietnam increase income from agriculture and reduce its trade deficit. However, this historical land resource base (i.e., existing land plus the return of abandoned land) does not provide a basis for much economic development, according to results from a linear programming model developed in this study to measure the impact of alternative resource uses (see page 11 for land resource base descriptions). Unless the land resource base is expanded or improved beyond its traditional limits, Vietnam can expect continued deficits in food production. Deficits will occur in livestock feed production and/or rice production, depending on the amount of paddy fed to livestock, even if attainable yield improvements are made and farmers shift to optimum enterprise combinations. This land resource base will not permit self-sufficiency in production of both rice and livestock.

Even with optimum shifts in production patterns within the historical land base, rice would still occupy more than three-fourths of Vietnam's cropland. The small shifts that are indicated in land use, however, would have a large impact on agricultural income and the trade deficit. These shifts are indicated for regions where resistance to change would likely be great because of very small farm size structure. In addition to technical advice on production of alternative crops, farmers in these areas would need to be assured of reliable markets for commodities other than rice before they could afford to shift production patterns.

All model solutions also reflect continued expansion of area planted to high-yielding rice varieties. In addition, output levels for other commodities reflect some improvement in level of technology. These shifts and improvements have a large impact on agricultural income and the trade balance, and suggest a need for continued emphasis on supplying farmers with necessary production inputs at reasonable cost.

The slight expansion of the resource base that could be made possible through additional irrigation by individual farmers would have beneficial effects, without question. Given more stable conditions, this development is likely to occur over time without external stimulation.

Measures to reduce the impact of salt intrusion in the Delta would increase national agricultural income by about 7 billion piasters and reduce the trade deficit about 11 billion piasters. This development could occur over the planning period used for this study. Investment of public capital would be required in unknown amounts.

It is likely that the land resource base could be expanded through public projects to increase the amount of irrigated land in the Delta. It is not likely that such developments could occur over the course of the planning period. Requirements for expenditure of public capital cannot be specified on the basis of existing information. Such expansion would have a positive effect on agricultural income and trade balance. The additional irrigated land would be used primarily for rice production.

The greatest potential for agricultural economic development over the planning period covered by the analysis lies in expansion of agriculture onto previously unused land. In model solutions, the addition of a specified amount of new land to the resource base increases agricultural income by about 50 billion piasters and moves the agricultural trade balance from a large deficit to a large surplus. This expansion would also involve an expenditure of public capital in unspecified amounts. The requirement for public capital expenditure would vary considerably with the degree of government involvement in the settlement program.

National rice production is relatively insensitive to reductions in price, particularly within the limits of the historical land resource base. As the price of rice declines, the amount of paddy fed to livestock increases. Price changes have little effect, of course, on the amount of rice consumed on farms. With the land base expanded to include the additional land resource, a reduction in price to 20 percent below export price level does have some impact on total paddy production, and causes a substantial reduction in rice exports. Rice production would be maintained, then, at price levels considerably lower than current levels.

Corn and peanuts are indicated as major expansion crops on old as well as new land. Expansion of sorghum production is indicated on old and new land in the coastal regions and as a supplementary crop in the floating rice areas. Soybeans show promise on new land.

At the prices used in the model, sugarcane production, sufficient to supply a major portion of the domestic sugar requirement, enters solutions with new land added to the resource base. (Most sugarcane production occurs on new land.)

The analysis indicates that rubber production should be expanded. Rubber almost always comes in on old land to the limits permitted. It comes into solutions on new land with model prices and also with model prices less 10 percent. It does not enter model solutions on new land with rubber price reduced 20 percent. (The model price for rubber may be slightly low relative to other prices.)

Tobacco enters all solutions to the limits permitted. It shows promise as an expansion crop, especially on very small farms, if quality standards can be improved.

Jute and kenaf show strength as potential expansion crops, also on very small farms.

Bananas for export show great strength in all solutions, even with limited resources.

Coffee comes in on a relatively large land area after new land is added to the resource base. Expansion prospects for this crop probably should be viewed with some caution. (The model price of coffee may be somewhat high relative to the type of coffee produced.)

Cotton and wheat production were permitted on special runs of the model. They were not permitted as part of the potential enterprise mix in other

solutions because of lack of experience with these crops in Vietnam. Cotton showed promise as an alternative new crop. Wheat also entered solutions when permitted to do so, but had less impact on the economy than cotton. Wheat showed considerably more promise when run with the additional land base than with the historical land base. Adaptive research to test the potential of these crops appears to be warranted, especially if the land resource base is expanded.

Even with resource situations where national feed supplies became plentiful, large-scale commercial swine and poultry enterprises did not perform well. Additional units of these enterprises never entered solutions for hogs and did so only rarely and reluctantly for poultry. Small-scale farm commercial hog enterprises, using family labor and very simple production facilities, did enter solutions very strongly. There is every reason to believe that similar small-scale poultry enterprises would perform well in the model.

Beef production continues to be a by-product of cattle and buffalo kept primarily for work stock. Commercial beef cattle enterprises did not come into any solution. Beef production could be increased under the existing system by improving reproduction and survival rates. It appears that large scale beef enterprises cannot compete with crops for resources in areas with potential for crop production. This is not to say that areas without significant crop potential but with beef cattle production potential do not exist in Vietnam. However, no such areas were defined for purposes of this study.

To the maximum extent possible, even to the extent of importing additional livestock, work stock should continue to furnish farm power requirements in Vietnam. Mechanization of draft power requirements at this stage of development will reduce agricultural income and increase the expenditure of foreign exchange. On the other hand, there are some mechanization requirements that must be met in order for rapid development to occur. Specifically, requirements for mechanization of threshing operations are built into the model. Preliminary calculations indicated that farm families otherwise could not handle sufficient areas of crops on new land to earn adequate incomes.

Farm size on new land will have to be considerably larger than in traditional farming areas for families to attain adequate incomes. Satisfactory incomes obviously will be needed as inducement for competent settlers. Size of farm will also need to differ considerably among new land areas, depending on productivity and crop suitability, if comparable incomes are to be attained by farm families in different areas.

Internal capital requirements were generated in connection with all model solutions. Runs were made with capital restricted at 75 and 50 percent of the optimum levels generated. These solutions indicated that internal capital use could be reduced considerably below optimum levels without appreciably affecting income levels. Effects on trade balance are likely to be more severe than on income. Sugarcane production is eliminated in a relatively early stage of capital reduction.

All model solutions, in addition to generating requirements for processing and marketing facilities, carry an implicit assumption that the distribution

structure necessary to support the particular solution is in existence. Solution results would be invalid in the absence of this assumption. Efforts to expand output by any means without at least concurrent development of an effective distribution system would surely fail. Stable expansion in output will not occur, especially for new enterprises, unless farmers can be assured of reliable markets.

# INTRODUCTION

The mission assigned for the production economics phase of the Economic Research Service--U.S. Department of Agriculture (ERS-USDA) Vietnam economic studies was to appraise production capacity and supply response in Vietnam's agriculture.

This implicitly requires a determination of the amount and mix of agricultural commodities to satisfy some objective under a given or specified set of conditions with respect to resource availability, technology, prices, institutions, markets, and other conditions. It further implies a determination of the impact of varying some of these conditions on physical and economic indicators, including the objective function, of agriculture's performance. Maximization of Vietnam's agricultural income was selected as the objective function to be used in the analysis.

A supply response analysis normally is concerned largely with production relationships. An agricultural supply response or production capacity analysis usually stops at the farm gate; marketing systems and price relationships are taken as given. However, conditions in Vietnam 1/ dictated special and formal consideration of distribution and price phenomena in conjunction with price relationships. Therefore, it was necessary to expand the scope of the study; this analysis might properly be identified as a production-distribution analysis. In subsequent discussions, the framework within which the analysis was conducted will be referred to as the production-distribution model or, alternatively, as the model.

Within the model, production possibilities and associated input requirements are defined for each land resource situation (see discussion, page 11) for each of six production-marketing regions (Frontispiece). Domestic consumption requirements defined for each included end-use commodity, either by region or for the country, based on estimated per capita consumption rates and 1980 population projections. 2/ A transportation submodel is included for moving commodities between areas at appropriate costs. A marketing-processing submodel is also included for marketing, necessary processing, and transferring each commodity, at appropriate costs, either directly to consumption, to export, or to the transportation system for movement to consumption or export in another region. Consumption requirements of a given region can be satisfied by production within the region, transporting production from another region, or by importing into the country.

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1/ See Appendix 1 for a discussion of the effect of conditions in Vietnam on study procedures with respect to information development, assumptions, and model formulation.

2/ Assuming a 3 percent rate of population increase.

For a given set of conditions, the model simultaneously considers all included variables in determining maximum agricultural income to the country. For the particular set of conditions specified, it generates information on optimum commodity production mix and land use for the country, by regions, and by land resource situations. A partial listing of other information provided with each of the solutions includes:

On a national basis--quantities of individual commodities imported and exported, value of imports and exports, foreign exchange requirements, trade balances, various private capital requirements, and total marketing costs for individual commodities.

For each region--processing facility requirements, quantities of each commodity moving through each marketing and/or processing activity, inter-regional movements of each commodity, and quantities of production inputs.

In the sections that follow, selected information will be presented for optimum solutions under specified varied situations with respect to resources or other conditions. Information will first be presented for major land resource bases specified for Vietnam. Movement to two of these resource bases resulted in drastic changes in agricultural income, resource allocation, and associated variables. Therefore, various specified changes were made within these two land resource bases to determine their impact on the performance and requirements of the agricultural economy.

In addition to the assumptions and procedures described in the appendix, various other conditions and limits have been placed on the various optima. The purpose of such conditions is always to attempt to attain as much realism as possible. It is not always possible to state an objective reason for the precise quantitative condition imposed; in some instances it is based primarily on the intuition of the researcher. Some of the more significant conditions are:

1. Home livestock enterprises are not permitted to expand by more than 60 percent over the planning period. The precise figure of 60 percent might be questioned. Certainly there is a limit by which these enterprises can expand while providing output for consumption.

2. Rubber, coffee, and tea production on old land is limited to the approximate maximum area that these crops occupied in the past, by region.

3. New pineapple production (above that which is expected to occur on excluded land) is limited to 15,000 hectares (ha). There is considerable question about export markets for large quantities of pineapple. Without this limitation, pineapple would be produced in far greater quantity in many solutions.

4. A rotation requirement is imposed on peanuts, limiting this crop to not more than 50 percent of a given land resource.

5. Within given land resources, jute and kenaf are limited to 5-10 percent of the area, reflecting a requirement of nearness to a retting site.

6. Export of tobacco is not permitted. In view of quality improvements needed to provide all the cigarette tobacco needed, it is questionable whether domestic requirements for this commodity could be satisfied over the planning period. It is assumed that these improvements could occur, but production is arbitrarily limited to the quantity necessary for supplying domestic requirements.

7. Banana export is limited to 200,000 metric tons (M.T.).

8. Export of each livestock commodity is limited to 5,000 M.T. Existing health conditions prevent export of most of these commodities. Permitting limited export quantities in the model gives an indication of situations in which export might be expected to occur if health and sanitary problems were corrected.

These conditions affect the various optimal solutions. Effects on some commodities are so general that they will be touched upon here, rather than in connection with specific solutions.

Rubber, tea, and coffee come into most solutions on old land up to the limits permitted. They would come in on larger areas if permitted.

Tobacco always comes into solutions to the extent necessary to supply domestic consumption requirements. It would almost always come in for export, if export were permitted. The strength that tobacco shows certainly warrants giving tobacco attention as a crop with economic potential, particularly in the area of bringing quality up to standards necessary to satisfy domestic requirements. Tobacco comes in on very small farms, and appears to be an attractive alternative for such farms, of which there are many in all areas.

Jute also always comes into solutions, usually at least to the extent of satisfying domestic requirements. It also comes in on very small farms and would become more attractive on such farms in a more market oriented economy, i.e., one with a high assurance of markets for sale of produce and purchase of necessities.

Small quantities of chicken eggs and ducks are exported in all solutions. No significance should be attached to these quantities. They apparently result from anomalies in the coefficients used for poultry and egg consumption, and for output of these commodities from home livestock enterprises. That is, a small surplus of eggs results from satisfying chicken consumption requirements, and a small surplus of ducks results from satisfying duck egg consumption requirements. It is questionable whether these quantities, particularly for chicken eggs, would exist in actual practice.

Pork exports reach the upper limit permitted with most resource situations that provide plentiful feed supplies. Export quantities of pork result primarily from small farm commercial enterprises.

Banana production always occurs to the limit imposed by the export restriction. With the relationships included in the model, much larger quantities of bananas would be produced if there were no arbitrary constraints. The model would produce all the bananas that could be marketed. Such output would not impinge greatly on resources needed for other commodities, since banana production is a relatively intensive user of land.

Coconut is produced in a constant quantity on all resource bases except the existing one, in most solutions. This production occurs on some 40,000 ha of land which were identified as having no alternative use because of saline content. In most solutions, coconut is exported in the form of copra. The model processes copra into oil only when land resources are very limited.

Sorghum almost always comes into solutions on 178,000 ha of land in the floating rice area. It could be grown on residual moisture after floating rice was harvested. There is no alternative use for the resources used and variable costs are more than covered by the value of the crop. However, since per hectare returns are low, there is a question whether this much production would actually occur.

Note on income figures: All summary tables contain a total income figure, made up of two components: farm income and consumers' surplus.

The total figure represents the level of net agricultural income (gross agricultural income, including the value of rice consumed on farms, less production costs and processing, marketing, and transportation margins) that would be associated with each solution if all farm products were in a deficit supply position, i.e., all gross commodity values would be based on import price levels.

The farm income figure represents the actual net agricultural income associated with the particular solution: it reflects the actual level (export or import) of price for each commodity, based on whether it is in a deficit or surplus supply position in the solutic .

The difference between total and farm income is called consumers' surplus: it represents the monetary advantage accruing to consumers from lower prices on those commodities with production in excess of domestic consumption requirements, i.e., consumption expenditures for commodities being exported are reduced by amounts reflecting the difference between their import and export prices.

For example, as shown in table 1, rice moves into export with the irrigation land resource base. When this occurs, the price of rice would fall from the import to the export level. At this point, consumers presumably would realize a surplus of about 25 billion piasters in the form of lower price (since price would fall for all rice and not just for the increment exported), at the expense of farmers' income.

This phenomenon poses problems in price and income policy as production of commodities approaches export levels. When commodities move from deficit to surplus positions, the margin between export and import prices could be used--depending upon policy decisions--for the benefit of consumers in the form of lower prices, for producers in the form of subsidies, to generate government revenues, for other purposes, or for some combination of purposes.

In this connection, it is important to understand that, for any given solution, national farm income is maximized, along with that of each region, each soil resource, and each typical farm, for that set of conditions. However, these optima might be higher or lower relative to total farm incomes, or relative to other regions or other farms, under a different set of conditions. For example, again from table 1, total farm income would be lower for the salt intrusion land base (although total value, including cosumer surplus, would be increased) than for the historical land base. Or, individual rice farmers' income would be lower with irrigation and additional land bases than for the existing, historical, and salt intrusion land bases, even though total farm income would be higher for the additional land base than for any other situation shown.

In the discussion included with this report, references to income or agricultural income will be understood to refer to total value, including consumers' surplus, unless farm income is specified. Most of the consumers' surplus generated with various model solutions is associated with rice.

Table 1. Selected information from Vietnam Production Distribution Model for five major land resource bases, 1980

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | | |
| Farm income | 264.2 | 302.1 | 291.5 | 270.8 | 320.7 |
| Consumers' surplus | 7.4 | 7.8 | 25.5 | 50.6 | 50.8 |
| Total | 271.6 | 309.9 | 317.0 | 321.4 | 371.5 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 31.9 | 39.3 | 42.7 | 49.0 | 135.9 |
| Commodity import | 102.7 | 54.7 | 44.9 | 44.1 | 24.6 |
| Annual inputs | 31.1 | 35.7 | 38.0 | 38.7 | 52.0 |
| Imports | 133.8 | 90.4 | 82.9 | 82.8 | 76.6 |
| Annual balance | -101.9 | -51.1 | -40.2 | -33.8 | 59.3 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 10.1 | 21.7 | 26.3 | 26.5 | 56.8 |
| Distribution | 16.5 | 25.6 | 25.4 | 27.3 | 88.0 |
| Total | 26.6 | 47.3 | 51.7 | 53.8 | 144.8 |
| Foreign exchange | 14.7 | 29.2 | 31.3 | 32.7 | 94.5 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports | | | | | |
| Rice | | | | 96.8 | 539.2 |
| Corn | | | | | 1053.9 |
| Sorghum | | | | | 87.1 |
| Soybeans | | | | | 165.1 |
| Peanuts | | | .5 | | 107.9 |
| Peanut oil | | | | 1.8 | 30.2 |
| Rubber | 137.4 | 167.9 | 167.9 | 167.9 | 212.5 |
| Tea | | .5 | .5 | .5 | .7 |
| Coffee | 2.7 | 2.7 | 2.7 | 2.7 | 44.9 |
| Coconut meal | | 8.6 | | | |
| Copra | | 28.9 | 53.3 | 53.3 | 53.3 |
| Pineapple | | | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | | | | | 46.5 |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Pork | | | 2.0 | 5.0 | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | | |
| Rice | 386.2 | | | | |
| Corn | 61.4 | | | | |
| Soybean meal | 48.5 | 39.5 | 12.8 | 11.6 | |
| Soybean oil | 24.0 | | | | |
| Raw sugar | 286.6 | 286.6 | 273.4 | 259.0 | |
| Sugar | 118.6 | 99.2 | 99.2 | 99.2 | 53.6 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| Pork | 67.4 | 17.8 | | | |
| Chicken | 5.8 | 5.8 | | | |
| Beef | 18.3 | 14.4 | 13.8 | 13.7 | 2.8 |

(Continued)

Table 1. (Continued)

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 1710.0 | 1983.9 | 2023.2 | 2082.9 | 2111.6 |
| Rice, HYV* | 1223.0 | 1357.5 | 1477.6 | 1523.4 | 1491.8 |
| Rice, floating | 577.4 | 656.3 | 656.3 | 639.1 | 639.1 |
| Corn | 25.2 | 88.0 | 63.7 | 65.2 | 754.2 |
| Sorghum | 290.8 | 349.8 | 347.2 | 336.3 | 352.6 |
| Soybeans | | | ** | | 148.7 |
| Peanuts | 48.8 | 67.3 | 95.1 | 98.8 | 236.6 |
| Sugarcane | | 4.4 | 6.2 | 8.2 | 88.5 |
| Tobacco | 19.1 | 20.2 | 20.1 | 20.4 | 21.1 |
| Rubber | 116.0 | 140.0 | 140.0 | 140.0 | 174.3 |
| Tea | 7.3 | 7.2 | 7.2 | 7.2 | 7.5 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 48.6 |
| Coconut | | 40.0 | 40.0 | 40.0 | 40.0 |
| Pineapple | | | 10.0 | 10.0 | 10.0 |
| Bananas | 8.6 | 8.6 | 8.6 | 8.9 | 8.9 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 2768.5 | 3419.9 | 3419.9 | 3567.8 | 4351.1 |
| Paddy home use | 3300.1 | 3328.5 | 3328.5 | 3358.0 | 3385.8 |
| Paddy fed | 366.0 | 495.9 | 810.6 | 810.2 | |
| Total paddy | 6434.6 | 7244.3 | 7559.0 | 7736.0 | 7736.9 |
| Corn marketed | 27.2 | 86.6 | 52.4 | 52.7 | 1390.0 |
| Corn home fed | 30.1 | 100.9 | 73.4 | 76.1 | 465.1 |
| Total corn | 57.3 | 187.5 | 125.8 | 128.8 | 1 55.1 |
| Sorghum marketed | 135.8 | 150.6 | 149.6 | 149.8 | 161.6 |
| Sorghum home fed | 267.0 | 351.4 | 348.1 | 333.1 | 342.1 |
| Total sorghum | 402.8 | 502.0 | 497.7 | 482.9 | 503.7 |
| Soybeans | | | ** | | 181.6 |
| Peanuts | 86.8 | 119.0 | 171.2 | 175.6 | 391.8 |
| Sugarcane | | 220.0 | 336.0 | 523.6 | 3889.8 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 145.5 | 176.0 | 176.0 | 176.0 | 220.6 |
| Tea | 5.9 | 6.4 | 6.4 | 6.4 | 6.6 |
| Coffee | 8.4 | 8.4 | 8.4 | 8.4 | 50.5 |
| Coconut | | 480.0 | 480.0 | 480.0 | 480.0 |
| Pineapple | | | 80.0 | 80.0 | 80.0 |
| Bananas | 215.3 | 215.3 | 215.3 | 222.2 | 222.2 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1164.2 | 1346.0 | 1398.9 | 1436.7 | 1446.4 |
| Rice HYV* | 786.8 | 869.3 | 1035.6 | 1056.3 | 1065.6 |
| Rice, floating | 577.4 | 656.3 | 656.3 | 639.1 | 639.1 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 13.6 | 10.0 | 10.9 | 13.7 | 4.0 |
| Coconut | | 40.0 | 40.0 | 40.0 | 40.0 |
| Bananas | 2.5 | 2.5 | 2.5 | | |



(Continued)

Table 1. (Continued)

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Crop Production (Continued) | | | | | |
| Eastern Crops | | | | | |
| Rice | 165.6 | 218.1 | 205.5 | 216.1 | 210.0 |
| Rice HYV* | 163.2 | 194.7 | 149.3 | 162.7 | 115.5 |
| Corn | 2.1 | 16.0 | 10.0 | 10.0 | 459.0 |
| Corn* | | | | | 459.0 |
| Sorghum | | | | 2.0 | |
| Soybeans | | | | | 31.8 |
| Soybeans* | | | | | 27.4 |
| Peanuts | 9.6 | 10.7 | 16.7 | 16.7 | 37.8 |
| Peanuts* | | | | | 20.1 |
| Sugarcane | | | 1.8 | 3.8 | 84.1 |
| Sugarcane* | | | | | 79.2 |
| Tobacco | 5.4 | 10.3 | 9.3 | 6.7 | 17.2 |
| Rubber | 98.5 | 120.0 | 120.0 | 120.0 | 154.3 |
| Rubber* | | | | | 34.3 |
| Pineapple | | | 10.0 | 10.0 | 10.0 |
| Bananas | 6.1 | 6.1 | 6.1 | 8.9 | 8.9 |
| Lower Coastal Crops | | | | | |
| Rice | 95.6 | 104.5 | 104 5 | 108.9 | 111.4 |
| Rice HYV* | 83.7 | 91.8 | 91.8 | 97.4 | 97.4 |
| Corn | | 2.4 | 2.4 | 2.4 | 7.9 |
| Corn* | | | | | 6.8 |
| Sorghum | 8.6 | 17.7 | 15.1 | 11.8 | 26.6 |
| Sorghum* | | | | | 26.6 |
| Soybeans | | | ** | | 38.3 |
| Soybeans* | | | | | 32.6 |
| Peanuts | 1.3 | 4.8 | 7.5 | 7.5 | 20.5 |
| Peanuts* | | | | | 8.0 |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Central Coastal Crops | | | | | |
| Rice | 133.4 | 146.3 | 146.3 | 148.3 | 154.6 |
| Rice, HYV* | 99.8 | 101.9 | 101.9 | 104.0 | 110.3 |
| Corn | 3.8 | 2.3 | 2.3 | 2.3 | 7.8 |
| Corn* | | | | | 5.5 |
| Sorghum | 42.1 | 61.7 | 61.7 | 58.3 | 71.2 |
| Sorghum* | | | | | 26.0 |
| Peanuts | 9.1 | 10.8 | 10.8 | 12.9 | 31.5 |
| Peanuts* | | | | | 11.7 |
| Sugarcane | | 4.4 | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| North Coastal Crops | | | | | |
| Rice | 123.8 | 134.2 | 134.2 | 139.1 | 149.6 |
| Rice, HYV* | 62.1 | 65.1 | 65.1 | 69.2 | 69.2 |
| Corn | 2.1 | 21.1 | 21.1 | 22.6 | 26.1 |
| Corn* | | | | | 13.0 |
| Sorghum | 62.1 | 86.6 | 86.6 | 80.3 | 76.8 |
| Sorghum* | | | | | 24.9 |
| Peanuts | 7.9 | 7.9 | 7.9 | 9.5 | 51.1 |
| Peanuts* | | | | | 14.2 |
| Jute | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 |

(Continued)

Table 1. (Continued)

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | - - - - - - - - - | Thousand Hectares | - - - - - - - - - | | |
| Highland Crops | | | | | |
| Rice | 27.3 | 34.7 | 33.8 | 33.8 | 39.6 |
| Rice, HYV* | 27.3 | 34.7 | 33.8 | 33.8 | 33.8 |
| Corn | 17.3 | 46.2 | 28.0 | 27.9 | 253.4 |
| Corn* | | | | | 253.4 |
| Sorghum | | 5.8 | 5.8 | 5.8 | |
| Soybeans | | | | | 78.6 |
| Soybeans* | | | | | 51.0 |
| Peanuts | 13.8 | 26.1 | 45.3 | 45.3 | 88.7 |
| Peanuts* | | | | | 43.5 |
| Rubber | 17.5 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.3 | 7.2 | 7.2 | 7.2 | 7.5 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 48.6 |
| Coffee* | | | | | 41.6 |
| | - - - - - - - - - - - - | Units | - - - - - - - - - - - - | | |
| New Facility Requirement | | | | | |
| Tobacco processing | | | | | |
| East | .5 | .5 | .5 | .5 | .5 |
| Banana marketing | | | | | |
| Delta | 1.0 | 1.0 | 1.0 | | |
| East | 2.3 | 2.3 | 2.3 | 3.3 | 3.3 |
| Fiber processing | | | | | |
| East | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| Rubber processing | | | | | |
| East | 78.1 | 106.0 | 106.0 | 106.0 | 150.6 |
| Highland | 17.5 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea processing | | | | | |
| Highland | 1.7 | 3.5 | 3.5 | 3.5 | 4.3 |
| Rice mill | | | | | |
| East | | | | | 3.8 |
| Lower Coast | 4.3 | 7.2 | 4.6 | 7.0 | 9.7 |
| Highland | | 3.0 | .3 | .3 | 3.0 |
| Rice drying | | | | | |
| Delta | 50.1 | 52.1 | 81.9 | 80.8 | 109.4 |
| East | 12.1 | 12.1 | 12.1 | 12.1 | 9.4 |
| Grain storage | | | | | |
| Delta | 142.7 | 280.5 | 295.2 | 324.2 | 488.6 |
| East | | | | | 168.0 |
| Lower Coast | | | | | 33.9 |
| Highland | 5.0 | 26.6 | 11.3 | 11.4 | 188.0 |
| Threshing-Shelling | | | | | |
| Delta | 194.2 | 194.2 | 194.2 | 194.2 | 194.2 |
| East | 2.5 | 17.4 | 9.7 | 15.1 | 830.9 |
| Lower Coast | 13.4 | 27.9 | 24.1 | 19.2 | 79.3 |
| Central Coast | 65.0 | 94.0 | 94.0 | 89.2 | 105.8 |
| North Coast | 95.1 | 136.8 | 136.8 | 127.9 | 119.9 |
| Highland | 20.7 | 64.7 | 41.3 | 41.3 | 544.5 |
| Feed mill | | | | | |
| Delta | 7.9 | 2.8 | 1.5 | 1.5 | .5 |
| Lower Coast | .6 | .7 | .7 | .6 | .6 |
| Central Coast | .2 | 1.5 | 1.3 | 1.6 | 2.3 |
| North Coast | 1.1 | 1.3 | 1.4 | 1.3 | 1.3 |
| Highland | 2.5 | 5.8 | 3.7 | 3.7 | 15.3 |

(Continued)

Table 1. (Continued)

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | | | Units | | |
| New Facility Requirement (Continued) | | | | | |
| Oil mill | | | | | |
| Delta | .2 | .7 | .2 | .2 | .2 |
| East | .3 | .3 | .5 | .5 | .8 |
| Lower Coast | ** | .1 | .2 | .2 | |
| Central Coast | .2 | .3 | .3 | .3 | .8 |
| North Coast | .2 | .2 | .2 | .2 | |
| Highland | .4 | .8 | 1.4 | 1.4 | 2.6 |
| Sugar mill | | | | | |
| East | | | | | 6.6 |
| Sugar refinery | | | | | |
| East | | | | | .4 |
| Central Coast | | .2 | .2 | .2 | .2 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

**Less than .05.

## LAND RESOURCE SITUATIONS

### Major Land Resource Bases

Five major national land resource bases were delineated. They were identified as: (I) existing; (II) historical; (III) salt intrusion; (IV) irrigation; and (V) additional. They are defined as follows:

I. Existing--cadastral area used for crops in 1971;

II. Historical--existing, plus land previously abandoned;

III. Salt Intrusion--historical, plus alterations to the land resource base resulting from Delta salt intrusion improvements.

IV. Irrigation--salt intrusion, plus alterations to the land resource base resulting from additional irrigation that could be performed by farmers without new irrigation projects.

V. Additional--irrigation, plus previously unused land that could be brought into cultivation.

There are many possible land resource situations, based on different combinations involving additions of or alterations to various categories of resources, for which solutions could be developed. The five basic situations considered at this point were considered to represent feasible and logical developments over the planning period used for this study. The existing resource base is obviously significant if only for purposes of comparison. It is reasonable to expect that additions and modifications of resources involving abandoned land and irrigation within the capability of individual farmers would occur with a return to peaceful conditions. These improvements could occur without significant expenditure of public capital or specific government programs, although policies could be adopted that would either hasten or retard their development. Significant settlement of new land could also occur without appreciable expenditure of public capital, although additional roads would be required in order to bring in all the new land considered in the additional land base situation. Improvements included in the salt intrusion situation would require public projects and the expenditure of public capital. Salt water exclusion improvements are incorporated as a separate major resource situation because they presumably existed in the past; the Vietnamese generally consider this reconstruction to be a desirable objective.

The additions and improvements included in these five situations could be considered in different combinations, or they could be incorporated in a different sequence than the one used. Reordering the sequence of incorporation would have some effect on the impact shown for the various additions. For example, the salt intrusion improvements would show less impact on income and related variables if they were added after, rather than before, the addition of new land. However, the sequence used gives a reasonable representation of the relative impacts of the individual additions or modifications associated with the different land bases. The major reason for placing the additional land resource

base last was that this development would represent a break from Vietnam's traditional agriculture, whereas other situations represent extensions to existing or traditional agriculture.

Income, foreign exchange considerations, production, and land use on a national basis, and land use on a regional basis, are shown for each of the five major land base situations in table 1. The following brief paragraphs cover only a few points of interest from the table, relating to each of the optimal solutions.

The optimum solution for the existing land resource base would involve some shift in land resource use, compared with present land use. Rice would occupy more than four-fifths of all cropland; but compared with past and current land use, there would be modest displacement of rice with sorghum, corn, and peanuts--primarily in the Coastal and Highland regions. The amount of rice land in high-yield varieties (HYV) would be roughly doubled as compared with 1971. The value of imports for commodities included in the analysis exceeds 100 billion piasters. Rubber and bananas are the only significant export items. Almost 400,000 M.T. of rice would be imported.

The introduction of abandoned land into the land resource base would have a substantial impact on the performance of the agricultural economy. Income would increase by almost 40 billion piasters. The major portion of the abandoned land added would go into rice production in the Delta and Eastern regions. Sorghum, peanuts, and corn would show much higher relative hectare increases than rice in the Coastal and Highland regions. The annual trade deficit would be reduced by about one-half. Grain and oil imports would be eliminated. Capital requirements would increase by about 20 billion piasters: major items requiring production capital are pumps and sprayers. Grain processing and storage facilities would be the major items requiring new distribution of capital.

Alteration in the land resource base to reflect salt intrusion modifications would increase total income about 7 billion piasters, including consumers' surplus. At this point, however, total farm income would decrease because of reduced hog prices as hogs moved into export. The trade balance would improve by about 12 billion piasters. Hectare and production shifts associated with this situation would occur primarily in the Delta region. Slight changes would occur in other regions, however, because of changes in comparative advantage resulting from increased availability of rice and its by-products in the country. All of the additional paddy rice produced with this situation would be used for livestock feed. Relieved pressure for feed grain would cause some shift of land to oil seed crops, primarily peanuts.

Additional improvement of about 4 billion piasters in agricultural income would result from resource modification involving increased irrigation. Again, however, farmers' income would decrease substantially, with consumer surplus increased, as rice price moved from the import to the export level. Trade deficit would be reduced by about 6 billion piasters, mostly as a result of rice export. Production changes associated with this resource situation would primarily involve increases in area and production of rice, with a substantial portion of the additional rice resulting from increased area in high-yielding varieties. The improvement in trade balance would result entirely from increased rice export.

The addition of previously unused land to the resource base would increase agricultural income by some 50 billion piasters, improving trade balance by 93 billion piasters, yielding a positive trade balance of almost 60 billion piasters. Rice, rubber, coffee, and vegetable oil exports would increase substantially. Corn, peanuts, sorghum, and soybeans would attain export positions. The vegetable oil available for export apparently would occur as a surplus over domestic consumption requirements in conjunction with providing for animal protein feed needs. High processing and marketing margins for oil crops appear to be the major factors limiting the production of vegetable oil specifically for export purposes. Almost 90 percent of sugar imports would be replaced by domestically produced sugar as sugarcane comes in on new land.

Total new capital requirements associated with the additional land resource use would amount to about 91 billion piasters. More than two-thirds of this would represent requirements for distribution facilities. Importation of additional work stock and new tools would account for a major share of the production capital requirements. Sugar mills and additional grain storage and thresher-sheller capacity would be the major items requiring new capital for distribution facilities. About two-thirds of the new capital requirements would involve the expenditure of foreign exchange.

Feed grains and oil seed crops would occupy the major portion of the new land. Corn would be the predominant feed grain in the Eastern and Highland regions, while sorghum would come in stronger in the Coastal regions. Sugarcane and rubber would be produced on new land in the Eastern region. There would be some increase in rice production on old land in the Coastal regions as pressure would be relieved on feed grain production.

Except on soil H24R, 3/ which is considered to be suitable only for tree crops, new land is brought into the resource base in 10 ha units (farms). It is assumed that the labor supply on these farms is provided by the family. This assumption limits the production of some enterprises with high labor requirements, most notably rubber and peanuts. In this analysis rubber is considered as a farm enterprise and not on a plantation basis. On a per hectare basis, under these conditions, rubber would be the most profitable alternative on some land resource situations and would come in on much larger areas with higher labor to land ratios.

Livestock: Output of livestock products by region is shown in table 2 for the five major land resource bases. Except in the case of hogs and beef, there would be little change in the distribution of production among regions in moving from one resource base to another. A small farm commercial hog enterprise that was included as an enterprise alternative would compete strongly with the yard-type hog enterprise when commercial feed supplies are available. Hog production tends to follow the location of feed supply in the solutions. In the historical and salt intrusion solutions, the largest increase in hog production would be in the Delta because of the additional rice produced there with these situations. With additional feed grain produced in conjunction with the additional land resource base, however, there would be a tendency for hog production to move to the Eastern and Highland regions.

3/ See the land discussion on page 109, Appendix A.

**Table 2.** Production of livestock products, Vietnam Production Distribution Model solutions with five major land resource bases, 1980

| Item | Existing | Historical | Salt intrusion | Irrigation | Additional |
|---|---|---|---|---|---|
| | - - - - - - - - - - | Thousand Metric Tons | - - - - - - - - - - | | |
| Pork 1/ | | | | | |
| Delta | 132.4 | 166.1 | 201.5 | 201.6 | 152.9 |
| Eastern | 58.2 | 60.2 | 62.6 | 68.6 | 80.6 |
| Lower | 11.9 | 17.0 | 20.2 | 20.2 | 20.2 |
| Central | 23.1 | 32.2 | 28.8 | 28.1 | 34.9 |
| North | 24.6 | 39.0 | 38.2 | 37.6 | 37.4 |
| Highland | 12.1 | 26.7 | 21.3 | 21.3 | 51.6 |
| Vietnam | 262.3 | 341.2 | 372.6 | 377.4 | 377.6 |
| Chicken 1/ | | | | | |
| Delta | 52.4 | 52.4 | 52.4 | 52.4 | 52.4 |
| Eastern | 19.3 | 19.3 | 19.3 | 19.3 | 19.3 |
| Lower | 3.8 | 3.8 | 4.7 | 3.8 | 3.8 |
| Central | 5.9 | 5.9 | 11.7 | 12.9 | 13.1 |
| North | 6.3 | 6.3 | 7.9 | 7.6 | 7.5 |
| Highland | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Vietnam | 90.2 | 90.2 | 98.5 | 98.7 | 98.6 |
| Duck 1/ | | | | | |
| Delta | 44.3 | 44.3 | 44.1 | 44.1 | 44.7 |
| Eastern | 6.7 | 6.7 | 6.7 | 6.7 | 6.3 |
| Lower | 1.9 | 1.9 | 2.0 | 2.0 | 1.9 |
| Central | 2.1 | 2.1 | 2.1 | 2.1 | 2.1 |
| North | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Highland | .1 | .1 | .2 | .2 | .1 |
| Vietnam | 57.0 | 57.0 | 57.0 | 57.0 | 57.0 |
| Chicken Egg | | | | | |
| Delta | 20.8 | 20.8 | 20.8 | 20.8 | 20.8 |
| Eastern | 10.4 | 10.4 | 10.4 | 10.4 | 10.4 |
| Lower | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| Central | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 |
| North | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| Highland | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Vietnam | 40.6 | 40.6 | 40.6 | 40.6 | 40.6 |
| Duck Egg | | | | | |
| Delta | 9.7 | 9.6 | 10.3 | 10.3 | 7.6 |
| Eastern | .2 | .2 | .2 | .2 | 2.2 |
| Lower | .7 | .7 | .1 | .1 | .7 |
| Central | .9 | .9 | .9 | .9 | .9 |
| North | .8 | .8 | .8 | .8 | .8 |
| Highland | * | .1 | * | * | .1 |
| Vietnam | 12.3 | 12.3 | 12.3 | 12.3 | 12.3 |
| Beef 1/ | | | | | |
| Delta | 20.3 | 27.6 | 28.6 | 28.8 | 28.8 |
| Eastern | 8.1 | 8.1 | 8.1 | 8.1 | 18.3 |
| Lower | 6.2 | 6.2 | 6.2 | 6.2 | 6.2 |
| Central | 9.3 | 9.3 | 9.3 | 9.3 | 9.3 |
| North | 5.8 | 5.8 | 5.8 | 5.8 | 5.8 |
| Highland | 3.1 | 3.1 | 3.1 | 3.1 | 12.7 |
| Vietnam | 52.8 | 60.1 | 61.1 | 61.3 | 81.1 |

1/ Live weight. *Less than .05.

Beef production would increase in the Eastern and Highland regions for the additional land situation, as a result of increased numbers of work stock in these regions.

Poultry production would change very little between land resource bases. No small-scale (farm) commercial poultry enterprises were included as alternative enterprise possibilities. Chicken would be imported into the Coastal regions in the existing and historical base solutions. In remaining solutions, with pressure relieved on feed supplies, additional large-scale broiler enterprises would enter these regions to the extent necessary to provide domestic consumption requirements.

Existing large-scale commercial swine and poultry enterprises were fixed in the various regions. Except for the limited entry of broiler enterprises in the Coastal regions, no additional large-scale livestock enterprise, of the type now found in Vietnam, enter any solutions.

Grain feed for livestock: The mix of grain products used for livestock feed with the major land resource situations is shown in table 3. Paddy rice would be an important component of the grain feed mix until previously unused land is added to the land resource base. In actual practice it is likely that more paddy than shown would be fed for the existing, historical, and additional land resource bases. The model imported appreciable quantities of livestock products for the existing and historical solutions. It is more likely that more paddy would be fed, more rice imported, and livestock imports reduced or eliminated. Likewise, it is unlikely that the point would be reached over the course of the planning period where farmers in surplus rice areas would not feed any paddy. If more paddy were fed, however, it would have little impact on overall solution results, except as it affected imports and exports of rice and livestock products. Income and trade balance effects would largely balance out.

The sorghum fed for all solutions includes 214,000 M.T. of sorghum produced behind floating rice. If this sorghum were not produced, the deficit would be replaced primarily by paddy.

Note on processing facilities: The processing facilities shown in table 1 are an integral part of, and at the same time a necessary condition for, the solution. Without the additional rice milling capacity shown for the Lower Coastal region, for example, the amount of rice production shown would not occur.

These facilities come into solutions in fractional units. For example, with the abandoned land situation, there would be 0.3 oil mill for the Central region. In the real world, of course, these facilities would exist in whole units or not at all. There are options for adjusting size of plants, but in terms of whole units. It is not likely that the real world optimum solution for the abandoned land situation would involve an oil milling plant in each of the three Coastal regions. Neither is it likely that it would involve no plant in any of the regions. Most likely, it would involve location of one plant in one of the three regions. All three alternatives would result in different model solutions. However, numerous additional solutions, with plant numbers fixed at specified levels, would be necessary for greater precision with respect to plant size and location for various processing facilities. Considerable

Table 3. Grain products used for livestock feed, Vietnam Supply Distribution Model solutions with five major land resource bases, 1980

| Product | Land resource base | | | | |
|---|---|---|---|---|---|
| | Existing | Historical | Salt intrusion | Irrigation | Additional |
| | - - - - - - - - - - - Thousand Metric Tons - - - - - - - - - - - | | | | |
| Paddy | 366.0 | 495.9 | 810.6 | 810.2 | -- |
| Broken rice | 305.8 | 349.3 | 349.3 | 365.5 | 439.4 |
| Bran | 555.6 | 613.5 | 613.4 | 629.6 | 703.5 |
| Corn | 116.2 | 179.8 | 121.1 | 121.3 | 672.9 |
| Sorghum | 390.4 | 488.4 | 484.2 | 484.2 | 403.9 |
| Wheat bran | 46.5 | 46.5 | 46.5 | 46.5 | -- |
| Total | 1780.5 | 2126.6 | 2425.1 | 2457.3 | 2219.7 |

refinement in data would also be needed. The matter of fractional units poses little problem in those instances where large numbers of new facilities are needed in a region or when the investment requirements for individual units are relatively small. At any rate, it is felt that the information as developed by the model is useful in terms of specifying general requirements for additional capacity and that efforts to attain greater precision are not warranted at this point. One solution will be presented at a later point with a requirement that some facilities come in only whole units. It will be seen that this requirement has some effect on monetary variables and on production patterns, but that the major thrust of the solution is not changed.

## Other Land Resource Situations

As indicated previously, there are numerous possibilities for adding to or altering the land resource base. Major attention was given to defining and delineating those included to this point because they are considered to be feasible developments, with a return to relative peace, over the planning period used for this study. There are others that might be of interest to Vietnam over a longer-run period. Table 4 contains information from optimum solutions relating to two developments that would undoubtedly extend beyond 1980 and which probably would require relatively large expenditure of public capital: reducing the impact of flooding in the Coastal regions and relatively large scale irrigation projects for the Delta region. Table 4 also contains information from a solution involving the addition of new land directly onto the historical land base, without simultaneously including salt intrusion and irrigation improvements as was done in table 1.

Table 4. Selected information from Vietnam Production Distribution Model, other land resource base combinations, 1980

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | |
| Farm income | 310.7 | 326.8 | 281.7 | 312.2 |
| Consumers' surplus | 7.8 | 50.6 | 50.6 | 50.8 |
| Total | 318.5 | 377.4 | 331.3 | 363.0 |
| Annual Foreign Exchange | | | | |
| Commodity export | 41.2 | 144.9 | 65.0 | 117.3 |
| Commodity import | 48.2 | 24.6 | 43.2 | 24.9 |
| Annual inputs | 36.5 | 53.5 | 38.9 | 48.5 |
| Imports | 84.7 | 78.1 | 82.1 | 73.4 |
| Annual balance | -43.5 | 66.8 | -17.1 | 43.9 |
| Capital Investment (one-time requirement) | | | | |
| Production | 21.6 | 59.2 | 23.9 | 52.0 |
| Distribution | 24.7 | 90.9 | 33.4 | 83.8 |
| Total | 46.3 | 150.1 | 57.3 | 135.8 |
| Foreign exchange | 29.0 | 98.9 | 34.3 | 87.9 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | |
| Exports | | | | |
| Rice | | 683.4 | 398.1 | 235.5 |
| Corn | | 1076.5 | | 1029.5 |
| Sorghum | | 92.0 | | 64.4 |
| Soybeans | | 165.1 | | 120.2 |
| Soybean oil | | | | 1.9 |
| Peanuts | | 143.3 | | 93.3 |
| Peanut oil | 2.9 | 22.0 | 1.8 | 41.2 |
| Rubber | 167.9 | 212.2 | 167.9 | 211.3 |
| Tea | .5 | .7 | .5 | ** |
| Coffee | 2.7 | 44.9 | 2.7 | 44.9 |
| Copra | 53.3 | 53.3 | 53.3 | 53.3 |
| Pineapple | | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | | 46.5 | | 46.5 |
| Duck feathers | .9 | .9 | .9 | .9 |
| Pork | | 5.0 | 5.0 | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | |
| Corn | 9.5 | | | |
| Soybean meal | 14.9 | | 11.6 | |
| Soybean oil | ** | | | |
| Raw sugar | 286.6 | | 259.0 | |
| Sugar | 99.2 | 53.6 | 99.2 | 53.6 |
| Fiber | 6.6 | | | |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 |
| Chicken | 4.9 | | | |
| Beef | 14.4 | 2.8 | 11.1 | 3.7 |

(Continued)

Table 4. (Continued)

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | |
| Crops | | | | |
| Rice, nonfloating | 1969.8 | 2109.1 | 2229.4 | 2002.5 |
| Rice, HYV* | 1418.0 | 1598.7 | 1556.5 | 1280.2 |
| Rice, floating | 656.2 | 639.1 | 639.1 | 656.3 |
| Corn | 63.1 | 753.3 | 65.2 | 765.5 |
| Sorghum | 358.2 | 346.8 | 336.3 | 358.5 |
| Soybeans | | 148.7 | ** | 118.9 |
| Peanuts | 104.6 | 246.5 | 98.8 | 247.9 |
| Sugarcane | 4.4 | 89.1 | 8.2 | 91.3 |
| Tobacco | 20.1 | 20.7 | 20.1 | 20.9 |
| Rubber | 140.0 | 174.1 | 140.0 | 173.4 |
| Tea | 7.2 | 7.5 | 7.2 | 7.5 |
| Coffee | 7.0 | 48.6 | 7.0 | 48.6 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 |
| Pineapple | | 10.0 | 10.0 | 10.0 |
| Bananas | 8.7 | 8.9 | 8.9 | 8.6 |
| Jute | 4.4 | 8.1 | 11.1 | 11.1 |
| Kenaf | | 3.0 | | |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | |
| Crop Production | | | | |
| Paddy marketed | 3288.9 | 4541.8 | 4120.2 | 3823.9 |
| Paddy home use | 3459.5 | 3459.5 | 3358.0 | 3356.3 |
| Paddy fed | 716.2 | | 672.2 | |
| Total paddy | 7464.6 | 8001.3 | 8150.4 | 7180.2 |
| Corn marketed | 58.3 | 1384.9 | 52.7 | 1417.4 |
| Corn home fed | 73.0 | 467.6 | 76.1 | 465.1 |
| Total corn | 131.3 | 1852.5 | 128.8 | 1882.5 |
| Sorghum marketed | 151.5 | 165.9 | 149.8 | 158.1 |
| Sorghum home fed | 367.5 | 327.8 | 333.1 | 355.4 |
| Total sorghum | 519.0 | 493.7 | 482.9 | 513.5 |
| Soybeans | | 181.6 | ** | 144.7 |
| Peanuts | 179.2 | 402.7 | 175.6 | 413.6 |
| Sugarcane | 220.0 | 3889.8 | 523.7 | 3889.8 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 176.0 | 220.4 | 176.0 | 219.4 |
| Tea | 6.4 | 6.6 | 6.4 | 5.9 |
| Coffee | 8.4 | 50.6 | 8.4 | 50.6 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 |
| Pineapple | | 80.0 | 80.0 | 80.0 |
| Bananas | 215.3 | 222.2 | 222.2 | 215.3 |
| Jute | 4.4 | 8.1 | 11.1 | 11.1 |
| Kenaf | | 3.0 | | |

(Continued)

Table 4. (Continued)

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | |
| Delta Crops | | | | |
| Rice, nonfloating | 1346.1 | 1445.5 | 1583.2 | 1352.0 |
| Rice, HYV* | 870.5 | 1065.6 | 1089.4 | 875.3 |
| Rice, floating | 656.2 | 639.1 | 639.1 | 656.3 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 8.8 | 3.1 | 13.4 | 4.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 |
| Bananas | 2.5 | | | 2.5 |
| Jute | 1.1 | 1.5 | | |
| Kenaf | | .3 | | |
| Eastern Crops | | | | |
| Rice | 214.8 | 202.6 | 216.1 | 203.3 |
| Rice, HYV* | 152.0 | 110.9 | 162.7 | 106.1 |
| Corn | 13.9 | 458.1 | 10.0 | 454.2 |
| Corn* | | 458.1 | | 454.2 |
| Sorghum | | | 2.0 | |
| Soybeans | | 31.8 | ** | 29.5 |
| Soybeans* | | 27.4 | | 27.4 |
| Peanuts | 12.8 | 36.6 | 16.7 | 39.1 |
| Peanuts* | | 20.1 | 3.8 | 20.1 |
| Sugarcane | | 84.7 | | 86.9 |
| Sugarcane* | | 80.4 | | 85.1 |
| Tobacco | 10.3 | 17.7 | 6.7 | 16.9 |
| Rubber | 120.0 | 154.1 | 120.0 | 153.4 |
| Rubber* | | 34.1 | | 33.4 |
| Pineapple | | 10.0 | 10.0 | 10.0 |
| Bananas | 6.1 | 8.9 | 8.9 | 6.1 |
| Jute | 3.3 | 6.7 | | |
| Kenaf | | 2.6 | | |
| Lower Coastal Crops | | | | |
| Rice | 105.3 | 112.1 | 108.9 | 110.3 |
| Rice, HYV* | 100.8 | 106.4 | 97.4 | 91.8 |
| Corn | 2.4 | 7.9 | 2.4 | 7.9 |
| Corn* | | 6.8 | | 6.8 |
| Sorghum | 15.1 | 26.6 | 11.8 | 26.6 |
| Sorghum* | | 26.6 | | 26.6 |
| Soybeans | | 38.3 | | 38.3 |
| Soybeans* | | 32.6 | | 32.6 |
| Peanuts | 7.5 | 20.5 | 7.5 | 20.5 |
| Peanuts* | | 8.0 | | 8.0 |
| Jute | | | .7 | .7 |

(Continued)

Table 4. (Continued)

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | |
| Central Coastal Crops | | | | |
| Rice | 142.9 | 159.7 | 148.3 | 152.6 |
| Rice, HYV* | 140.4 | 157.3 | 104.0 | 108.2 |
| Corn | 7.3 | 7.8 | 2.3 | 7.8 |
| Corn* | | 5.5 | | 5.5 |
| Sorghum | 70.2 | 71.2 | 58.3 | 72.4 |
| Sorghum* | | 26.0 | | 26.0 |
| Peanuts | 5.8 | 31.5 | 12.9 | 31.5 |
| Peanuts* | | 11.7 | | 11.7 |
| Sugarcane | 4.4 | 4.4 | 4.4 | 4.4 |
| Jute | | | 5.1 | 5.1 |
| North Coastal Crops | | | | |
| Rice | 126.0 | 149.6 | 139.1 | 144.7 |
| Rice, HYV* | 119.6 | 124.8 | 69.2 | 65.1 |
| Corn | 11.6 | 26.1 | 22.6 | 24.6 |
| Corn* | | 13.0 | | 13.0 |
| Sorghum | 89.2 | 71.0 | 80.3 | 81.5 |
| Sorghum* | | 24.9 | | 24.9 |
| Peanuts | 27.2 | 62.2 | 9.5 | 51.1 |
| Peanuts* | | 14.2 | | 14.2 |
| Tobacco | 1.1 | | | |
| Jute | | | 5.3 | 5.3 |
| Highland Crops | | | | |
| Rice | 34.7 | 39.6 | 33.8 | 39.6 |
| Rice, HYV* | 34.7 | 33.8 | 33.8 | 33.8 |
| Corn | 27.9 | 253.4 | 27.9 | 271.0 |
| Corn* | | 253.4 | | 271.0 |
| Sorghum | 5.8 | | 5.8 | |
| Soybeans | | 78.6 | | 51.1 |
| Soybeans* | | 51.0 | | 26.7 |
| Peanuts | 44.4 | 88.7 | 45.3 | 98.6 |
| Peanuts* | | 43.5 | | 50.3 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.2 | 7.5 | 7.2 | 7.5 |
| Coffee | 7.0 | 48.6 | 7.0 | 48.6 |
| Coffee* | | 41.6 | | 41.6 |

(Continued)

Table 4. (Continued)

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - - - - | | Units - - - - - - - - - - - - | |
| New Facility Requirement | | | | |
| Tobacco processing | | | | |
| East | .5 | .5 | .5 | .5 |
| Banana marketing | | | | |
| Delta | 1.0 | | | 1.0 |
| East | 2.3 | 3.3 | 3.3 | 2.3 |
| Fiber processing | | | | |
| East | | 2.6 | 2.6 | 2.6 |
| Rubber processing | | | | |
| East | 106.0 | 150.0 | 106.0 | 149.3 |
| Highland | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea processing | | | | |
| Highland | 3.5 | 4.3 | 3.5 | 1.8 |
| Rice mill | | | | |
| East | | 1.7 | | 1.5 |
| Lower Coast | 9.9 | 12.3 | 7.0 | 7.5 |
| Central Coast | 1.5 | 5.0 | | |
| North Coast | 6.8 | 10.8 | | |
| Highland | 3.0 | 3.0 | .3 | 3.0 |
| Rice drying | | | | |
| Delta | 52.6 | 109.4 | 52.6 | 70.1 |
| East | 12.1 | 9.2 | 12.0 | 12.0 |
| Grain storage | | | | |
| Delta | 217.7 | 488.1 | 458.1 | 373.1 |
| East | | 168.6 | | 147.1 |
| Lower Coast | 4.7 | 42.8 | | 26.5 |
| Central Coast | | 8.8 | | |
| Highland | 18.8 | 188.0 | 11.4 | 191.3 |
| Threshing-Shelling | | | | |
| Delta | 194.2 | 194.2 | 194.2 | 194.2 |
| East | 14.9 | 826.3 | 15.1 | 801.5 |
| Lower Coast | 24.1 | 79.3 | 19.2 | 79.3 |
| Central Coast | 109.2 | 105.8 | 89.2 | 107.7 |
| North Coast | 141.2 | 110.9 | 127.9 | 126.7 |
| Highland | 41.3 | 544.5 | 41.3 | 554.3 |

(Continued)

Table 4. (Continued)

| Item | Flooding controlled in coastal areas with | | Historical land base plus | |
|---|---|---|---|---|
| | Historical base | Additional base | Additional irrigation 1/ | 1,178,000 Ha new land |
| | - - - - - - - - - - - - | | Units - - - - - - - - - - - - | |
| New Facility Requirement (Continued) | | | | |
| Feed Mill | | | | |
| Delta | 2.5 | .5 | 1.5 | 2.4 |
| Lower Coast | .6 | .6 | .6 | .6 |
| Central Coast | .5 | 2.3 | 1.6 | 2.2 |
| North Coast | 2.8 | 1.2 | 1.3 | 1.3 |
| Highland | 4.0 | 12.1 | 3.7 | 21.1 |
| Oil mill | | | | |
| Delta | .2 | .2 | .2 | .2 |
| East | .4 | .4 | .5 | 1.5 |
| Lower Coast | .2 | | .2 | |
| Central Coast | .1 | .7 | .3 | .7 |
| North Coast | .6 | | .2 | |
| Highland | 1.3 | 2.6 | 1.4 | 2.9 |
| Sugar mill | | | | |
| East | | 6.7 | | 7.1 |
| Sugar refinery | | | | |
| East | | .4 | | .4 |
| Central Coast | .2 | .2 | .2 | .2 |

1/ Assumes 200,000 hectares irrigation projection in the Delta, in addition to irrigation increases that could be made by individual farmers.

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

**Less than .05.

Much of the farm land in the Coastal regions is subject to severe flooding during the rainy season. This flooding limits the choice of crop alternatives and seriously limits the yield of rice, which is the major crop that can be produced under these conditions. If rainy season flooding were controlled in these regions in conjunction with the historical land base (compare table 4 with table 1), agricultural income would increase by about 9 billion piasters. The annual trade deficit would decline by about 7 billion piasters. Most of the improvement would result from increased use of high-yielding rice varieties in the Coastal regions and from some shift of land to peanuts in these regions.

Limiting flooding in the Coastal regions in conjunction with the additional land resource base would increase income by about 6 billion piasters and reduce the trade deficit by about 7 billion piasters. Again, most of the improvements arise directly or indirectly from the production of more rice in the Coastal regions. Changes indicated, for both the additional and historical land bases, would occur entirely as a result of controlling flooding during the rainy season, without any impact assumed on irrigation and dry season crops.

The column in table 4 with the heading additional irrigation, reflects a situation that assumes a 200,000 ha irrigation project in the Delta, plus irrigation improvements that individual farmers could make. Compared with the historical land base (table 1), this situation would result in additional value from agriculture of about 21 billion piasters. The trade deficit would be reduced by 34 billion piasters. Internal capital requirements would increase by about 10 billion piasters. Part of the improvement associated with this situation, of course, would result from the irrigation improvements assumed to be made by individual farmers. In fact, it is interesting that production and land use figures in the additional irrigation column of table 4 are identical with those in the irrigation column of table 1 except for rice production in the Delta. The effect of additional irrigation in the Delta, then, results entirely from increased production and export of rice.

The last column in table 4 reflects the effect of adding the new land resource directly to the historical land base, without including the salt water exclusion and irrigation improvements. This addition would result in increased value from agriculture of about 53 billion piasters; there would be a positive effect of about 95 billion piasters on the annual trade balance. Additional requirements for internal capital would amount to almost 90 billion piasters. Production and land use relationships are similar to those shown for the additional land base situation in table 1.

## Summary Comments on Land Resource Situations

The analysis to this point indicates that there is a need for Vietnam to expand its land resource base. Even with very substantial additional adoption of yield-increasing technology, the existing land resource base will not permit self-sufficiency in rice and livestock products as of 1980. A very large agricultural trade deficit will exist unless the land resource base is expanded.

The easiest and most logical approach to expanding the land resource base, with a return to relatively peaceful conditions, would be to bring previously

cultivated abandoned land back into production. This step would result in a large increase in agricultural income and a large decrease in the agricultural trade deficit. However, the country still would not be self-sufficient in grain and livestock production. Again, it should be pointed out that study results for this situation approach the best results that could be attained from the historical land base, assuming a very substantial additional adoption of improved technology and that farmers shift to income-maximizing enterprises for their particular land resources.

Alterations in the land resource base through water control, irrigation, and salt intrusion improvements, if accomplished, would result in growth of Vietnam's agriculture largely through extension of traditional production patterns. Most of the increased output would emanate from increased rice production. There would be some shifts away from rice production on low-producing rice land in some regions as pressure on rice supplies decreased. But, basically, the agriculture would continue to center around rice production. Marketing and other institutions related to agriculture would not necessarily change.

The addition of previously unused land to the agricultural resource base would represent a new thrust in terms of production patterns and agricultural institutions. Rice production would be maintained on the better rice land, which makes up most of the historical land resource base, and rice would retain a dominant position in the economy. New land would be used primarily for feed grain and oil seed production. Feed grain would substitute for paddy rice as livestock feed, releasing a substantial quantity of rice for export. Large surpluses of corn and oil seed would also be available for export. A positive agricultural trade balance would be expected.

There is little doubt that the productive potential of much of the historical land resource base could be increased through measures to improve water control, increase irrigation, and reduce the effect of salt water intrusion. Feasibility data relating to these measures are sketchy. However, for purposes of this study, estimates were made as to the extent of such improvements that could be reasonably expected to occur over the planning period. With these improvements made, and still assuming optimum adjustments in terms of technology and enterprise selection, Vietnam could attain self-sufficiency in rice and livestock products. The country would still have an agricultural trade deficit.

It probably would be technically possible to extend water control and irrigation improvements far beyond those assumed in the study, perhaps to the point resulting in a positive net trade balance attributable to agriculture. It is believed, however, that developments of this magnitude would require large expenditures of public development capital, and that they could not be accomplished over the planning period used in this study. Technical and engineering feasibility work needed for a sound economic evaluation of this development alternative was beyond the scope and capability of this study, but should be accomplished.

The solutions developed for all land resource bases obviously rest on many assumptions with respect to price and other variables. To the extent possible, these assumptions were kept constant between resource situations, except for variables controlling the amounts of land resource of various types. Altering

assumptions clearly would affect optimum solutions for each land resource situation. Most of the remainder of this report will be devoted to an examnation of the effect of changing various assumptions. Movement to the historical and additional land resource bases showed large effects on the agricultural economy; therefore, solutions with changes in various assumptions will be presented for these two resource bases. To some extent, the information presented can be extrapolated to the other resource bases.

## EFFECTS ON OPTIMAL SOLUTIONS OF VARYING SPECIFIED ASSUMPTIONS FOR HISTORICAL AND ADDITIONAL LAND RESOURCE BASES

### Rice Price Reduction

The effects of reducing rice prices 10 percent and 20 percent below the export price are shown in tables 5 and 6 for the historical and additional land bases, respectively.

On the historical land base, each 10 percent reduction in the price of rice would reduce income by about 10 billion piasters. Total paddy production would decline only slightly with each increment of price reduction. However, an increase of 200,000--300,000 M.T. of paddy fed to livestock would be associated with each 10 percent reduction in price. Rice imports would increase more than 150,000 M.T. with each 10 percent price reduction. Shifts in production patterns would be minor. There would be slight shifts from feed grain to peanut production, especially in the Highland and Eastern regions, and pineapple production would enter the solution in the Eastern region.

On the additional land base, each 10 percent reduction in the price of rice would reduce income by about 2 billion piasters. The first increment of price reduction would reduce the trade balance by 3 billion piasters. Other effects from the first 10 percent reduction in rice price would be minor. When the price reduction is increased from 10 to 20 percent, however, paddy production would decrease by about 600,000 M.T., rice exports would decrease by more than 350,000 M.T., and the trade balance would decline by more than 10 billion piasters. Most of the production changes would be due to a shift from high-yielding varieties to traditional varieties of rice. There would be little shift in cropping patterns. Slight reductions in rice cultivated areas would be replaced by peanuts in most regions.

### Rubber Price Reduction

The effects of reducing rubber price 10 and 20 percent below the previously-assumed level are shown in tables 5 and 6 for the historical and additional land resource bases, respectively.

On the historical land base, each 10 percent reduction in rubber price would decrease income by about 2.6 billion piasters and increase the trade deficit by about 3 billion piasters. The first 10 percent reduction in price had no other impact on the solution; the second reduction caused a slight reduction in rubber production.

On the additional land resource base, the first 10 percent reduction in rubber price would reduce income and trade balance slightly more than 3 billion piasters; the second 10 percent price reduction would cause income to decline by slightly less than 3 billion piasters and the trade balance to decline by about 4 billion piasters. The first price reduction would cause only a slight reduction in rubber output. However, the second price reduction would eliminate rubber production on new land. Rubber on this land would be replaced largely by peanuts.

Table 5. Selected information from Vietnam Production Distribution Model with specified reduction in price levels for rice and rubber, historical land base, 1980

| Item | Historical base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | | |
| Farm income | 302.1 | 292.0 | 281.6 | 299.5 | 296.9 |
| Consumers' surplus | 7.8 | 7.8 | 7.8 | 7.7 | 7.8 |
| Total | 309.9 | 299.8 | 289.4 | 307.2 | 304.7 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 39.3 | 39.7 | 44.1 | 36.5 | 33.1 |
| Commodity import | 54.7 | 57.7 | 60.9 | 54.7 | 54.2 |
| Annual inputs | 35.7 | 35.0 | 35.0 | 35.7 | 35.6 |
| Imports | 90.4 | 92.7 | 95.9 | 90.4 | 89.8 |
| Annual balance | -51.1 | -53.0 | -51.8 | -53.8 | -56.7 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 21.7 | 18.8 | 21.0 | 21.7 | 22.0 |
| Distribution | 25.6 | 23.6 | 21.5 | 25.6 | 25.4 |
| Total | 47.3 | 42.4 | 42.5 | 47.3 | 47.4 |
| Foreign exchange | 29.2 | 25.8 | 25.4 | 29.2 | 29.4 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Exports | | | | | |
| Peanut oil | | | 2.9 | | |
| Rubber | 167.9 | 167.9 | 167.9 | 167.9 | 162.6 |
| Tea | .5 | .5 | .7 | .5 | .5 |
| Coffee | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Coconut meal | 8.6 | 6.3 | | 8.6 | 8.3 |
| Copra | 28.9 | 35.3 | 53.3 | 28.9 | 29.6 |
| Pineapple | | | 80.0 | | |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | | | 5.3 | | |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Pork | | | 5.0 | | |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | | |
| Rice | | 171.3 | 317.5 | | |
| Soybean meal | 39.5 | 33.0 | 8.7 | 39.5 | 39.1 |
| Raw sugar | 286.6 | 286.6 | 272.4 | 286.6 | 286.6 |
| Sugar | 99.2 | 99.2 | 99.2 | 99.2 | 99.2 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| Pork | 17.8 | | | 17.8 | 16.5 |
| Chicken | 5.8 | 4.9 | | 5.8 | 5.8 |
| Beef | 14.4 | 14.3 | 14.4 | 14.4 | 14.4 |

(Continued)

Table 5. (Continued)

| Item | Historical base solution | Rice price reduced 10 percent | Rice price reduced 20 percent | Rubber price reduced 10 percent | Rubber price reduced 20 percent |
|---|---|---|---|---|---|
| | | | Thousand Hectares | | |
| Crops | | | | | |
| Rice, nonfloating | 1983.9 | 1983.9 | 1969.3 | 1983.9 | 1987.5 |
| Rice, HYV* | 1357.5 | 1314.8 | 1310.2 | 1357.5 | 1361.2 |
| Rice, floating | 656.3 | 656.3 | 656.3 | 656.3 | 656.3 |
| Corn | 88.0 | 82.9 | 63.4 | 88.0 | 88.1 |
| Sorghum | 349.8 | 347.2 | 340.4 | 349.8 | 349.8 |
| Soybeans | | | ** | | |
| Peanuts | 67.3 | 75.0 | 101.9 | 67.3 | 68.7 |
| Sugarcane | 4.4 | 4.4 | 6.2 | 4.4 | 4.4 |
| Tobacco | 20.2 | 20.2 | 20.3 | 20.2 | 20.2 |
| Rubber | 140.0 | 140.0 | 140.0 | 140.0 | 134.7 |
| Tea | 7.2 | 7.2 | 7.5 | 7.2 | 7.2 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Pineapple | | | 10.0 | | |
| Bananas | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| | | | Thousand Metric Tons | | |
| Crop Production | | | | | |
| Paddy marketed | 3419.9 | 3118.2 | 2861.2 | 3419.9 | 3419.9 |
| Paddy home use | 3328.5 | 3328.5 | 3328.5 | 3328.5 | 3328.5 |
| Paddy fed | 495.9 | 763.5 | 982.9 | 495.9 | 508.0 |
| Total paddy | 7244.3 | 7210.2 | 7172.6 | 7244.3 | 7256.4 |
| Corn marketed | 86.6 | 79.7 | 52.0 | 86.6 | 86.9 |
| Corn home fed | 100.9 | 95.2 | 73.1 | 101.1 | 101.1 |
| Total corn | 187.5 | 174.9 | 125.1 | 187.7 | 188.0 |
| Sorghum marketed | 150.6 | 149.6 | 148.7 | 150.6 | 150.6 |
| Sorghum home fed | 351.4 | 348.1 | 338.8 | 351.4 | 351.4 |
| Total sorghum | 502.0 | 497.7 | 487.5 | 502.0 | 502.0 |
| Soybeans | | | ** | | |
| Peanuts | 119.0 | 132.2 | 179.3 | 119.0 | 120.4 |
| Sugarcane | 220.0 | 220.0 | 366.0 | 220.0 | 220.0 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 176.0 | 176.0 | 176.0 | 176.0 | 170.7 |
| Tea | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |
| Coffee | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 | 480.0 |
| Pineapple | | | 80.0 | | |
| Bananas | 215.3 | 215.3 | 215.3 | 215.3 | 215.3 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| | | | Thousand Hectares | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1346.0 | 1346.0 | 1344.9 | 1346.0 | 1346.0 |
| Rice, HYV* | 869.0 | 869.3 | 868.2 | 869.3 | 869.3 |
| Rice, floating | 656.3 | 656.3 | 656.3 | 656.3 | 656.3 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 10.0 | 10.0 | 11.0 | 10.0 | 10.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Bananas | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

(Continued)

Table 5. (Continued)

| Item | Historical base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Crop Production (Continued) | | | | | |
| Eastern Crops | | | | | |
| Rice | 218.1 | 218.1 | 205.5 | 218.1 | 218.1 |
| Rice, HYV* | 194.7 | 152.0 | 149.3 | 194.7 | 194.7 |
| Corn | 16.0 | 13.9 | 10.0 | 16.0 | 16.0 |
| Peanuts | 10.7 | 12.8 | 16.7 | 10.7 | 10.7 |
| Sugarcane | | | 1.8 | | |
| Tobacco | 10.3 | 10.3 | 9.3 | 10.3 | 10.3 |
| Rubber | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| Pineapple | | | 10.0 | | |
| Bananas | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| Lower Coastal Crops | | | | | |
| Rice | 104.5 | 104.5 | 104.5 | 104.5 | 104.5 |
| Rice, HYV* | 91.8 | 91.8 | 91.8 | 91.8 | 91.8 |
| Corn | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Sorghum | 17.7 | 15.1 | 15.1 | 17.7 | 17.7 |
| Peanuts | 4.8 | 7.5 | 7.5 | 4.8 | 4.8 |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Central Coastal Crops | | | | | |
| Rice | 146.3 | 146.3 | 146.3 | 146.3 | 146.3 |
| Rice, HYV* | 101.9 | 101.9 | 101.9 | 101.9 | 101.9 |
| Corn | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| Sorghum | 61.7 | 61.7 | 56.9 | 61.7 | 61.7 |
| Peanuts | 10.8 | 10.8 | 15.6 | 10.8 | 10.8 |
| Sugarcane | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| North Coastal Crops | | | | | |
| Rice | 134.2 | 134.2 | 134.2 | 134.2 | 134.2 |
| Rice, HYV* | 65.1 | 65.1 | 65.1 | 65.1 | 65.1 |
| Corn | 21.1 | 21.1 | 21.1 | 21.1 | 21.1 |
| Sorghum | 86.6 | 86.6 | 84.6 | 86.6 | 86.6 |
| Peanuts | 7.9 | 7.9 | 9.9 | 7.9 | 7.9 |
| Jute | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 |
| Highland Crops | | | | | |
| Rice | 34.7 | 34.7 | 33.8 | 34.7 | 38.4 |
| Rice, HYV* | 34.7 | 34.7 | 33.8 | 34.7 | 38.4 |
| Corn | 46.2 | 43.2 | 27.6 | 46.2 | 46.3 |
| Sorghum | 5.8 | 5.8 | 5.8 | 5.8 | 5.8 |
| Peanuts | 26.1 | 29.1 | 45.3 | 26.1 | 27.6 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 | 14.7 |

(Continued)

Table 5. (Continued)

| Item | Historical base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Highland Crops (Continued) | | | | | |
| Tea | 7.2 | 7.2 | 7.5 | 7.2 | 7.2 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

**Less than .05.

Table 6. Selected information from Vietnam Production Distribution Model with specified reduction in price levels for rice and rubber, additional land base, 1980

| Item | Historical base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | | |
| Farm income | 320.7 | 308.9 | 296.9 | 317.4 | 314.6 |
| Consumers' surplus | 50.8 | 50.0 | 50.0 | 50.8 | 50.8 |
| Total | 371.5 | 358.9 | 346.9 | 368.2 | 365.4 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 135.9 | 132.7 | 116.7 | 132.6 | 128.1 |
| Commodity import | 24.6 | 24.7 | 24.7 | 24.6 | 24.4 |
| Annual inputs | 52.0 | 51.8 | 46.2 | 52.1 | 51.6 |
| Imports | 76.6 | 76.5 | 70.9 | 76.7 | 76.0 |
| Annual balance | 59.3 | 56.2 | 45.8 | 55.9 | 52.1 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 56.8 | 55.9 | 45.1 | 56.7 | 57.2 |
| Distribution | 88.0 | 87.1 | 79.2 | 89.7 | 86.5 |
| Total | 144.8 | 143.0 | 124.3 | 146.4 | 143.7 |
| Foreign exchange | 94.5 | 93.0 | 79.3 | 95.8 | 95.0 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports | | | | | |
| Rice | 539.2 | 502.5 | 140.3 | 546.7 | 546.7 |
| Corn | 1053.9 | 1047.7 | 1010.7 | 1046.1 | 922.7 |
| Sorghum | 87.1 | 86.9 | 78.8 | 87.2 | 87.2 |
| Soybeans | 165.1 | 169.8 | 169.8 | 165.1 | 165.1 |
| Peanuts | 107.9 | 101.6 | 125.1 | 111.2 | 260.4 |
| Peanut oil | 30.2 | 32.4 | 41.1 | 29.9 | 29.9 |
| Rubber | 212.5 | 212.8 | 212.8 | 211.5 | 167.9 |
| Tea | .7 | .7 | .7 | .7 | .7 |
| Coffee | 44.9 | 44.9 | 44.9 | 45.0 | 45.0 |
| Copra | 53.3 | 66.7 | 66.7 | 53.3 | 53.3 |
| Pineapple | 80.0 | 80.0 | 120.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Fiber | | 5.3 | 7.1 | | |
| Wheat bran | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Pork | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |

(Continued)

Table 6. (Continued)

| Item | Additional base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Exports (Continued) | | | | | |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | | |
| Sugar | 53.6 | 53.6 | 53.6 | 53.6 | 53.6 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| Beef | 2.8 | 3.0 | 2.9 | 2.8 | 2.2 |
| | - - - - - - - - Thousand Hectares - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 2111.6 | 2088.1 | 2051.0 | 2115.3 | 2115.3 |
| Rice, HYV* | 1491.8 | 1466.0 | 1066.5 | 1495.4 | 1495.4 |
| Rice, floating | 639.1 | 639.1 | 639.1 | 639.1 | 639.1 |
| Corn | 754.2 | 755.5 | 755.5 | 750.3 | 701.8 |
| Sorghum | 352.6 | 352.6 | 356.6 | 352.6 | 352.6 |
| Soybeans | 148.7 | 154.5 | 154.5 | 148.7 | 148.7 |
| Peanuts | 236.6 | 237.0 | 267.6 | 238.0 | 320.0 |
| Sugarcane | 88.5 | 88.0 | 88.1 | 90.7 | 90.7 |
| Tobacco | 21.1 | 21.4 | 20.6 | 21.1 | 21.1 |
| Rubber | 174.3 | 174.5 | 174.5 | 173.6 | 140.0 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 |
| Coconut | 40.0 | 50.0 | 50.0 | 40.0 | 40.0 |
| Pineapple | 10.0 | 10.0 | 15.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | 11.1 | 16.4 | 17.8 | 11.1 | 11.1 |
| Kenaf | | | .3 | | |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 4351.1 | 4285.1 | 3629.3 | 4365.0 | 4365.0 |
| Paddy home use | 3385.8 | 3384.5 | 3376.2 | 3385.8 | 3385.8 |
| Paddy fed | | | 90.3 | | |
| Total paddy | 7736.9 | 7669.6 | 7095.8 | 7750.8 | 7750.8 |

(Continued)

Table 6. (Continued)

| Item | Additional base solution | Rice price reduced 10 percent | Rice price reduced 20 percent | Rubber price reduced 10 percent | Rubber price reduced 20 percent |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production (Continued) | | | | | |
| Corn marketed | 1390.0 | 1391.6 | 1383.8 | 1380.4 | 1244.7 |
| Corn home fed | 465.1 | 467.2 | 475.0 | 463.8 | 463.8 |
| Total corn | 1855.1 | 1858.8 | 1858.8 | 1844.2 | 1708.5 |
| Sorghum marketed | 161.6 | 161.3 | 152.3 | 161.6 | 161.6 |
| Sorghum home fed | 342.1 | 342.4 | 351.4 | 342.1 | 342.1 |
| Total sorghum | 503.7 | 503.7 | 503.7 | 503.7 | 503.7 |
| Soybeans | 181.6 | 186.8 | 186.8 | 181.6 | 181.6 |
| Peanuts | 391.8 | 392.5 | 448.4 | 394.5 | 558.6 |
| Sugarcane | 3889.8 | 3889.8 | 3889.8 | 3889.8 | 3889.8 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 220.6 | 221.0 | 221.0 | 219.6 | 176.0 |
| Tea | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |
| Coffee | 50.5 | 50.6 | 50.6 | 50.6 | 50.6 |
| Coconut | 480.0 | 600.0 | 600.0 | 480.0 | 480.0 |
| Pineapple | 80.0 | 80.0 | 120.0 | 80.0 | 80.0 |
| Bananas | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 |
| Jute | 11.1 | 16.4 | 17.8 | 11.1 | 11.1 |
| Kenaf | | | .3 | | |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1446.4 | 1436.4 | 1422.6 | 1446.4 | 1446.4 |
| Rice, HYV* | 1065.6 | 1042.3 | 698.8 | 1065.6 | 1065.6 |
| Rice, floating | 639.1 | 639.1 | 639.1 | 639.1 | 639.1 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 12.3 | 7.0 | 7.0 |
| Tobacco | 4.0 | 4.0 | 5.6 | 4.0 | 4.0 |
| Coconut | 40.0 | 50.0 | 50.0 | 40.0 | 40.0 |
| Pineapple | | | 5.0 | | |
| Jute | | | 1.5 | | |
| Kenaf | | | .3 | | |
| Eastern Crops | | | | | |
| Rice | 210.0 | 204.3 | 204.3 | 213.6 | 213.6 |
| Rice, HYV* | 115.5 | 113.1 | 76.6 | 119.1 | 119.1 |
| Corn | 459.0 | 460.3 | 460.3 | 455.1 | 406.7 |
| Corn | 459.0 | 460.3 | 460.3 | 455.1 | 406.7 |

(Continued)

Table 6. (Continued)

| Item | Additional base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - - - | Thousand Hectares | - - - - - - - - - - | | |
| Eastern Crops (Continued) | | | | | |
| Soybeans | 31.8 | 31.8 | 31.8 | 31.8 | 31.8 |
| Soybeans* | 27.4 | 27.4 | 27.4 | 27.4 | 27.4 |
| Peanuts | 37.8 | 38.1 | 40.1 | 39.1 | 121.2 |
| Peanuts* | 20.1 | 20.1 | 20.1 | 20.1 | 102.1 |
| Sugarcane | 84.1 | 83.5 | 83.7 | 86.3 | 86.3 |
| Sugarcane* | 79.2 | 77.7 | 77.7 | 83.9 | 83.9 |
| Tobacco | 17.2 | 17.4 | 15.0 | 17.1 | 17.1 |
| Rubber | 154.3 | 154.5 | 154.5 | 153.6 | 120.0 |
| Rubber* | 34.3 | 34.5 | 34.5 | 33.6 | |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | | 3.3 | 3.3 | | |
| Lower Coastal Crops | | | | | |
| Rice | 111.4 | 111.4 | 102.4 | 111.4 | 111.4 |
| Rice, HYV* | 97.4 | 97.4 | 88.4 | 97.4 | 97.4 |
| Corn | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| Corn* | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 |
| Sorghum | 26.6 | 26.6 | 26.6 | 26.6 | 26.6 |
| Sorghum* | 26.6 | 26.6 | 26.6 | 26.6 | 26.6 |
| Soybeans | 38.3 | 38.3 | 38.3 | 38.3 | 38.3 |
| Soybeans* | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 |
| Peanuts | 20.5 | 20.5 | 29.5 | 20.5 | 20.5 |
| Peanuts* | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Central Coastal Crops | | | | | |
| Rice | 154.6 | 154.6 | 154.6 | 154.6 | 154.6 |
| Rice, HYV* | 110.3 | 110.3 | 110.3 | 110.3 | 110.3 |
| Corn | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| Corn* | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| Sorghum | 71.2 | 71.2 | 71.2 | 71.2 | 71.2 |
| Sorghum* | 26.0 | 26.0 | 26.0 | 26.0 | 26.0 |
| Peanuts | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 |
| Peanuts* | 11.7 | 11.7 | 11.7 | 11.7 | 11.7 |

(Continued)

Table 6. (Continued)

| Item | Additional base solution | Rice price reduced | | Rubber price reduced | |
|---|---|---|---|---|---|
| | | 10 percent | 20 percent | 10 percent | 20 percent |
| | - - - - - - - - - | Thousand Hectares | | - - - - - - - - - | |
| Central Coastal Crops (Continued) | | | | | |
| Sugarcane | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| North Coastal Crops | | | | | |
| Rice | 149.6 | 147.7 | 142.4 | 149.6 | 149.6 |
| Rice, HYV* | 69.2 | 69.2 | 67.7 | 69.2 | 69.2 |
| Corn | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 |
| Corn* | 13.0 | 13.0 | 13.0 | 13.0 | 13.0 |
| Sorghum | 76.8 | 76.8 | 76.8 | 76.8 | 76.8 |
| Sorghum* | 24.9 | 24.9 | 24.9 | 24.9 | 24.9 |
| Peanuts | 51.1 | 51.1 | 56.4 | 51.1 | 51.1 |
| Peanuts* | 14.2 | 14.2 | 14.2 | 14.2 | 14.2 |
| Jute | 5.3 | 7.2 | 7.2 | 5.3 | 5.3 |
| Highland Crops | | | | | |
| Rice | 39.6 | 33.8 | 24.7 | 39.6 | 39.6 |
| Rice, HYV* | 33.8 | 33.8 | 24.7 | 33.8 | 33.8 |
| Corn | 253.4 | 253.4 | 253.4 | 253.4 | 253.4 |
| Corn* | 253.4 | 253.4 | 253.4 | 253.4 | 253.4 |
| Soybeans | 78.6 | 84.4 | 84.4 | 78.6 | 78.6 |
| Soybeans* | 51.0 | 51.0 | 51.0 | 51.0 | 51.0 |
| Peanuts | 88.7 | 88.7 | 97.8 | 88.7 | 88.7 |
| Peanuts* | 43.5 | 43.5 | 43.5 | 43.5 | 43.5 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 |
| Coffee* | 41.6 | 41.6 | 41.6 | 41.6 | 41.6 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

Table 7. Selected information from Vietnam Production Distribution Model with sugar production forced and with wheat and cotton enterprises considered, historical land base, 1980

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cot on | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - - Billion Piasters - - - - - - - - - - | | | | |
| Farm income | 302.1 | 299.1 | 294.6 | 303.8 | 304.2 |
| Consumers' surplus | 7.8 | 7.8 | 7.8 | 7.4 | 7.4 |
| Total | 309.9 | 306.9 | 302.4 | 311.2 | 311.6 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 39.3 | 34.6 | 27.7 | 38.6 | 38.6 |
| Commodity import | 54.7 | 49.7 | 42.7 | 52.2 | 51.1 |
| Annual inputs | 35.7 | 35.5 | 35.4 | 35.7 | 35.6 |
| Imports | 90.4 | 85.2 | 78.1 | 87.9 | 86.7 |
| Annual balance | -51.1 | -50.6 | -50.4 | -49.3 | -48.1 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 21.7 | 21.7 | 21.5 | 20.9 | 20.4 |
| Distribution | 25.6 | 37.5 | 55.4 | 29.5 | 30.0 |
| Total | 47.3 | 59.2 | 76.9 | 50.4 | 50.5 |
| Foreign exchange | 29.2 | 39.6 | 54.7 | 31.9 | 31.1 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports | | | | | |
| Rubber | 167.9 | 139.5 | 98.3 | 167.9 | 167.9 |
| Tea | .5 | .5 | .5 | | |
| Coffee | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Coconut meal | 8.6 | 8.8 | 8.9 | 12.1 | 12.0 |
| Copra | 28.9 | 28.2 | 27.9 | 18.6 | 19.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | | |
| Corn | | | | .2 | 9.4 |
| Soybean meal | 39.5 | 37.1 | 37.0 | 19.1 | 39.9 |
| Raw sugar | 286.6 | 116.7 | | 286.6 | 286.6 |

(Continued)

Table 7. (Continued)

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cotton | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Imports (Continued) | | | | | |
| Sugar | 99.2 | 83.3 | | 99.2 | 102.0 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 7.3 | 7.3 |
| Pork | 17.8 | 30.4 | 40.7 | 36.3 | 29.3 |
| Chicken | 5.8 | 5.8 | 5.8 | 5.8 | 5.8 |
| Beef | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 1983.9 | 1960.3 | 1939.6 | 1983.0 | 1983.0 |
| Rice, HYV* | 1357.5 | 1333.9 | 1313.2 | 1356.6 | 1356.6 |
| Rice, floating | 656.3 | 656.3 | 656.3 | 656.3 | 656.3 |
| Corn | 88.0 | 81.6 | 81.8 | 43.1 | 38.6 |
| Sorghum | 349.8 | 346.2 | 337.1 | 348.1 | 323.2 |
| Peanuts | 67.3 | 66.2 | 66.4 | 42.9 | 42.3 |
| Sugarcane | 4.4 | 45.3 | 91.9 | 4.4 | 3.8 |
| Tobacco | 20.2 | 20.3 | 20.3 | 19.0 | 19.0 |
| Rubber | 140.0 | 118.2 | 86.5 | 140.0 | 140.0 |
| Tea | 7.2 | 7.2 | 7.2 | 6.6 | 6.6 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Bananas | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| Wheat | | | | | 31.4 |
| Cotton | | | | 73.6 | 73.6 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 3419.9 | 3421.6 | 3454.6 | 3419.9 | 3419.9 |
| Paddy home use | 3328.5 | 3326.7 | 3293.8 | 3328.5 | 3328.5 |
| Paddy fed | 495.9 | 407.0 | 323.7 | 490.5 | 490.5 |
| Total paddy | 7244.3 | 7155.3 | 7072.1 | 7238.9 | 7238.9 |
| Corn marketed | 86.6 | 77.4 | 77.7 | 20.2 | 18.9 |
| Corn home fed | 100.9 | 93.0 | 93.3 | 53.1 | 46.5 |
| Total corn | 187.5 | 170.4 | 171.0 | 73.3 | 65.4 |

(Continued)

Table 7. (Continued)

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cotton | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - - Thousand Metric Tons - - - - - - - - - - | | | | |
| Crop Production (Continued) | | | | | |
| Sorghum marketed | 150.6 | 150.0 | 148.8 | 150.0 | 146.7 |
| Sorghum home fed | 351.4 | 345.6 | 333.1 | 349.3 | 316.5 |
| Total sorghum | 502.0 | 495.6 | 481.9 | 499.3 | 463.2 |
| Peanuts | 119.0 | 117.5 | 117.0 | 69.8 | 70.6 |
| Sugarcane | 220.0 | 2269.8 | 4498.1 | 220.0 | 188.7 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 176.0 | 147.6 | 106.4 | 176.0 | 176.0 |
| Tea | 6.4 | 6.4 | 6.4 | 5.9 | 5.9 |
| Coffee | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 | 480.0 |
| Bananas | 215.3 | 215.3 | 215.3 | 215.3 | 215.3 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 | 11.1 |
| Wheat | | | | | 62.7 |
| Cotton | | | | 89.3 | 89.3 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1346.0 | 1344.9 | 1344.9 | 1340.5 | 1340.5 |
| Rice, HYV* | 869.0 | 868.2 | 868.2 | 863.8 | 863.8 |
| Rice, floating | 656.3 | 656.2 | 656.3 | 656.3 | 656.3 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 10.0 | 11.0 | 11.0 | 15.5 | 15.5 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Bananas | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Eastern Crops | | | | | |
| Rice | 218.1 | 196.0 | 196.0 | 218.1 | 218.1 |
| Rice, HYV* | 194.7 | 172.6 | 172.6 | 194.7 | 194.7 |
| Corn | 16.0 | 12.1 | 12.1 | 3.2 | 3.2 |
| Peanuts | 10.7 | 10.6 | 10.6 | 3.2 | 3.2 |
| Sugarcane | | 37.2 | 68.9 | | |
| Tobacco | 10.3 | 9.2 | 9.3 | 3.5 | 3.5 |
| Rubber | 120.0 | 98.2 | 66.5 | 120.0 | 120.0 |
| Bananas | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| Cotton | | | | 27.1 | 27.1 |

(Continued)

Table 7. (Continued)

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cotton | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Lower Coastal Crops | | | | | |
| Rice | 104.5 | 104.5 | 93.0 | 104.5 | 104.5 |
| Rice, HYV* | 91.8 | 91.8 | 80.3 | 91.8 | 91.8 |
| Corn | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Sorghum | 17.7 | 17.7 | 17.7 | 16.0 | 16.0 |
| Peanuts | 4.8 | 4.8 | 4.8 | 3.1 | 3.1 |
| Sugarcane | | | 5.8 | | |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Cotton | | | | 3.4 | 3.4 |
| Central Coastal Crops | | | | | |
| Rice | 146.3 | 145.8 | 136.7 | 146.3 | 146.3 |
| Rice, HYV* | 101.9 | 101.4 | 92.3 | 101.9 | 101.9 |
| Corn | 2.3 | 2.3 | 2.3 | 6.8 | 2.3 |
| Sorghum | 61.7 | 58.1 | 48.9 | 61.7 | 52.3 |
| Peanuts | 10.8 | 7.7 | 7.7 | 6.3 | 11.4 |
| Sugarcane | 4.4 | 8.0 | 17.2 | 4.4 | 3.8 |
| Jute | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| Wheat | | | | | 10.0 |
| North Coastal Crops | | | | | |
| Rice | 134.2 | 134.2 | 134.2 | 134.2 | 134.2 |
| Rice, HYV* | 65.1 | 65.1 | 65.1 | 65.1 | 65.1 |
| Corn | 21.1 | 21.1 | 21.1 | 21.1 | 21.1 |
| Sorghum | 86.6 | 86.6 | 86.6 | 86.6 | 71.1 |
| Peanuts | 7.9 | 7.9 | 7.9 | 7.9 | 2.1 |
| Jute | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 |
| Wheat | | | | | 21.3 |
| Highland Crops | | | | | |
| Rice | 34.7 | 34.7 | 34.7 | 39.3 | 39.3 |
| Rice, HYV* | 34.7 | 34.7 | 34.7 | 39.3 | 39.3 |
| Corn | 46.2 | 43.7 | 43.9 | 9.7 | 9.7 |
| Sorghum | 5.8 | 5.8 | 5.8 | 5.8 | 5.8 |
| Peanuts | 26.1 | 28.6 | 28.4 | 15.5 | 15.5 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |

(Continued)

Table 7. (Continued)

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cotton | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Highland Crops (Continued) | | | | | |
| Tea | 7.2 | 7.2 | 7.2 | 6.6 | 6.6 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Cotton | | | | 43.1 | 43.1 |
| | - - - - - - - - - - - - - - Units - - - - - - - - - - - - - | | | | |
| New Facility Requirement | | | | | |
| Tobacco processing | | | | | |
| East | .5 | .5 | .5 | .5 | .5 |
| Banana marketing | | | | | |
| Delta | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| East | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| Fiber processing | | | | | |
| East | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| Rubber processing | | | | | |
| East | 106.0 | 77.7 | 36.4 | 106.0 | 106.0 |
| Highland | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea processing | | | | | |
| Highland | 3.5 | 3.5 | 3.5 | 1.7 | 1.7 |
| Rice mill | | | | | |
| Lower Coast | 7.2 | 7.2 | 2.8 | 7.2 | 7.2 |
| Highland | 3.0 | 3.0 | 3.0 | 3.7 | 3.7 |
| Rice drying | | | | | |
| Delta | 52.1 | 51.7 | 51.7 | 49.9 | 49.9 |
| East | 12.1 | 4.3 | 4.3 | 12.1 | 12.1 |
| Grain storage | | | | | |
| Delta | 280.5 | 280.9 | 301.1 | 278.4 | 278.4 |
| Highland | 26.6 | 25.6 | 25.6 | 13.1 | 13.1 |
| Threshing-Shelling | | | | | |
| Delta | 194.2 | 194.2 | 194.2 | 194.2 | 194.2 |
| East | 17.4 | 12.2 | 12.2 | 2.7 | 2.7 |
| Lower Coast | 27.9 | 27.9 | 27.9 | 25.4 | 25.4 |
| Central Coast | 94.0 | 88.2 | 75.7 | 95.2 | 100.1 |
| North Coast | 136.8 | 136.8 | 136.8 | 136.8 | 155.0 |
| Highland | 64.7 | 61.5 | 61.8 | 17.9 | 17.9 |

(Continued)

Table 7. (Continued)

| Item | Historical base solution | Sugar production forced | | Production permitted for | |
|---|---|---|---|---|---|
| | | Portion of domestic requirements produced | | Cotton | Cotton and wheat |
| | | One-half | All | | |
| | - - - - - - - - - - - - - - - Units - - - - - - - - - - - - - - - | | | | |
| New Facility Requirement (Continued) | | | | | |
| Feed mill | | | | | |
| Delta | 2.8 | 2.3 | 2.3 | 1.2 | 1.2 |
| Lower Coast | .7 | .6 | .6 | .6 | .6 |
| Central Coast | 1.5 | .7 | .7 | .6 | 2.7 |
| North Coast | 1.3 | 1.3 | 1.3 | 1.3 | 6.6 |
| Highland | 5.8 | 6.2 | 6.1 | 1.5 | 1.5 |
| Oil mill | | | | | |
| Delta | .7 | .7 | .7 | 1.0 | .9 |
| East | .3 | .3 | .3 | .6 | .6 |
| Lower Coast | .1 | .1 | .1 | .2 | .2 |
| Central Coast | .3 | .2 | .2 | .2 | .3 |
| North Coast | .2 | .2 | .2 | .2 | .1 |
| Highland | .8 | .9 | .9 | 1.2 | 1.2 |
| Sugar mill | | | | | |
| East | | 2.9 | 5.6 | | |
| Lower Coast | | | .9 | | |
| Central Coast | | .4 | 1.3 | | |
| Sugar refinery | | | | | |
| East | | | ** | | |
| Lower Coast | | | .4 | | |
| Central Coast | .2 | .4 | .8 | .2 | .2 |
| Cotton gin | | | | | |
| East | | | | 4.3 | 4.3 |
| Lower Coast | | | | .7 | .7 |
| Highland | | | | 6.9 | 6.9 |

*Included in total above.

**Less than .05.

Table 8. Selected information from Vietnam Production Distribution Model with sugar production forced and with wheat and cotton enterprises considered, additional land base, 1980

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for: Cotton | Production permitted for: Cotton and wheat |
|---|---|---|---|---|
| | - - - - - - - - - - Billion Piasters - - - - - - - - - - | | | |
| Farm income | 320.7 | 320.3 | 324.5 | 328.0 |
| Consumers' surplus | 50.8 | 50.9 | 52.1 | 52.1 |
| Total | 371.5 | 371.1 | 376.6 | 380.1 |
| Annual Foreign Exchange | | | | |
| Commodity export | 135.9 | 134.7 | 132.8 | 122.8 |
| Commodity import | 24.6 | 21.5 | 14.9 | 4.0 |
| Annual inputs | 52.0 | 52.1 | 52.6 | 51.6 |
| Imports | 76.6 | 73.6 | 67.5 | 55.6 |
| Annual balance | 59.3 | 61.1 | 65.3 | 67.2 |
| Capital Investment (one-time requirement) | | | | |
| Production | 56.8 | 56.8 | 56.5 | 56.0 |
| Distribution | 88.0 | 93.5 | 94.4 | 98.0 |
| Total | 144.8 | 150.3 | 150.9 | 154.0 |
| Foreign exchange | 94.5 | 99.2 | 98.6 | 100.9 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | |
| Exports | | | | |
| Rice | 539.2 | 539.2 | 524.5 | 529.1 |
| Corn | 1053.9 | 1021.3 | 1053.1 | 755.5 |
| Sorghum | 87.1 | 87.2 | 121.0 | 121.0 |
| Soybeans | 165.1 | 165.1 | 69.4 | 50.0 |
| Soybean oil | | | | 1.2 |
| Peanuts | 107.9 | 107.9 | 95.5 | 80.1 |
| Peanut oil | 30.2 | 30.2 | 16.5 | 22.5 |
| Rubber | 212.5 | 209.3 | 212.2 | 210.6 |
| Tea | .7 | .7 | ** | ** |
| Coffee | 44.9 | 44.9 | 45.3 | 36.3 |
| Copra | 53.3 | 53.3 | 53.3 | 53.3 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | 46.5 | 46.5 | 46.5 | 68.6 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for: Cotton | Production permitted for: Cotton and wheat |
|---|---|---|---|---|
| | - - - - - - - - - - Thousand Metric Tons - - - - - - - - - - | | | |
| Exports (Continued) | | | | |
| Cotton | | | 9.5 | 9.5 |
| Cottonseed meal | | | 6.5 | 4.4 |
| Cottonseed oil | | | 8.6 | 7.9 |
| Duck feathers | .9 | .9 | .9 | .9 |
| Pork | 5.0 | 5.0 | 5.0 | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | |
| Sugar | 53.6 | | 53.6 | 53.6 |
| Flour | 107.1 | 107.1 | 107.1 | |
| Wheat | 185.9 | 185.9 | 185.9 | |
| Cotton | 39.4 | 39.4 | | |
| Beef | 2.8 | 2.8 | 2.8 | 2.6 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | |
| Crops | | | | |
| Rice, nonfloating | 2111.6 | 2111.6 | 2101.4 | 2103.7 |
| Rice, HYV* | 1491.8 | 1491.8 | 1486.4 | 1448.6 |
| Rice, floating | 639.1 | 639.1 | 639.1 | 639.1 |
| Corn | 754.2 | 741.5 | 756.6 | 641.7 |
| Sorghum | 352.6 | 352.6 | 372.2 | 326.0 |
| Soybeans | 148.7 | 148.7 | 63.4 | 52.1 |
| Peanuts | 236.6 | 236.6 | 198.1 | 196.2 |
| Sugarcane | 88.5 | 103.7 | 89.1 | 89.9 |
| Tobacco | 21.1 | 21.1 | 20.4 | 20.4 |
| Rubber | 174.3 | 171.9 | 174.1 | 172.9 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 48.9 | 41.5 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 |
| Wheat | | | | 130.8 |
| Cotton | | | 112.5 | 112.8 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for: Cotton | Production permitted for: Cotton and wheat |
|---|---|---|---|---|
| | - - - - - - - - - - Thousand Metric Tons - - - - - - - - - - | | | |
| Crop Production | | | | |
| Paddy marketed | 4351.1 | 4351.1 | 4324.2 | 4332.6 |
| Paddy home use | 3385.8 | 3385.8 | 3385.8 | 3385.8 |
| Total paddy | 7736.9 | 7736.9 | 7710.0 | 7718.4 |
| Corn marketed | 1390.0 | 1354.2 | 1391.0 | 1104.6 |
| Corn home fed | 465.1 | 465.2 | 467.9 | 467.0 |
| Total corn | 1855.1 | 1891.4 | 1858.9 | 1571.6 |
| Sorghum marketed | 161.6 | 161.6 | 198.7 | 192.6 |
| Sorghum home fed | 342.1 | 342.1 | 342.1 | 280.7 |
| Total sorghum | 503.7 | 503.7 | 540.8 | 473.3 |
| Soybeans | 181.6 | 181.6 | 76.3 | 62.8 |
| Peanuts | 391.8 | 391.8 | 318.1 | 319.4 |
| Sugarcane | 3889.8 | 4498.1 | 3889.8 | 3889.8 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 220.6 | 217.4 | 220.4 | 218.8 |
| Tea | 6.6 | 6.6 | 5.9 | 5.9 |
| Coffee | 50.5 | 50.6 | 50.9 | 42.0 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 222.2 | 222.2 | 222.2 | 222.2 |
| Jute | 11.1 | 11.1 | 11.1 | 11.1 |
| Wheat | | | | 361.6 |
| Cotton | | | 135.8 | 135.8 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | |
| Delta Crops | | | | |
| Rice, nonfloating | 1446.4 | 1446.4 | 1446.4 | 1446.4 |
| Rice, HYV* | 1065.6 | 1065.6 | 1065.6 | 1065.6 |
| Rice, floating | 639.1 | 639.1 | 639.1 | 639.1 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 4.0 | 4.0 | 4.0 | 4.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for Cotton | Production permitted for Cotton and wheat |
|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | |
| Eastern Crops | | | | |
| Rice | 210.0 | 210.0 | 199.8 | 202.1 |
| Rice, HYV* | 115.5 | 115.5 | 110.1 | 112.3 |
| Corn | 459.0 | 446.3 | 474.8 | 469.5 |
| Corn* | 459.0 | 446.3 | 474.8 | 469.5 |
| Soybeans | 31.8 | 31.8 | 2.3 | 4.1 |
| Soybeans* | 27.4 | 27.4 | | 1.9 |
| Peanuts | 37.8 | 37.8 | 25.3 | 21.7 |
| Peanuts* | 20.1 | 20.0 | 13.0 | 9.4 |
| Sugarcane | 84.1 | 99.3 | 84.7 | 85.5 |
| Sugarcane* | 79.2 | 94.5 | 80.4 | 82.4 |
| Tobacco | 17.2 | 17.2 | 16.5 | 16.5 |
| Rubber | 154.3 | 151.9 | 154.1 | 152.9 |
| Rubber* | 34.3 | 31.9 | 34.1 | 32.9 |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 |
| Cotton | | | 37.4 | 43.7 |
| Cotton* | | | 17.8 | 24.1 |
| Lower Coastal Crops | | | | |
| Rice | 111.4 | 111.4 | 111.4 | 111.4 |
| Rice, HYV* | 97.4 | 97.4 | 97.4 | 97.4 |
| Corn | 7.9 | 7.9 | 7.9 | 7.9 |
| Corn* | 6.8 | 6.8 | 6.8 | 6.8 |
| Sorghum | 26.6 | 26.6 | 46.2 | 46.2 |
| Sorghum* | 26.6 | 26.6 | 46.2 | 46.2 |
| Soybeans | 38.3 | 38.3 | 4.0 | 4.0 |
| Soybeans* | 32.6 | 32.6 | | |
| Peanuts | 20.5 | 20.5 | 18.8 | 18.8 |
| Peanuts* | 8.0 | 8.0 | 8.0 | 8.0 |
| Jute | .7 | .7 | .7 | .7 |
| Cotton | | | 16.5 | 16.5 |
| Cotton* | | | 13.1 | 13.1 |
| Central Coastal Crops | | | | |
| Rice | 154.6 | 154.6 | 154.6 | 154.6 |
| Rice, HYV* | 110.3 | 110.3 | 110.3 | 110.3 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for | |
|---|---|---|---|---|
| | | | Cotton | Cotton and wheat |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | |
| Central Coastal Crops | | | | |
| Corn | 7.8 | 7.8 | 7.8 | 7.8 |
| Corn* | 5.5 | 5.5 | 5.5 | 5.5 |
| Sorghum | 71.2 | 71.2 | 71.2 | 43.4 |
| Sorghum* | 26.0 | 26.0 | 26.0 | 12.8 |
| Peanuts | 31.5 | 31.5 | 31.5 | 29.5 |
| Peanuts* | 11.7 | 11.7 | 11.7 | 9.7 |
| Sugarcane | 4.4 | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | 5.1 | 5.1 | 5.1 |
| Wheat | | | | 29.8 |
| Wheat* | | | | 15.3 |
| North Coastal Crops | | | | |
| Rice | 149.6 | 149.6 | 149.6 | 149.6 |
| Rice, HYV* | 69.2 | 69.2 | 69.2 | 69.2 |
| Corn | 26.1 | 26.1 | 26.1 | 26.1 |
| Corn* | 13.0 | 13.0 | 13.0 | 13.0 |
| Sorghum | 76.8 | 76.8 | 76.8 | 58.3 |
| Sorghum* | 24.9 | 24.9 | 24.9 | 18.0 |
| Peanuts | 51.1 | 51.1 | 51.1 | 45.1 |
| Peanuts* | 14.2 | 14.2 | 14.2 | 13.0 |
| Jute | 5.3 | 5.3 | 5.3 | 5.3 |
| Wheat | | | | 24.4 |
| Wheat* | | | | 8.0 |
| Highland Crops | | | | |
| Rice | 39.6 | 39.6 | 39.6 | 39.6 |
| Rice, HYV* | 33.8 | 33.8 | 33.8 | 33.8 |
| Corn | 253.4 | 253.4 | 240.0 | 130.4 |
| Corn* | 253.4 | 253.4 | 240.0 | 130.4 |
| Soybeans | 78.6 | 78.6 | 57.3 | 44.1 |
| Soybeans* | 51.0 | 51.0 | 51.0 | 37.8 |
| Peanuts | 88.7 | 88.7 | 64.5 | 74.2 |
| Peanuts* | 43.5 | 43.5 | 43.5 | 47.1 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 48.9 | 41.5 |
| Coffee* | 41.6 | 41.6 | 41.9 | 34.5 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for: Cotton | Production permitted for: Cotton and wheat |
|---|---|---|---|---|
| | | Thousand Hectares | | |
| Highland Crops (Continued) | | | | |
| Wheat | | | | 126.6 |
| Wheat* | | | | 126.6 |
| Cotton | | | 58.7 | 52.6 |
| Cotton* | | | 13.0 | 13.0 |
| | | Units | | |
| New Facility Requirement | | | | |
| Tobacco processing | | | | |
| East | .5 | .4 | .5 | .5 |
| Banana marketing | | | | |
| East | 3.3 | 3.3 | 3.3 | 3.3 |
| Fiber processing | | | | |
| East | 2.6 | 2.6 | 2.6 | 2.6 |
| Rubber processing | | | | |
| East | 150.6 | 147.4 | 150.4 | 148.8 |
| Highland | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea processing | | | | |
| Highland | 4.3 | 4.3 | 1.8 | 1.8 |
| Rice mill | | | | |
| East | 3.8 | 3.8 | 1.4 | 2.2 |
| Lower Coast | 9.7 | 9.7 | 9.7 | 9.7 |
| Highland | 3.0 | 3.0 | 3.0 | 3.0 |
| Rice drying | | | | |
| Delta | 109.4 | 109.4 | 109.4 | 109.4 |
| East | 9.4 | 9.4 | 9.4 | 10.6 |
| Grain storage | | | | |
| Delta | 488.6 | 488.6 | 488.6 | 488.6 |
| East | 168.0 | 157.2 | 156.1 | 151.2 |
| Lower Coast | 33.9 | 34.0 | 30.6 | 30.0 |
| Central Coast | | | | 10.7 |
| Highland | 188.0 | 188.0 | 172.3 | 160.9 |
| Threshing-Shelling | | | | |
| Delta | 194.2 | 194.2 | 194.2 | 194.2 |
| East | 830.9 | 798.3 | 823.9 | 808.4 |
| Lower Coast | 79.3 | 79.3 | 80.5 | 80.5 |
| Central Coast | 105.8 | 105.8 | 105.8 | 123.1 |
| North Coast | 119.8 | 120.0 | 119.9 | 140.0 |
| Highland | 544.5 | 544.5 | 497.4 | 463.2 |

(Continued)

Table 8. (Continued)

| Item | Additional base solution | Forced production all sugar consumption | Production permitted for: Cotton | Production permitted for: Cotton and wheat |
|---|---|---|---|---|
| | - - - - - - - - - - - - - - - Units - - - - - - - - - - - - - - - | | | |
| New Facility Requirement (Continued) | | | | |
| Feed mill | | | | |
| Delta | .5 | .5 | .5 | .5 |
| Lower Coast | .6 | .6 | .6 | .6 |
| Central Coast | 2.3 | 2.3 | 2.3 | 3.1 |
| North Coast | 1.3 | 1.3 | 1.3 | 1.0 |
| Highland | 15.3 | 15.3 | 15.5 | 19.6 |
| Oil mill | | | | |
| Delta | .2 | .2 | .2 | .2 |
| East | .8 | .8 | 1.3 | 1.5 |
| Lower Coast | | | .4 | .4 |
| Central Coast | .8 | .7 | .7 | .7 |
| Highland | 2.6 | 2.6 | 2.9 | 3.1 |
| Sugar mill | | | | |
| East | 6.6 | 7.9 | 6.7 | 6.9 |
| Sugar refinery | | | | |
| East | .4 | 1.0 | .4 | .4 |
| Central Coast | .2 | .2 | .2 | .2 |
| Wheat mill | | | | |
| Central Coast | | | | 1.0 |
| North Coast | | | | .9 |
| Highland | | | | .9 |
| Cotton gin | | | | |
| East | | | 5.6 | 6.5 |
| Lower Coast | | | 3.5 | 3.5 |
| Highland | | | 9.0 | 8.0 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

**Less than .05.

It should be recalled that rubber production on new land occurs within the framework of a family farm operation on 10 ha. Rubber might not have been displaced from new land with a higher ratio of land to labor.

## Forcing Additional Sugarcane Production

A small amount of sugarcane would be produced in the Central Coastal region in the historical land base solution. In the additional land base solution, sufficient cane would be produced--primarily in the Eastern region--to provide for about seven-eights of domestic consumption requirements. The effect of forcing additional domestic sugar production is shown in tables 7 and 8 for the historical and additional land bases, respectively.

On the historical land base, forcing sugar production to satisfy one-half of domestic consumption requirements would reduce income by about 3 billion piasters; income would be reduced by about 7.5 billion piasters with all consumption requirements satisfied by domestic production. In both instances, the effect on the trade deficit would be negligible. Requirements for investment capital would be increased by about 12 billion piasters to produce one-half of domestic needs, and by about 30 billion piasters to produce all domestic consumption requirements. Some additional sugarcane would be produced in the Central Coastal region, replacing rice and sorghum. Most of the additional production would occur in the Eastern region, however. In the Eastern region, sugarcane would replace about 20,000 ha of rice; rubber would be replaced by sugarcane for the remaining area needed to produce specified sugar requirements.

With the additional land base, the requirement that all sugar be produced domestically had no appreciable effect on income. The trade balance would be increased by about 2 billion piasters. Capital requirements would be increased by about 6 billion piasters. A small amount of sugarcane would be produced in the Central Coastal region. The remainder would be produced in the Eastern region, with most production occurring on new land. The small additional area of land required for sugarcane with this solution would be taken mainly from corn production.

It should be remembered that the prices used for sugar in this analysis are somewhat higher, relative to prices of other commodities, than Vietnam has historically paid. On previous runs with lower prices, sugarcane did not enter any solutions without being forced. Even with the higher prices used in these solutions, sugarcane would not come in on land that is usually considered for sugarcane production in Vietnam. Sugarcane certainly should be considered as a major enterprise for Vietnam if the agricultural land base is expanded by adding new land, although some caution should be exercised in view of future price uncertainty and the fact that there is little experience with sugarcane in Vietnam on the type of land on which it enters model solutions. Experience elsewhere suggests that the model yields could be attained on this land, but some verification would be needed.

There are ample indications that sugarcane should not be considered as a major enterprise alternative for Vietnam within the historical land resource base, especially on land that is well suited for rice production. Even with sugarcane production forced on the historical land base, most production did not occur on good alluvial soils. Effects on income and foreign exchange would be highly unfavorable if production were forced on these soils.

With the prices assumed in this study, the sugarcane enterprise can develop on its own merit, without subsidy, if it can be successfully produced on new land as included in the model.

## Permitting Cotton Production to Enter Solutions

Although experience has been very limited, some research results suggest that cotton could be produced in Vietnam, at least at relatively low yield levels. 4/ Since prospects for cotton production are somewhat speculative, this enterprise was not permitted in basic solutions. Special runs were made to determine the impact of permitting cotton in the enterprise mix, assuming that the relatively conservative yield levels used are attainable. Solutions with cotton permitted are shown in tables 7 and 8 for the historical and additional land bases, respectively.

On the historical land base, the introduction of cotton would increase agricultural income slightly more than 1 billion piasters and reduce the trade deficit by slightly less than 2 billion piasters. Cotton would come in on almost 75,000 ha, mostly in the Highland and Eastern regions. Corn would be the major crop replaced. Because of reduced feed supply, imports of livestock products would be increased.

With cotton production permitted on the additional land resource base, agricultural income would be increased by about 5 billion piasters and the agricultural trade balance would be increased by about 6 billion piasters. Cotton production would satisfy all domestic consumption requirements for cotton, and small quantities of cotton, cottonseed oil, and cottonseed meal could be exported. It would be produced on more than 100,000 ha. distributed among the Highland, Eastern, and Lower Coastal regions. Soybeans would be the major crop displaced by cotton.

## Permitting Cotton and Wheat Production to Enter Solutions

Solutions including wheat production fall into an even more speculative category than those including cotton, since there is no experience with wheat production in Vietnam. 5/ Solutions with wheat production permitted, in addition to cotton production, are shown in table 7 and 8 for the historical and addition land base, respectively.

With both wheat and cotton permitted on the historical land base, total agricultural income would increase less than 2 billion piasters and the annual

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4/ Perspectives De Development de la Culture Cotonniere Au Viet Nam, Mission Francaise D'Aide Economique Et Technique Au Vietnam, La Maison Rustique, Paris, 1963.

5/ Wheat should not be considered as an alternative enterprise for Vietnam without comprehensive prior testing and adaptive research. It was included in the analysis purely on a "what if" basis, and with some reservation, only after extensive consultation by a member of the production economics team with wheat specialists in India and Mexico. Detailed reports on these consultations are available on request. They emphasize potential problems and need for advanced research, but indicate that relatively low yield wheat production might be feasible under some conditions.

foreign exchange balance would improve by 3 billion piasters. Wheat would come in on slightly more than 30,000 ha in the Central and North Coast regions. Wheat would displace sorghum in these regions and would be used entirely for feed grain. If cotton had not been permitted, the wheat enterprise probably would have had more independent impact on the solution. In effect, cotton production placed additional pressure on feed supplies which the model tried to partially relieve by replacing sorghum with wheat. However, with the limited land resources available with the historical land base, wheat production would not appear to have much potential impact on the agricultural economy, at least at the levels of performance assumed in this study.

With the additional land resource base, wheat production would come in at the level necessary to supply domestic flour consumption requirements. It would occupy about 180,000 ha, with the major portion of this area on new land in the Highland region. About 50,000 ha would be located in the North and Central Coastal regions. More than half of the wheat land in the Coastal regions would replace sorghum on old land. Wheat would displace corn in the Highland region. Wheat production appears to add about 3.5 billion piasters to agricultural income and about 2 billion piasters to the annual trade balance.

## Limited Adjustment in Some Regions

With the historical land base solution, the most significant shifts in production patterns, as compared with traditional patterns, would occur in the Coastal and Highland regions. With the optimum solution, substantial areas of cropland would shift from rice to sorghum, corn, and peanuts. Adjustments in production patterns may be less likely to occur in these regions than elsewhere in Vietnam. The typical farm unit in these regions is very small; the average size of farm is less than half that in the Delta. Pressure for rice production for subsistence is greater than on typical farms in the Delta and Eastern regions. With small units, the effect on individual farm incomes would be small from adjusting from a low yield crop of rice, for example, to sorghum, even if sorghum gives higher per hectare returns. At best, these farmers are not likely to consider such adjustments unless absolutely assured of markets for selling other commodities and buying rice for the family.

The effects of adjustments not occurring in enterprise organization in the Highland and Coastal regions are shown in tables 9 and 10 for the historical and additional land bases, respectively.

On the historical land base, agricultural income would be reduced about 7 billion piasters and the annual trade deficit would be increased almost 10 billion piasters when optimum shifts did not occur from rice to other crops in these regions. National rice production would increase and most of the increased rice production would be fed to livestock. Even with the increased use of paddy for feed, however, the feed deficit would increase, as indicated by additional imports of feed and livestock products.

With the additional land resource base, the impact of failure to make optimum enterprise adjustments on old land in the Highland and Coastal regions would be much less than with the historical land base. Income would be reduced and the trade deficit would be increased by less than 3 billion piasters. At this point, of

Table 9. Selected information from Vietnam Production Distribution Model, specified variations from base solution, historical land base, 1980

| Item | Historical base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Foreign exchange balance maximized |
|---|---|---|---|---|---|
| | - - - - - - - - - - Billion Piasters - - - - - - - - - - | | | | |
| Farm income | 302.1 | 295.2 | 299.8 | 294.4 | 220.5 |
| Consumers' surplus | 7.8 | 7.4 | 7.8 | 7.8 | 59.4 |
| Total | 309.9 | 302.6 | 307.6 | 302.2 | 279.9 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 39.3 | 37.5 | 39.4 | 39.4 | 63.5 |
| Commodity import | 54.7 | 63.9 | 56.7 | 77.1 | 47.6 |
| Annual inputs | 35.7 | 34.5 | 35.9 | 29.2 | 36.9 |
| Imports | 90.4 | 98.4 | 92.6 | 106.3 | 84.5 |
| Annual balance | -51.1 | -60.9 | -53.2 | -66.9 | -21.0 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 21.7 | 19.9 | 25.6 | 9.1 | 61.9 |
| Distribution | 25.6 | 22.1 | 25.6 | 23.7 | 61.2 |
| Total | 47.3 | 42.0 | 51.2 | 32.8 | 123.1 |
| Foreign exchange | 29.2 | 26.5 | 31.5 | 17.7 | 77.7 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports | | | | | |
| Rice | | | | | 109.0 |
| Peanut oil | | | | | 22.7 |
| Rubber | 167.9 | 167.9 | 167.9 | 167.9 | 167.9 |
| Tea | .5 | | .5 | .5 | .7 |
| Coffee | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Coconut | | | | | 600.0 |
| Coconut meal | 8.6 | 18.1 | 8.6 | 8.2 | |
| Copra | 28.9 | 1.6 | 28.9 | 29.9 | |
| Pineapple | | | | | 120.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Fiber | | | | | 4.4 |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Pork | | | | | 5.0 |
| Chicken | | | | | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Beef | | | | | 5.0 |

(Continued)

Table 9. (Continued)

| Item | Historical base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Foreign exchange balance maximized |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Imports | | | | | |
| Rice | | | | 257.5 | |
| Corn | | 13.0 | | | 499.2 |
| Soybean meal | 39.5 | 45.7 | 39.5 | 40.3 | 141.0 |
| Raw sugar | 286.6 | 286.6 | 286.6 | 286.6 | 117.9 |
| Sugar | 99.2 | 118.6 | 99.2 | 99.2 | |
| Fiber | | 11.1 | | | |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| Pork | 17.8 | 36.6 | 19.1 | 36.4 | |
| Chicken | 5.8 | 5.8 | 5.8 | 5.8 | |
| Beef | 14.4 | 14.4 | 19.1 | 15.1 | |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 1983.9 | 2226.6 | 2044.5 | 2040.0 | 1703.1 |
| Rice, HYV* | 1357.5 | 1414.0 | 1357.5 | 1000.0 | 1299.8 |
| Rice, floating | 656.3 | 656.3 | 595.6 | 595.6 | 838.2 |
| Corn | 88.0 | 68.5 | 88.0 | 91.7 | 53.1 |
| Sorghum | 349.8 | 179.5 | 349.8 | 349.8 | 274.4 |
| Soybeans | | | | | 11.4 |
| Peanuts | 67.3 | 34.8 | 67.3 | 68.2 | 148.6 |
| Sugarcane | 4.4 | | 4.4 | 4.4 | 52.6 |
| Tobacco | 20.2 | 20.2 | 20.2 | 20.2 | 19.3 |
| Rubber | 140.0 | 140.0 | 140.0 | 140.0 | 140.0 |
| Tea | 7.2 | 6.6 | 7.2 | 7.2 | 7.5 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 50.0 |
| Pineapple | | | | | 15.0 |
| Bananas | 8.6 | 8.6 | 8.6 | 8.6 | 8.1 |
| Jute | 11.1 | | 11.1 | 11.1 | 14.3 |
| Kenaf | | | | | 1.2 |

(Continued)

Table 9. (Continued)

| Item | Historical base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Foreign exchange balance maximized |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 3419.9 | 3290.8 | 3419.9 | 2968.3 | 3773.6 |
| Paddy home use | 3328.5 | 3457.6 | 3328.5 | 3326.9 | 3174.6 |
| Paddy fed | 495.9 | 721.4 | 483.8 | 400.8 | |
| Total paddy | 7244.3 | 7469.8 | 7232.2 | 6696.0 | 6948.2 |
| Corn marketed | 86.6 | 62.8 | 86.6 | 92.1 | 50.4 |
| Corn home fed | 100.9 | 80.4 | 100.9 | 105.2 | 58.9 |
| Total corn | 187.5 | 143.2 | 187.5 | 197.3 | 109.3 |
| Sorghum marketed | 150.6 | 116.8 | 150.6 | 150.6 | 132.5 |
| Sorghum home fed | 351.4 | 99.5 | 351.4 | 351.4 | 242.4 |
| Total sorghum | 502.0 | 216.3 | 502.0 | 502.0 | 374.9 |
| Peanuts | 119.0 | 62.6 | 119.0 | 121.1 | 241.2 |
| Sugarcane | 220.0 | | 220.0 | 220.0 | 3201.0 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 176.0 | 176.0 | 176.0 | 176.0 | 176.0 |
| Tea | 6.4 | 5.9 | 6.4 | 6.4 | 6.6 |
| Coffee | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 | 600.0 |
| Pineapple | | | | | 120.0 |
| Bananas | 215.3 | 215.3 | 215.3 | 215.3 | 202.3 |
| Jute | 11.1 | | 11.1 | 11.1 | 14.3 |
| Kenaf | | | | | 1.2 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1346.0 | 1346.0 | 1407.8 | 1406.7 | 1149.8 |
| Rice, HYV* | 869.0 | 869.3 | 870.5 | 594.9 | 893.6 |
| Rice, floating | 656.3 | 656.3 | 595.6 | 595.6 | 838.2 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 10.0 | 10.0 | 8.8 | 10.0 | 3.1 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 50.0 |
| Pineapple | | | | | 5.0 |
| Bananas | 2.5 | 2.5 | 2.5 | 2.5 | 7.2 |
| Jute | | | | | .3 |
| Kenaf | | | | | .3 |
| Soybeans | | | | | 11.8 |

(Continued)

Table 9. (Continued)

| Item | Historical base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Foreign exchange balance maximized |
|---|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Eastern Crops | | | | | |
| Rice | 218.1 | 218.1 | 217.0 | 218.1 | 189.5 |
| Rice, HYV* | 194.7 | 186.7 | 193.6 | 118.8 | 166.1 |
| Corn | 16.0 | 16.0 | 16.0 | 16.0 | 10.5 |
| Peanuts | 10.7 | 10.6 | 10.6 | 10.6 | 12.8 |
| Sugarcane | | | | | 20.2 |
| Tobacco | 10.3 | 10.3 | 11.4 | 10.3 | 4.5 |
| Rubber | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| Pineapple | | | | | 10.0 |
| Bananas | 6.1 | 6.1 | 6.1 | 6.1 | .9 |
| Jute | | | | | .9 |
| Kenaf | | | | | .9 |
| Lower Coastal Crops | | | | | |
| Rice | 104.5 | 127.5 | 104.5 | 104.5 | 93.0 |
| Rice, HYV* | 91.8 | 94.4 | 91.8 | 91.8 | 80.3 |
| Corn | 2.4 | 1.1 | 2.4 | 2.4 | 1.1 |
| Sorghum | 17.7 | | 17.7 | 17.7 | 5.7 |
| Soybeans | | | | | 5.6 |
| Peanuts | 4.8 | 1.6 | 4.8 | 4.8 | 12.5 |
| Sugarcane | | | | | 5.8 |
| Jute | .7 | | .7 | .7 | .7 |
| Central Coastal Crops | | | | | |
| Rice | 146.3 | 230.0 | 146.3 | 146.3 | 117.7 |
| Rice, HYV* | 101.9 | 128.5 | 101.9 | 100.8 | 73.2 |
| Corn | 2.3 | 4.6 | 2.3 | 2.3 | 2.3 |
| Sorghum | 61.7 | .4 | 61.7 | 61.7 | 41.6 |
| Peanuts | 10.8 | | 10.8 | 10.8 | 15.0 |
| Sugarcane | 4.4 | | 4.4 | 4.4 | 26.7 |
| Jute | 5.1 | | 5.1 | 5.1 | 5.1 |
| North Coastal Crops | | | | | |
| Rice | 134.2 | 235.0 | 134.2 | 134.2 | 119.4 |
| Rice, HYV* | 65.1 | 65.1 | 65.1 | 63.6 | 52.8 |
| Corn | 21.1 | 19.0 | 21.1 | 21.1 | 11.6 |
| Sorghum | 86.6 | 1.1 | 86.6 | 86.6 | 49.0 |

(Continued)

Table 9. (Continued)

| Item | Historical base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Foreign exchange balance maximized |
|---|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| North Coastal Crops (Continued) | | | | | |
| Peanuts | 7.9 | | 7.9 | 7.9 | 56.1 |
| Tobacco | | | | | 11.7 |
| Jute | 5.3 | | 5.3 | 5.3 | 7.2 |
| Highland Crops | | | | | |
| Rice | 34.7 | 70.0 | 34.7 | 30.1 | 33.8 |
| Rice, HYV* | 34.7 | 70.0 | 34.7 | 30.1 | 33.8 |
| Corn | 46.2 | 27.8 | 46.2 | 49.9 | 27.6 |
| Sorghum | 5.8 | | 5.8 | 5.8 | 5.8 |
| Peanuts | 26.1 | 15.5 | 26.1 | 27.0 | 45.3 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.2 | 6.6 | 7.2 | 7.2 | 7.5 |
| Coffee | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Soybeans | | | | | 5.8 |

*Included in total above.

Table 10. Selected information from Vietnam Production Distribution Model, specified variations from base solution, additional land base, 1980

| Item | Additional base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Livestock export not limited |
|---|---|---|---|---|---|
| | - - - - - - - - - - Billion Piasters - - - - - - - - - - | | | | |
| Farm income | 320.7 | 318.3 | 312.6 | 316.1 | 330.1 |
| Consumers' surplus | 50.8 | 50.7 | 50.8 | 50.8 | 50.6 |
| Total | 371.5 | 369.0 | 363.4 | 366.9 | 380.7 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 135.9 | 132.2 | 136.2 | 112.1 | 153.3 |
| Commodity import | 24.6 | 24.6 | 31.1 | 24.8 | 27.1 |
| Annual inputs | 52.0 | 51.2 | 54.1 | 44.1 | 51.7 |
| Imports | 76.6 | 75.8 | 85.2 | 68.9 | 78.8 |
| Annual balance | 59.3 | 56.4 | 51.0 | 43.2 | 74.5 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 56.8 | 56.5 | 74.7 | 43.0 | 70.1 |
| Distribution | 88.0 | 92.5 | 85.6 | 79.3 | 94.9 |
| Total | 144.8 | 149.0 | 160.3 | 122.3 | 165.0 |
| Foreign exchange | 94.5 | 97.1 | 104.2 | 76.9 | 99.8 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports | | | | | |
| Rice | 539.2 | 625.3 | 530.5 | 130.3 | 258.5 |
| Corn | 1053.9 | 990.4 | 1064.5 | 1063.5 | |
| Sorghum | 87.1 | 91.4 | 87.2 | 54.3 | |
| Soybeans | 165.1 | 69.7 | 165.1 | 94.7 | |
| Soybean oil | | 4.4 | | 2.0 | 51.9 |
| Peanuts | 107.9 | 27.0 | 99.9 | 93.4 | |
| Peanut oil | 30.2 | 37.0 | 30.7 | 46.1 | 69.9 |
| Rubber | 212.5 | 210.8 | 213.7 | 212.8 | 200.5 |
| Tea | .7 | .7 | .7 | ** | ** |
| Coffee | 44.9 | 44.9 | 47.0 | 44.9 | 44.9 |
| Copra | 53.3 | 53.3 | 53.3 | 53.3 | 53.3 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | 46.5 | 46.5 | 46.5 | 46.5 | 46.5 |

(Continued)

Table 10. (Continued)

| Item | Additional base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Livestock export not limited |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Exports (Continued) | | | | | |
| Duck feathers | .9 | .9 | .9 | .9 | .9 |
| Pork | 5.0 | 5.0 | 5.0 | 5.0 | 214.8 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | | |
| Sugar | 53.6 | 53.6 | 70.0 | 53.6 | 95.9 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| Beef | 2.8 | 2.8 | 19.1 | 3.4 | 2.6 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 2111.6 | 2312.8 | 2153.2 | 2150.3 | 2069.5 |
| Rice, HYV* | 1491.8 | 1511.3 | 1489.9 | 1000.0 | 1469.5 |
| Rice, floating | 639.1 | 639.1 | 595.6 | 595.6 | 639.1 |
| Corn | 754.2 | 767.1 | 759.3 | 792.4 | 669.6 |
| Sorghum | 352.6 | 255.5 | 352.6 | 352.6 | 363.1 |
| Soybeans | 148.7 | 83.4 | 148.7 | 94.5 | 288.8 |
| Peanuts | 236.6 | 189.6 | 233.1 | 256.7 | 231.3 |
| Sugarcane | 88.5 | 90.9 | 83.3 | 88.1 | 81.7 |
| Tobacco | 21.1 | 20.7 | 21.4 | 20.9 | 21.1 |
| Rubber | 174.3 | 173.0 | 175.3 | 174.5 | 165.1 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 52.1 | 48.6 | 48.6 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | 11.1 | 8.9 | 11.1 | 11.1 | 11.1 |
| Kenaf | | 2.2 | | | |

(Continued)

Table 10. (Continued)

| Item | Additional base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Livestock export not limited |
|---|---|---|---|---|---|
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 4351.1 | 4435.4 | 4335.2 | 3607.5 | 3851.3 |
| Paddy home use | 3385.8 | 3459.5 | 3385.8 | 3379.8 | 3371.1 |
| Paddy fed | | | | | 402.3 |
| Total paddy | 7736.9 | 7894.9 | 7721.0 | 6987.3 | 7624.7 |
| Corn marketed | 1390.0 | 1430.3 | 1403.5 | 1472.7 | 1191.3 |
| Corn home fed | 465.1 | 456.9 | 465.9 | 478.2 | 456.2 |
| Total corn | 1855.1 | 1887.2 | 1869.4 | 1950.9 | 1647.5 |
| Sorghum marketed | 161.6 | 151.5 | 161.6 | 149.5 | 151.2 |
| Sorghum home fed | 342.1 | 190.3 | 342.1 | 354.1 | 371.3 |
| Total sorghum | 503.7 | 341.8 | 503.7 | 503.6 | 522.5 |
| Soybeans | 181.6 | 105.4 | 181.6 | 117.2 | 378.0 |
| Peanuts | 391.8 | 326.2 | 384.7 | 430.9 | 387.5 |
| Sugarcane | 3889.8 | 3889.8 | 3708.9 | 3889.8 | 3410.0 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 220.6 | 219.0 | 221.8 | 220.9 | 208.6 |
| Tea | 6.6 | 6.6 | 6.6 | 5.9 | 5.9 |
| Coffee | 50.5 | 50.6 | 52.7 | 50.6 | 50.6 |
| Coconut | 480.0 | 480.0 | 480.0 | 480.0 | 480.0 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 |
| Jute | 11.1 | 8.9 | 11.1 | 11.1 | 11.1 |
| Kenaf | | 2.2 | | | |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1446.4 | 1445.5 | 1489.9 | 1488.2 | 1425.5 |
| Rice, HYV* | 1065.6 | 1065.6 | 1065.6 | 705.0 | 1045.1 |
| Rice, floating | 639.1 | 639.1 | 595.6 | 595.6 | 639.1 |
| Sorghum | 178.0 | 178.0 | 178.0 | 178.0 | 178.0 |
| Soybeans | | | | | 20.9 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 4.0 | 3.1 | 4.0 | 5.7 | 4.0 |
| Coconut | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Jute | | 1.5 | | | |
| Kenaf | | .3 | | | |

(Continued)

Table 10. (Continued)

| Item | Additional base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectares | Livestock export not limited |
|---|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Eastern Crops | | | | | |
| Rice | 210.0 | 204.8 | 208.1 | 207.6 | 209.8 |
| Rice, HYV* | 115.5 | 113.1 | 113.6 | 76.6 | 118.4 |
| Corn | 459.0 | 452.4 | 464.1 | 460.3 | 394.2 |
| Corn* | 459.0 | 452.4 | 464.1 | 460.3 | 394.2 |
| Soybeans | 31.8 | 31.8 | 31.8 | 31.8 | 115.8 |
| Soybeans* | 27.4 | 27.4 | 27.4 | 27.4 | 108.3 |
| Peanuts | 37.8 | 37.4 | 34.2 | 39.9 | 37.3 |
| Peanuts* | 20.1 | 20.1 | 20.1 | 20.0 | 17.5 |
| Sugarcane | 84.1 | 90.3 | 78.9 | 83.7 | 77.3 |
| Sugarcane* | 79.2 | 87.1 | 73.2 | 77.7 | 74.9 |
| Tobacco | 17.2 | 17.7 | 17.4 | 15.2 | 17.1 |
| Rubber | 154.3 | 153.1 | 155.3 | 154.5 | 145.1 |
| Rubber* | 34.3 | 33.0 | 35.3 | 34.5 | 25.1 |
| Coffee | | | 3.5 | | |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | | 6.7 | | | |
| Kenaf | | 1.9 | | | |
| Lower Coastal Crops | | | | | |
| Rice | 111.4 | 127.5 | 111.4 | 110.6 | 106.7 |
| Rice, HYV* | 97.4 | 97.4 | 97.4 | 46.9 | 92.7 |
| Corn | 7.9 | 7.9 | 7.9 | 7.9 | 3.1 |
| Corn* | 6.8 | 6.8 | 6.8 | 6.8 | 2.0 |
| Sorghum | 26.6 | 26.6 | 26.6 | 26.6 | 26.6 |
| Sorghum* | 26.6 | 26.6 | 26.6 | 26.6 | 26.6 |
| Soybeans | 38.3 | 32.6 | 38.3 | 38.3 | 46.4 |
| Soybeans* | 32.6 | 32.6 | 32.6 | 32.6 | 40.8 |
| Peanuts | 20.5 | 10.0 | 20.5 | 21.2 | 21.8 |
| Peanuts* | 8.0 | 8.0 | 8.0 | 8.0 | 4.6 |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Central Coastal Crops | | | | | |
| Rice | 154.6 | 230.0 | 154.6 | 154.6 | 154.6 |
| Rice, HYV* | 110.3 | 129.4 | 110.3 | 102.9 | 110.3 |
| Corn | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| Corn* | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |

(Continued)

Table 10. (Continued)

| Item | Additional base solution | Limited adjustment in some regions | Cattle import not permitted | HYV rice limited to 1,000,000 hectrares | Livestock export not limited |
|---|---|---|---|---|---|
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| Central Coastal Crops (Continued) | | | | | |
| Sorghum | 71.2 | 26.0 | 71.2 | 71.2 | 71.2 |
| Sorghum* | 26.0 | 26.0 | 26.0 | 26.0 | 26.0 |
| Peanuts | 31.5 | 14.0 | 31.5 | 31.5 | 31.5 |
| Peanuts* | 11.7 | 11.7 | 11.7 | 11.7 | 11.7 |
| Sugarcane | 4.4 | .6 | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | | 5.1 | 5.1 | 5.1 |
| North Central Crops | | | | | |
| Rice | 149.6 | 235.0 | 149.6 | 149.6 | 139.1 |
| Rice, HYV* | 69.2 | 69.2 | 69.2 | 67.7 | 69.2 |
| Corn | 26.1 | 22.5 | 26.1 | 26.1 | 26.1 |
| Corn* | 13.0 | 13.0 | 13.0 | 13.0 | 13.0 |
| Sorghum | 76.8 | 25.0 | 76.8 | 76.8 | 87.3 |
| Sorghum* | 24.9 | 25.0 | 24.9 | 24.9 | 24.9 |
| Peanuts | 51.1 | 26.5 | 51.1 | 51.1 | 51.1 |
| Peanuts* | 14.2 | 14.2 | 14.2 | 14.2 | 14.2 |
| Jute | 5.3 | | 5.3 | 5.3 | 5.3 |
| Highland Crops | | | | | |
| Rice | 39.6 | 70.0 | 39.6 | 39.6 | 33.8 |
| Rice, HYV* | 33.8 | 36.6 | 33.8 | .9 | 33.8 |
| Corn | 253.4 | 276.5 | 253.4 | 290.3 | 238.4 |
| Corn* | 253.4 | 276.5 | 253.4 | 290.3 | 238.4 |
| Soybeans | 78.6 | 19.0 | 78.6 | 24.5 | 105.6 |
| Soybeans* | 51.0 | 19.0 | 51.0 | | 75.3 |
| Peanuts | 88.7 | 94.8 | 88.7 | 106.0 | 82.6 |
| Peanuts* | 43.5 | 52.4 | 43.5 | 57.7 | 34.2 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |
| Coffee | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 |
| Coffee* | 41.6 | 41.6 | 41.6 | 41.6 | 41.6 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

**Less than .05.

course, pressure would have been removed from feed supply, so that secondary feed and livestock considerations would not influence income effects.

## Import of Work Stock Restricted

Tractors, and cattle and buffalo, were fixed in the model according to their regional distribution in 1971. For additional power requirements, the model gave the option of importing additional tractors or additional livestock. Cattle imported for this purpose represent a one-time investment and foreign exchange requirement. Their numbers expand by natural increase over time and would supply beef as well as power.

All solutions in the analysis would import cattle for power needs in preference to tractors. The historical land base solution would import 24,300 cattle and the additional land base solution would import 84,500. The effects of not permitting imports of additional cattle are shown in tables 9 and 10 for these two land bases, respectively.

With the historical land base, the partial additional shift to mechanical power would reduce income 2.3 billion piasters. This reduction occurs because of increased expenses accompanying tractor use and reduced revenue from beef production. There would be no significant effect on cropping patterns or crop production; some land in the traditional double-transplant area would shift from improved floating rice varieties to double-transplant rice. The annual trade deficit would increase about 2 billion piasters, primarily as a result of increased beef imports. New investment requirements would increase 4 billion piasters, and requirements for investment of foreign exchange would grow more than 2 billion piasters.

With the additional land base, the elimination of work stock imports would reduce agricultural income and the annual trade balance by about 8 billion piasters. Total new capital investment requirements would increase more than 16 billion piasters, of which 10 billion would require foreign exchange expenditure. The same shift of land that was noted above--from improved floating rice to double-transplant rice--would occur. Other shifts in production patterns would be minor.

The impact of limiting work stock on new investment would be highly conservative, especially for the additional land base situation. At best, the requirement for new tractors would likely be two to three times that reflected in the solutions. The scheme providing tractor power on new land would involve only one tractor for each 100 ha. This is the approximate amount of land reported to be handled by many Vietnamese custom operators in old farming areas. For the type of farming projected for the new lands, one tractor would do well to handle half this amount. Employment of one tractor for 50 ha would still reflect joint use by several farmers. It is problematical whether effective and satisfactory systems for joint power use on a large scale could be developed in Vietnam. The point is that, with the most conservative possible estimates of requirements, a major shift to mechanical power would involve a high price in terms of reduced income and increased investment.

It should be understood that these solutions do not imply full mechanization of additional land, but only for the portion that could not be handled with existing livestock. With complete mechanization, income and investment effects would be much larger than those shown.

## HYV Rice Limited to One Million Hectares

Solutions with HYV rice limited to 1 million ha of cropland are shown in tables 9 and 10 for the historical and additional land resource bases, respectively.

With the historical land base, this limitation on HYV rice would reduce income almost 8 billion piasters and increase the trade deficit almost 16 billion piasters. Imports of rice and livestock products would be increased substantially. There would be little impact on production patterns for other crops. Capital investment requirements would be reduced about 15 billion piasters.

With the additional land base, the limitation on HYV rice cropland would reduce income 4.6 billion piasters and trade balance about 16 billion piasters. Investment requirements would be reduced more than 22 billion piasters. Effect on cropping patterns would be negligible, except in the Highland region where cropland area would be increased for corn and peanuts and decreased for soybeans.

## Foreign Exchange Balance Maximized

A solution was run for the historical land base only, with the objective function changed from maximization of income to maximization of the foreign exchange balance (table 9). The same commodity limits discussed in the introduction were retained for this run. Results would be different, of course, if these limits had been changed. Without limits, the results would be transparently ridiculous. Without restrictions on livestock export and/or feed import, for example, feed would be imported and livestock exported in infinite quantities.

This run was included only because maximizing trade balance is often stated as an objective for Vietnam's agriculture. A solution of this kind actually has no economic meaning. Costs and returns are not active variables in computations since the objective function is not related to income. Model decisions are based only on values of imported and exported items; there is no concern for whether output occurs at a loss. In fact, efforts to improve trade balance, given optimum resource use in an economic framework, could only be attained at a loss.

With this solution, the trade deficit would be reduced 30 billion piasters, but the deficit, reflecting commodities in the study, would still amount to 21 billion piasters. Total value of agricultural output would be reduced 30 billion piasters and farm income would be reduced more than 90 billion piasters. Capital investment requirements would be increased 76 billion piasters.

Major changes in cropping patterns would include displacement of corn and sorghum by peanuts and sugarcane. Large quantities of feed would be imported to:

(1) replace fed paddy, releasing rice for export; and (2) permit feeding additional livestock, eliminating livestock imports and creating livestock exports. These particular commodities for export, and for import substitution, clearly do not make economic sense as long as the land resource base is very limited.

## Limits Removed on Livestock Export

A solution was run, for the additional land base only, with limits removed on export of livestock products (table 10). No feed imports are permitted. Such a solution would be obviously irrelevant for the historical land base.

Large quantities of pork would be exported with this solution. No significant quantities of other livestock products would be exported. Pork production would come largely from small farm commercial enterprises. It should be remembered that comparable poultry enterprises were not incorporated into the model.

With this solution, the value of agricultural production would be increased 9 billion piasters and the trade balance would be increased 15 billion piasters. Capital investment requirements would be increased 20 billion piasters.

Briefly stated, this solution seeks to convert the maximum amount of feed possible into pork production. Protein supplement would become the limiting factor and land would be shifted to production of more oil seed to obtain additional oil meal. Most of the cropland shifts would occur in the Eastern and Highland regions, primarily on new land.

This solution suggests that pork production could be expanded appreciably in Vietnam if disease problems can be controlled, if additional land becomes available for feed production, and if export markets are available.

## Internal Capital Restricted

Two levels of internal capital restriction were imposed: to approximately three-fourths and one-half of the new capital requirements generated in optimum solutions without capital limitations. Selected information from these solutions is shown in tables 11 and 12 for the historical and additional land bases, respectively.

With the historical land base, the first increment of capital reduction would reduce income almost 2 billion piasters and increase the trade deficit by 6.6 billion piasters. The major portion of the capital reduction would occur in connection with shifts away from commercial hog production and HYV rice production. Rice would be imported because of reduced rice production plus increased feeding of paddy to livestock. The small amount of sugarcane production in the Central Coastal region would be eliminated.

With new investment capital reduced by about one-half, income would be reduced about 7 billion piasters and the trade deficit would increase about 16 billion piasters. Capital for new distribution facilities would account for a

Table 11. Selected information from Vietnam Production Distribution Model with specified reductions in total internal capital available, historical land resource base, 1980

| Item | Historical land base | Internal capital reductions | |
|---|---|---|---|
| | | 27 percent | 52 percent |
| | - - - - - - - - Billion Piasters - - - - - - - - - - | | |
| Farm income | 302.1 | 300.7 | 295.3 |
| Consumers' surplus | 7.8 | 7.4 | 7.4 |
| Total | 309.9 | 308.1 | 302.7 |
| Annual Foreign Exchange | | | |
| Commodity export | 39.3 | 40.1 | 43.6 |
| Commodity import | 54.7 | 63.9 | 78.4 |
| Annual inputs | 35.7 | 33.9 | 32.2 |
| Imports | 90.4 | 97.8 | 110.6 |
| Annual balance | -51.1 | -57.7 | -67.0 |
| Capital Investment (one-time requirement) | | | |
| Production | 21.7 | 12.4 | 6.1 |
| Distribution | 25.6 | 22.0 | 16.8 |
| Total | 47.3 | 34.4 | 22.9 |
| Foreign exchange | 29.2 | 19.9 | 12.8 |
| | - - - - - - - Thousand Metric Tons - - - - - - - - - | | |
| Exports | | | |
| Sorghum | | | .2 |
| Peanuts | | | 41.5 |
| Rubber | 167.9 | 167.9 | 167.6 |
| Tea | .5 | | |
| Coffee | 2.7 | 2.7 | 2.7 |
| Coconut meal | 8.6 | 2.9 | |
| Copra | 28.9 | 45.1 | 53.3 |
| Bananas | 200.0 | 200.0 | 200.0 |
| Wheat bran | | | 46.5 |
| Duck feathers | .9 | .9 | .9 |
| Duck | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 |
| Imports | | | |
| Rice | | 202.8 | 367.8 |
| Soybean meal | 39.5 | 21.0 | 12.9 |
| Soybean oil | | | 23.1 |

(Continued)

Table 11. (Continued)

| Item | Historical land base | Internal capital reductions | |
|---|---|---|---|
| | | 27 percent | 52 percent |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - - | | |
| Imports (Continued) | | | |
| Raw sugar | 286.6 | 286.6 | 286.6 |
| Sugar | 99.2 | 118.6 | 118.6 |
| Flour | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 |
| Pork | 17.8 | 7.2 | 11.0 |
| Chicken | 5.8 | 5.8 | 5.8 |
| Beef | 14.4 | 14.4 | 15.3 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Crops | | | |
| Rice, nonfloating | 1983.9 | 1986.9 | 2124.7 |
| Rice, HYV* | 1357.5 | 1252.4 | 1212.0 |
| Rice, floating | 656.3 | 656.3 | 595.6 |
| Corn | 88.0 | 71.4 | 35.8 |
| Sorghum | 349.8 | 352.7 | 299.3 |
| Peanuts | 67.3 | 85.1 | 78.4 |
| Sugarcane | 4.4 | | |
| Tobacco | 20.2 | 22.4 | 21.1 |
| Rubber | 140.0 | 140.0 | 139.7 |
| Tea | 7.2 | 6.6 | 6.6 |
| Coffee | 7.0 | 7.0 | 7.0 |
| Coconut | 40.0 | 40.0 | 40.0 |
| Bananas | 8.6 | 8.6 | 8.6 |
| Jute | 11.1 | 11.1 | 4.5 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - - | | |
| Crop Production | | | |
| Paddy marketed | 3419.9 | 3049.0 | 2722.5 |
| Paddy use | 3328.5 | 3342.5 | 3378.5 |
| Paddy fed | 495.9 | 735.9 | 1054.0 |
| Total paddy | 7244.3 | 7127.4 | 7155.0 |
| Corn marketed | 86.6 | 60.7 | 14.9 |
| Corn home fed | 100.9 | 83.1 | 45.9 |
| Total corn | 187.5 | 143.8 | 60.8 |
| Sorghum marketed | 150.6 | 151.1 | 136.6 |
| Sorghum home fed | 351.4 | 356.5 | 286.7 |
| Total sorghum | 502.0 | 507.6 | 423.3 |

(Continued)

Table 11. (Continued)

| Item | Historical land base | Internal capital reductions | |
|---|---|---|---|
| | | 27 percent | 52 percent |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - - | | |
| Crop Production (Continued) | | | |
| Peanuts | 119.0 | 152.4 | 135.8 |
| Sugarcane | 220.0 | | |
| Tobacco | 25.9 | 25.9 | 25.9 |
| Rubber | 176.0 | 176.0 | 175.7 |
| Tea | 6.4 | 5.9 | 5.9 |
| Coffee | 8.4 | 8.4 | 8.4 |
| Coconut | 480.0 | 480.0 | 480.0 |
| Bananas | 215.3 | 215.3 | 215.3 |
| Jute | 11.1 | 11.1 | 4.5 |
| | - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Delta Crops | | | |
| Rice, nonfloating | 1346.0 | 1340.3 | 1409.1 |
| Rice, HYV* | 869.0 | 818.0 | 785.7 |
| Rice, floating | 656.3 | 656.3 | 595.6 |
| Sorghum | 178.0 | 178.0 | 173.5 |
| Peanuts | 7.0 | 7.0 | 5.8 |
| Tobacco | 10.0 | 15.7 | 8.8 |
| Coconut | 40.0 | 40.0 | 40.0 |
| Bananas | 2.5 | 2.5 | 2.5 |
| Eastern Crops | | | |
| Rice | 218.1 | 221.6 | 226.8 |
| Rice, HYV* | 194.7 | 155.5 | 153.8 |
| Corn | 16.0 | 13.9 | 3.2 |
| Peanuts | 10.7 | 12.8 | 12.8 |
| Tobacco | 10.3 | 6.7 | 12.4 |
| Rubber | 120.0 | 120.0 | 120.0 |
| Bananas | 6.1 | 6.1 | 6.1 |
| Lower Coastal Crops | | | |
| Rice | 104.5 | 104.5 | 104.5 |
| Rice, HYV* | 91.8 | 91.8 | 66.2 |
| Corn | 2.4 | 2.4 | 2.4 |
| Sorghum | 17.7 | 17.7 | 15.1 |
| Peanuts | 4.8 | 4.8 | 7.5 |
| Jute | .7 | .7 | .7 |

(Continued)

Table 11. (Continued)

| Item | Historical land base | Internal capital reductions | |
|---|---|---|---|
| | | 27 percent | 52 percent |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Central Coastal Crops | | | |
| Rice | 146.3 | 153.0 | 165.8 |
| Rice, HYV* | 101.9 | 108.6 | 109.4 |
| Corn | 2.3 | 4.6 | 4.6 |
| Sorghum | 61.7 | 66.1 | 45.3 |
| Peanuts | 10.8 | 6.2 | 4.8 |
| Sugarcane | 4.4 | | |
| Tea | 5.1 | 5.1 | 3.8 |
| [illegible] | | | |
| | 134.2 | 134.2 | 150.0 |
| | 65.1 | 65.1 | 65.1 |
| | 21.1 | 21.1 | 21.1 |
| | 36.6 | 85.1 | 65.5 |
| | 7.9 | 9.4 | 7.0 |
| | 5.3 | 5.3 | |
| [illegible] | | | |
| R | 34.7 | 33.2 | 68.5 |
| S | 34.7 | 13.4 | 31.7 |
| Corn | 46.2 | 29.4 | 4.5 |
| Sorghum | 5.8 | 5.8 | |
| Peanuts | 26.1 | 44.9 | 40.6 |
| Rubber | 20.0 | 20.0 | 19.7 |
| Tea | 7.2 | 6.6 | 6.6 |
| Coffee | 7.0 | 7.0 | 7.0 |
| | - - - - - - - - - - - - Units - - - - - - - - - - - - | | |
| New Facility Requirement | | | |
| Tobacco processing | | | |
| East | .5 | .5 | .5 |
| Banana marketing | | | |
| Delta | 1.0 | 1.0 | 1.0 |
| East | 2.3 | 2.3 | 2.3 |
| Fiber processing | | | |
| East | 2.6 | 2.6 | |
| Rubber processing | | | |
| East | 106.0 | 106.0 | 106.0 |
| Highland | 20.0 | 20.0 | 19.7 |

(Continued)

Table 11. (Continued)

| Item | Historical land base | Internal capital reductions | |
|---|---|---|---|
| | | 27 percent | 52 percent |
| | - - - - - - - - - - - - Units - - - - - - - - - - - - | | |
| New Facility Requirement (Continued) | | | |
| Tea processing | | | |
| Highland | 3.5 | 1.7 | 1.7 |
| Rice mill | | | |
| Lower Coast | 7.2 | 5.0 | .1 |
| Highland | 3.0 | | |
| Rice drying | | | |
| Delta | 52.1 | 52.6 | 52.6 |
| East | 12.1 | 12.1 | 12.1 |
| Grain storage | | | |
| Delta | 280.5 | 204.8 | 138.4 |
| Highland | 26.6 | 11.2 | |
| Threshing-Shelling | | | |
| Delta | 194.2 | 194.2 | 189.3 |
| East | 17.4 | 14.9 | 2.7 |
| Lower Coast | 27.9 | 27.9 | 24.1 |
| Central Coast | 94.0 | 101.7 | 70.9 |
| North Coast | 136.8 | 134.8 | 105.6 |
| Highland | 64.7 | 43.2 | 5.8 |
| Feed mill | | | |
| Delta | 2.8 | .6 | .5 |
| Lower Coast | .7 | .6 | .6 |
| Central Coast | 1.5 | .6 | .3 |
| North Coast | 1.3 | 1.3 | 1.0 |
| Highland | 5.8 | 4.4 | .4 |
| Oil mill | | | |
| Delta | .7 | .4 | .1 |
| East | .3 | .4 | |
| Lower Coast | .1 | .1 | |
| Central Coast | .3 | .2 | .1 |
| North Coast | .2 | .2 | |
| Highland | .8 | 1.4 | 1.2 |
| Sugar refinery | | | |
| Central Coast | .2 | | |

*Included in total above.

Table 12. Selected information from Vietnam Production Distribution Model with specified reductions in total internal capital available, additional land resource base, 1980

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | |
| Farm income | 320.7 | 343.9 | 336.0 | 334.0 |
| Consumers' surplus | 50.8 | 25.5 | 25.1 | 25.1 |
| Total | 371.5 | 369.4 | 361.1 | 359.1 |
| Annual Foreign Exchange | | | | |
| Commodity export | 135.9 | 136.6 | 108.3 | 111.9 |
| Commodity import | 24.6 | 39.4 | 43.6 | 44.8 |
| Annual inputs | 52.0 | 49.8 | 43.2 | 45.2 |
| Imports | 76.6 | 89.2 | 86.8 | 90.0 |
| Annual balance | 59.3 | 47.4 | 21.5 | 21.9 |
| Capital Investment (one-time requirement) | | | | |
| Production | 56.8 | 48.8 | 35.6 | 33.1 |
| Distribution | 88.0 | 59.8 | 36.8 | 39.3 |
| Total | 144.8 | 108.5 | 72.4 | 72.4 |
| Foreign exchange | 94.5 | 64.3 | 44.9 | 43.3 |
| | - - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | |
| Exports | | | | |
| Rice | 539.2 | 433.7 | | |
| Rice bran | | | 52.0 | 52.0 |
| Corn | 1053.9 | 1184.9 | 635.9 | 1228.3 |
| Sorghum | 87.1 | 83.1 | 82.2 | 32.0 |
| Soybeans | 165.1 | 162.2 | 474.6 | |
| Peanuts | 107.9 | 96.0 | 242.7 | 457.6 |
| Peanut oil | 30.2 | 36.0 | | |
| Rubber | 212.5 | 228.9 | 167.9 | 167.9 |
| Tea | .7 | ** | | |
| Coffee | 44.9 | 44.9 | 47.0 | 47.0 |
| Copra | 53.3 | 66.7 | 66.7 | 66.7 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 | 200.0 |
| Wheat bran | 46.5 | 46.5 | 46.5 | 46.5 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | |
| Exports (Continued) | | | | |
| Duck feathers | .9 | .9 | .9 | .9 |
| Pork | 5.0 | 5.0 | 5.0 | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 |
| Imports | | | | |
| Soybean oil | | | 6.7 | 6.7 |
| Raw sugar | | 246.6 | 246.6 | 246.6 |
| Sugar | 53.6 | 99.2 | 118.6 | 118.6 |
| Fiber | | | 6.6 | 6.6 |
| Flour | 107.1 | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 | 39.4 |
| Chicken | | | 5.8 | 5.8 |
| Beef | 2.8 | 3.2 | 3.0 | 6.5 |
| | - - - - - - - - Thousand Hectares - - - - - - - - | | | |
| Crops | | | | |
| Rice, nonfloating | 2111.6 | 2098.2 | 2193.6 | 2194.1 |
| Rice, HYV* | 1491.8 | 1338.6 | 1057.5 | 1116.4 |
| Rice, floating | 639.1 | 639.1 | 595.6 | 595.6 |
| Corn | 754.2 | 820.9 | 551.0 | 314.8 |
| Sorghum | 352.6 | 352.6 | 324.8 | 240.8 |
| Soybeans | 148.7 | 145.6 | 426.5 | ** |
| Peanuts | 236.6 | 240.1 | 246.1 | 377.3 |
| Sugarcane | 88.5 | 10.2 | 5.8 | 5.8 |
| Tobacco | 21.1 | 22.3 | 19.7 | 19.1 |
| Rubber | 174.3 | 186.9 | 140.0 | 140.0 |
| Tea | 7.5 | 7.5 | 6.6 | 6.6 |
| Coffee | 48.6 | 48.6 | 52.1 | 52.1 |
| Coconut | 40.0 | 50.0 | 50.0 | 50.0 |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | 11.1 | 11.1 | 4.2 | 3.3 |
| Kenaf | | | .3 | 1.2 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | |
| Crop Production | | | | |
| Paddy marketed | 4351.1 | 4157.7 | 3333.7 | 3332.7 |
| Paddy home use | 3385.8 | 3385.8 | 3414.7 | 3415.7 |
| Paddy fed | | | 446.3 | 518.5 |
| Total paddy | 7736.9 | 7543.5 | 7194.7 | 7266.9 |
| Corn marketed | 1390.0 | 1553.9 | 800.4 | 1428.3 |
| Corn home fed | 465.1 | 472.6 | 551.4 | 550.3 |
| Total corn | 1855.1 | 2026.5 | 1351.8 | 1978.6 |
| Sorghum marketed | 161.6 | 157.1 | 144.8 | 89.4 |
| Sorghum home fed | 342.1 | 346.6 | 318.6 | 293.0 |
| Total sorghum | 503.7 | 503.7 | 462.4 | 382.4 |
| Soybeans | 181.6 | 178.5 | 522.1 | ** |
| Peanuts | 391.8 | 398.8 | 413.4 | 649.8 |
| Sugarcane | 3889.8 | 660.0 | 440.0 | 440.0 |
| Tobacco | 25.9 | 25.9 | 25.9 | 25.9 |
| Rubber | 220.6 | 237.0 | 176.0 | 176.0 |
| Tea | 6.6 | 5.9 | 5.9 | 5.9 |
| Coffee | 50.5 | 50.6 | 52.7 | 52.7 |
| Coconut | 480.0 | 600.0 | 600.0 | 600.0 |
| Pineapple | 80.0 | 80.0 | 80.0 | 80.0 |
| Bananas | 222.2 | 222.2 | 222.2 | 222.2 |
| Jute | 11.1 | 11.1 | 4.2 | 3.3 |
| Kenaf | | | .3 | 1.2 |
| | - - - - - - - - Thousand Hectares - - - - - - - - | | | |
| Delta Crops | | | | |
| Rice, nonfloating | 1446.4 | 1436.4 | 1483.2 | 1483.2 |
| Rice, HYV* | 1065.6 | 962.4 | 737.0 | 799.9 |
| Rice, floating | 639.1 | 639.1 | 595.6 | 595.6 |
| Sorghum | 178.0 | 178.0 | 176.1 | 66.8 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 |
| Tobacco | 4.0 | 4.0 | | |
| Coconut | 40.0 | 50.0 | 50.0 | 50.0 |
| Jute | | | .3 | .3 |
| Kenaf | | | .3 | .3 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | Thousand Hectares | | | |
| Eastern Crops | | | | |
| Rice | 210.0 | 206.6 | 212.6 | 209.7 |
| Rice, HYV* | 115.5 | 86.9 | 79.1 | 81.0 |
| Corn | 459.0 | 525.7 | 329.8 | 474.4 |
| Corn* | 459.0 | 525.7 | 329.8 | 474.4 |
| Sorghum | | | | 2.0 |
| Soybeans | 31.8 | 31.8 | 212.9 | ** |
| Soybeans* | 27.4 | 27.4 | 210.6 | |
| Peanuts | 37.8 | 38.2 | 93.0 | 158.9 |
| Peanuts* | 20.1 | 20.1 | 79.6 | 145.7 |
| Sugarcane | 84.1 | 5.8 | 5.8 | 5.8 |
| Sugarcane* | 79.2 | | | |
| Tobacco | 17.2 | 18.3 | 14.6 | 11.0 |
| Rubber | 154.3 | 166.9 | 120.0 | 120.0 |
| Rubber* | 34.3 | 46.9 | | |
| Coffee | | | 3.5 | 3.5 |
| Pineapple | 10.0 | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 | 8.9 |
| Jute | | | .3 | .8 |
| Kenaf | | | | .8 |
| Lower Coastal Crops | | | | |
| Rice | 111.4 | 111.4 | 100.4 | 100.0 |
| Rice, HYV* | 97.4 | 97.4 | 57.4 | 53.9 |
| Corn | 7.9 | 7.9 | 7.9 | 6.8 |
| Corn* | 6.8 | 6.8 | 6.8 | 6.8 |
| Sorghum | 26.6 | 26.6 | 26.6 | 49.9 |
| Sorghum* | 26.6 | 26.6 | 26.6 | 49.9 |
| Soybeans | 38.3 | 38.3 | 35.6 | |
| Soybeans* | 32.6 | 32.6 | 32.6 | |
| Peanuts | 20.5 | 20.5 | 28.9 | 38.8 |
| Peanuts* | 8.0 | 8.0 | 8.0 | 17.3 |
| Tobacco | | | 5.2 | 8.1 |
| Jute | .7 | .7 | .7 | .7 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | |
| Central Coastal Crops | | | | |
| Rice | 154.6 | 154.6 | 173.7 | 175.1 |
| Rice, HYV* | 110.3 | 110.3 | 111.5 | 111.5 |
| Corn | 7.8 | 7.8 | 7.8 | 7.8 |
| Corn* | 5.5 | 5.5 | 5.5 | 5.5 |
| Sorghum | 71.2 | 71.2 | 67.5 | 67.5 |
| Sorghum* | 26.0 | 26.0 | 28.3 | 28.3 |
| Peanuts | 31.5 | 31.5 | 16.5 | 16.5 |
| Peanuts* | 11.7 | 11.7 | 9.4 | 9.4 |
| Sugarcane | 4.4 | 4.4 | | |
| Jute | 5.1 | 5.1 | 2.8 | 1.3 |
| North Coastal Crops | | | | |
| Rice | 149.6 | 149.6 | 158.6 | 158.6 |
| Rice, HYV* | 69.2 | 69.2 | 69.2 | 69.2 |
| Corn | 26.1 | 26.1 | 35.6 | 35.6 |
| Corn* | 13.0 | 13.0 | 13.0 | 13.0 |
| Sorghum | 76.8 | 76.8 | 54.5 | 54.5 |
| Sorghum* | 24.9 | 24.9 | 28.8 | 28.8 |
| Peanuts | 51.1 | 51.1 | 52.7 | 52.7 |
| Peanuts* | 14.2 | 14.2 | 10.3 | 10.3 |
| Jute | 5.3 | 5.3 | | |
| Highland Crops | | | | |
| Rice | 39.6 | 39.6 | 65.1 | 67.5 |
| Rice, HYV* | 33.8 | 12.5 | 3.4 | .9 |
| Corn | 253.4 | 252.4 | 170.0 | 290.3 |
| Corn* | 253.4 | 252.4 | 170.0 | 290.3 |
| Soybeans | 78.6 | 75.5 | 178.0 | |
| Soybeans* | 51.0 | 51.0 | 178.0 | |
| Peanuts | 88.7 | 91.9 | 48.3 | 103.5 |
| Peanuts* | 43.5 | 43.5 | | 57.7 |
| Rubber | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea | 7.5 | 7.5 | 6.6 | 6.6 |
| Coffee | 48.6 | 48.6 | 48.6 | 48.6 |
| Coffee* | 41.6 | 41.6 | 41.6 | 41.6 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - - - Units - - - - - - - - - - - - | | | |
| New Facility Requirement | | | | |
| Tobacco processing | | | | |
| East | .5 | .5 | .5 | .5 |
| Banana marketing | | | | |
| East | 3.3 | 3.3 | 3.3 | 3.3 |
| Fiber processing | | | | |
| East | 2.6 | 2.6 | | |
| Rubber processing | | | | |
| East | 150.6 | 167.0 | 106.0 | 106.0 |
| Highland | 20.0 | 20.0 | 20.0 | 20.0 |
| Tea processing | | | | |
| Highland | 4.3 | 1.8 | 1.7 | 1.7 |
| Rice mill | | | | |
| East | 3.8 | | | |
| Lower Coast | 9.7 | 9.7 | 2.0 | .8 |
| Highland | 3.0 | .7 | 1.1 | 1.3 |
| Rice drying | | | | |
| Delta | 109.4 | 109.4 | 82.1 | 82.1 |
| East | 9.4 | 13.5 | 9.4 | 10.0 |
| Grain storage | | | | |
| Delta | 488.6 | 459.6 | 279.0 | 259.6 |
| East | 168.0 | 202.5 | 143.3 | 220.3 |
| Lower Coast | 33.9 | 32.6 | 13.3 | 3.9 |
| Highland | 188.0 | 179.5 | 158.8 | 197.0 |
| Threshing-Shelling | | | | |
| Delta | 194.2 | 194.2 | 192.1 | 72.9 |
| East | 830.9 | 982.4 | 677.2 | 760.8 |
| Lower Coast | 79.3 | 79.3 | 79.3 | 86.4 |
| Central Coast | 105.8 | 105.8 | 103.1 | 103.1 |
| North Coast | 119.9 | 119.9 | 89.3 | 89.3 |
| Highland | 544.5 | 539.2 | 473.1 | 533.5 |
| Feed mill | | | | |
| Delta | .5 | .5 | .5 | .5 |
| Lower Coast | .6 | .6 | .6 | 1.4 |
| Central Coast | 2.3 | 1.9 | .2 | .2 |
| North Coast | 1.3 | 1.3 | 1.0 | 1.0 |
| Highland | 15.3 | 17.9 | 3.4 | 2.5 |

(Continued)

Table 12. (Continued)

| Item | Additional land base | Internal capital reductions | | |
|---|---|---|---|---|
| | | 25 percent | 50 percent | |
| | | | Soybean export | No soybean export |
| | - - - - - - - - - - - - Units - - - - - - - - - - - - | | | |
| New Facility Requirement (Continued) | | | | |
| Oil mill | | | | |
| Delta | .2 | .2 | .2 | .2 |
| East | .8 | 1.1 | .7 | ** |
| Central Coast | .8 | .7 | ** | ** |
| Highland | 2.6 | 2.7 | 1.5 | 2.1 |
| Sugar mill | | | | |
| East | 6.6 | | | |
| Sugar refinery | | | | |
| East | .4 | | | |
| Central Coast | .2 | .2 | | |

*Included in total above. For all crops except HVY Rice this symbol indicates plantings on new land.

**Less than .05.

much larger proportion of the second new capital reduction than of the first one. With this solution, a larger amount of paddy would be fed to livestock and rice imports would increase. Vegetable oil would be imported because of reduced oil mill capacity. The amount of cropland in rice would increase, with a small additional reduction in HYV rice.

With the additional land base, the first increment of capital reduction would reduce income 2 billion piasters. Trade balance would be reduced 12 billion piasters. About three-fourths of the capital reduction would be in the form of investment for distribution facilities; a substantial portion of this would reflect a reduction in sugarcane processing facilities. The major changes in cropping patterns would involve some reduction in area planted to HYV rice and a large reduction in sugarcane land. Sugarcane on new land would be replaced by corn and rubber. Small areas of sugarcane would be retained on old land because of existing processing facilities. Decreased rice exports and increased sugar imports would account for most of the impact on trade balance.

With new investment capital reduced to one-half of the level used in the unrestricted solution, income and trade balances would be reduced about 10 and 38 billion piasters, respectively. Distribution facility capital would account for about 70 percent of the reduction. With this solution, there would be a further reduction in production of HYV rice. Cropland planted to soybeans would increase, primarily at the expense of feed grains. Rubber production on new land would be eliminated. Paddy would be substituted for some feed grain for livestock. This would be paddy harvested in the wet season; it would be used as feed in this solution because of reduced drying facilities. Increased feeding plus reduced paddy production, would result in elimination of rice exports.

Aside from the reduction in HYV rice production, the major change in production pattern associated with moving from the first to the second increment of capital reduction would be a large increase in soybean area and production. As indicated previously, Vietnam is not as close to having adapted commercial varieties for soybeans as for other crops that enter solutions on large areas of land. Therefore, a run was repeated for this capital situation with soybeans suppressed by not permitting their export (table 12). The major effect of this change would be the substitution of corn and peanuts for soybeans. There would be a small reduction in income and no significant change in the trade balance. Distribution capital requirements would increase and production capital requirements decrease. The amount of land in HYV rice would increase, more paddy would be fed to hogs, and the area of supplementary crop sorghum on floating rice land would decline.

## Lime Availability

All model solutions have assumed an availability of domestically-produced agricultural limestone. Peanuts were the only crop for which lime requirements were specified at a separate level of technology. It is highly likely that lime would have yield-increasing effects on other crops on some land resource situations. However, there was not sufficient information available to reflect such variations in the model.

Solutions were run for the historical and additional land bases with domestically-produced limestone not available. With the historical base, income would be decreased and the trade deficit would be increased less than a billion piasters. Area in peanuts would decrease about 23,000 ha and peanut production would decline by about 64,000 M.T.

With the additional land resource base, the restriction of lime availability would reduce income and the trade balance about 2 and 5 billion piasters, respectively. Peanut area would be reduced about 83,000 ha and peanut production would decline 200,000 M.T.

With previously unused land in the resource base, then, domestically produced limestone would conservatively add about 2 billion piasters annually to the agricultural economy. Several potential sources of limestone are understood to exist in the country.

## Varying Farm Size on Additional Land

Solutions were run for the additional land base (10 ha farms on new land) with farm size reduced to levels of 8 ha and 6 ha (table 13). Total agricultural income would increase about 8 billion piasters with each increment of size decrease. Trade balance would increase about 12 and 9 billion piasters, respectively, with the two increments of size change. New internal investment requirements would increase about 11 billion piasters with the shift to the 8 ha size and another 6 billion piasters in moving to the 6 ha size.

Increased income with reduced farm size would result, of course, from higher ratios of labor to land. Production shifts would occur from corn to more labor-intensive and higher-value crops, primarily rubber and peanuts. For these solutions, rubber was restricted on new land to approximately 10 percent of adapted land resources. Without this restriction, production of rubber likely would have been more, and peanuts less, with the 6 ha situation.

The average marginal per hectare increases in agricultural income associated with each new land resource situation are not precise measures of returns to farmers operating the particular land resource. Some of this increased return might accrue to farmers in other areas because of reduced transportation costs within the system or for other reasons. However, these figures converted to returns per family are shown in table 14, and should be indicative of relative returns to farms under the various land resource situations.

It is interesting that given soil resources, particularly in the North region but also in the Central region to a lesser degree, show much higher marginal returns than the same soil resources in other regions. In fact, these soils are of very low quality, compared with soil resources with much lower marginal returns in other regions. It is clear that production on these soils is being used to help satisfy area deficits, at some price advantage over production in other areas. This points up the particular need for, and high marginal benefits from, measures to increase agricultural productivity in the Coastal regions.

Returns to a given size farm vary considerably among the various soil resource situations. Reductions in farm size reduce family incomes to varying degrees, depending on basic productivity and effect on enterprise mix. For example, the family income shown for soil 12 in the North Coastal region would be almost 400,000 piasters with the 10 ha farm, but less than 250,000 piasters with the 6 ha farms. This indicates that marginal value of output per hectare would increase very little with the size reduction. On soil 14 in the Eastern region, family income would be 340,000 and 277,000 piasters for the 10 and 6 ha farms, respectively, indicating a larger marginal increase in value of production per hectare associated with moving to the smaller farm size.

The impacts on both national income (and associated variables) and individual family incomes are considerations in establishing policy on farm size for new land. In order to maintain comparability of family incomes in various areas, it obviously would be necessary for farm size to vary among soil resource situations.

Table 13. Selected information from Vietnam Production Distribution Model with farm size varied, additional land resource base, 1980

| Item | Farm size on added land | | |
|---|---|---|---|
| | 10 hectares | 8 hectares | 6 hectares |
| | - - - - - - - - Billion Piasters - - - - - - - - - - | | |
| Farm income | 320.7 | 328.6 | 336.9 |
| Consumers' surplus | 50.8 | 50.8 | 50.8 |
| Total | 371.5 | 379.4 | 387.7 |
| Annual Foreign Exchange | | | |
| Commodity export | 135.9 | 148.7 | 156.8 |
| Commodity import | 24.6 | 24.9 | 24.9 |
| Annual inputs | 52.0 | 52.6 | 52.0 |
| Imports | 76.6 | 77.5 | 76.9 |
| Annual balance | 59.3 | 71.2 | 79.9 |
| Capital Investment (one-time requirement) | | | |
| Production | 56.8 | 60.9 | 68.6 |
| Distribution | 88.0 | 94.6 | 93.1 |
| Total | 144.8 | 155.5 | 161.7 |
| Foreign exchange | 94.5 | 102.2 | 107.5 |
| | - - - - - - - Thousand Metric Tons - - - - - - - - | | |
| Exports | | | |
| Rice | 539.2 | 549.2 | 551.6 |
| Corn | 1053.9 | 869.8 | 315.8 |
| Sorghum | 87.1 | 74.0 | 170.2 |
| Soybeans | 165.1 | 154.6 | 121.9 |
| Peanuts | 107.9 | 209.4 | 554.4 |
| Peanut oil | 30.2 | 34.1 | 41.0 |
| Rubber | 212.5 | 249.6 | 255.0 |
| Tea | .7 | 14.9 | 16.4 |
| Coffee | 44.9 | 45.0 | 45.0 |
| Copra | 53.3 | 53.3 | 53.3 |
| Pineapple | 80.0 | 80.0 | 80.0 |
| Bananas | 200.0 | 200.0 | 200.0 |
| Wheat bran | 46.5 | 46.5 | 46.5 |
| Duck feathers | .9 | .9 | .9 |
| Pork | 5.0 | 5.0 | 5.0 |
| Duck | 2.0 | 2.0 | 2.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 |

(Continued)

Table 13. (Continued)

| Item | Farm size on added land | | |
|---|---|---|---|
| | 10 hectares | 8 hectares | 6 hectares |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | |
| Imports | | | |
| Sugar | 53.6 | 53.6 | 53.6 |
| Flour | 107.1 | 107.1 | 107.1 |
| Wheat | 185.9 | 185.9 | 185.9 |
| Cotton | 39.4 | 39.4 | 39.4 |
| Beef | 2.8 | 3.4 | 3.5 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Crops | | | |
| Rice, nonfloating | 2111.6 | 2116.4 | 2117.5 |
| Rice, HYV* | 1491.8 | 1496.6 | 1497.7 |
| Rice, floating | 639.1 | 639.1 | 639.1 |
| Corn | 754.2 | 666.8 | 403.7 |
| Sorghum | 352.6 | 333.9 | 403.5 |
| Soybeans | 148.7 | 139.4 | 111.8 |
| Peanuts | 236.6 | 309.2 | 523.2 |
| Sugarcane | 88.5 | 90.1 | 91.3 |
| Tobacco | 21.1 | 21.2 | 21.2 |
| Rubber | 174.3 | 202.9 | 209.4 |
| Tea | 7.5 | 21.8 | 24.0 |
| Coffee | 48.6 | 45.4 | 42.2 |
| Coconut | 40.0 | 40.0 | 40.0 |
| Pineapple | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 |
| Jute | 11.1 | 11.1 | 11.1 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | |
| Crop Production | | | |
| Paddy marketed | 4351.1 | 4369.5 | 4373.9 |
| Paddy home use | 3385.8 | 3385.8 | 3385.8 |
| Total paddy | 7736.9 | 7755.3 | 7759.7 |
| Corn marketed | 1390.0 | 1204.0 | 611.6 |
| Corn home fed | 465.1 | 456.6 | 417.9 |
| Total corn | 1855.1 | 1660.6 | 1029.5 |
| Sorghum marketed | 161.6 | 145.4 | 260.8 |
| Sorghum home fed | 342.1 | 327.1 | 330.3 |
| Total sorghum | 503.7 | 472.5 | 591.1 |
| Soybeans | 181.6 | 170.1 | 134.1 |

(Continued)

Table 13. (Continued)

| Item | Farm size on added land | | |
|---|---|---|---|
| | 10 hectares | 8 hectares | 6 hectares |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | |
| Crop Production (Continued) | | | |
| Peanuts | 391.8 | 517.0 | 920.3 |
| Sugarcane | 3889.8 | 3889.8 | 3889.8 |
| Tobacco | 25.9 | 25.9 | 25.9 |
| Rubber | 220.6 | 257.7 | 263.1 |
| Tea | 6.6 | 20.8 | 22.4 |
| Coffee | 50.5 | 50.7 | 50.7 |
| Coconut | 480.0 | 480.0 | 480.0 |
| Pineapple | 80.0 | 80.0 | 80.0 |
| Bananas | 222.2 | 222.2 | 222.2 |
| Jute | 11.1 | 11.1 | 11.1 |
| | - - - - - - - - Thousand Hectares - - - - - - - - | | |
| Delta Crops | | | |
| Rice, nonfloating | 1446.4 | 1446.4 | 1446.4 |
| Rice, HYV* | 1065.6 | 1065.6 | 1065.6 |
| Rice, floating | 639.1 | 639.1 | 639.1 |
| Sorghum | 178.0 | 178.0 | 178.0 |
| Peanuts | 7.0 | 7.0 | 7.0 |
| Tobacco | 4.0 | 4.0 | 4.0 |
| Coconut | 40.0 | 40.0 | 40.0 |
| Eastern Crops | | | |
| Rice | 210.0 | 214.8 | 215.9 |
| Rice, HYV* | 115.5 | 120.3 | 121.4 |
| Corn | 459.0 | 410.0 | 281.0 |
| Corn* | 459.0 | 410.0 | 281.0 |
| Soybeans | 31.8 | 37.3 | 37.3 |
| Soybeans* | 27.4 | 32.9 | 32.9 |
| Peanuts | 37.8 | 49.5 | 186.7 |
| Peanuts* | 20.1 | 30.4 | 166.7 |
| Sugarcane | 84.1 | 85.7 | 81.2 |
| Sugarcane* | 79.2 | 83.9 | 80.4 |
| Tobacco | 17.2 | 17.2 | 17.2 |
| Rubber | 154.3 | 182.9 | 179.1 |
| Rubber* | 34.3 | o2.9 | 59.1 |
| Pineapple | 10.0 | 10.0 | 10.0 |
| Bananas | 8.9 | 8.9 | 8.9 |

(Continued)

Table 13. (Continued)

| Item | Farm size on added land | | |
|---|---|---|---|
| | 10 hectares | 8 hectares | 6 hectares |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Lower Coastal Crops | | | |
| Rice | 111.4 | 111.4 | 111.4 |
| Rice, HYV* | 97.4 | 97.4 | 9 .4 |
| Corn | 7.9 | 6.4 | 1.6 |
| Corn* | 6.8 | 5.2 | .5 |
| Sorghum | 26.6 | 19.4 | 36.5 |
| Sorghum* | 26.6 | 19.4 | 36.5 |
| Soybeans | 38.3 | 34.7 | 5.7 |
| Soybeans* | 32.6 | 29.0 | |
| Peanuts | 20.5 | 32.8 | 49.5 |
| Peanuts* | 8.0 | 20.4 | 37.0 |
| Jute | .7 | .7 | .7 |
| Central Coastal Crops | | | |
| Rice | 154.6 | 154.6 | 154.6 |
| Rice, HYV* | 110.3 | 110.3 | 110.3 |
| Corn | 7.8 | 6.6 | 6.6 |
| Corn* | 5.5 | 4.2 | 4.2 |
| Sorghum | 71.2 | 65.3 | 62.6 |
| Sorghum* | 26.0 | 20.1 | 17.4 |
| Peanuts | 31.5 | 38.6 | 41.4 |
| Peanuts* | 11.7 | 18.9 | 21.6 |
| Sugarcane | 4.4 | 4.4 | 4.4 |
| Jute | 5.1 | 5.1 | 5.1 |
| North Coastal Crops | | | |
| Rice | 149.6 | 149.6 | 149.6 |
| Rice, HYV* | 69.2 | 69.2 | 69.2 |
| Corn | 26.1 | 23.4 | 22.8 |
| Corn* | 13.0 | 10.3 | 9.8 |
| Sorghum | 76.8 | 71.2 | 51.6 |
| Sorghum* | 24.9 | 19.3 | 16.3 |
| Peanuts | 51.1 | 59.4 | 79.6 |
| Peanuts* | 14.2 | 22.5 | 26.0 |
| Jute | 5.3 | 5.3 | 5.3 |

(Continued)

Table 13. (Continued)

| Item | Farm size on added land | | |
|---|---|---|---|
| | 10 hectares | 8 hectares | 6 hectares |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | |
| Highland crops | | | |
| Rice | 39.6 | 39.6 | 39.6 |
| Rice, HYV* | 33.8 | 33.8 | 33.8 |
| Corn | 253.4 | 220.5 | 91.6 |
| Corn* | 253.4 | 220.5 | 91.6 |
| Sorghum | | | 74.9 |
| Sorghum* | | | 74.9 |
| Soybeans | 78.6 | 67.5 | 68.9 |
| Soybeans* | 51.0 | 39.9 | 41.3 |
| Peanuts | 88.7 | 121.8 | 159.1 |
| Peanuts* | 43.5 | 76.5 | 113.8 |
| Sugarcane | | | 5.8 |
| Sugarcane* | | | 5.8 |
| Rubber | 20.0 | 20.0 | 30.4 |
| Rubber* | | | 10.4 |
| Tea | 7.5 | 21.8 | 24.0 |
| Tea* | | 14.3 | 16.5 |
| Coffee | 48.6 | 45.4 | 42.2 |
| Coffee* | 41.6 | 38.4 | 35.2 |

*Included in total above. For all crops except HYV Rice this symbol indicates plantings on new land.

Table 14. Average marginal increase in agricultural income per farm family added with the additional land resource base brought into cultivation at two different farm size levels, 1980

| Land resource situation | Size of farm | |
|---|---|---|
| | 10 hectares | 6 hectares |
| | - - - Thousand Piasters Per Family - - - | |
| Eastern soil number | | |
| 8 | 222.7 | 147.4 |
| 12 | 204.0 | 160.8 |
| 14 | 340.5 | 277.1 |
| 15 | 265.5 | 231.1 |
| 19 | 336.7 | 262.1 |
| 22 | 269.7 | 209.5 |
| Highland soil number | | |
| 12 | 152.7 | 138.3 |
| 14 | 220.3 | 192.2 |
| 19 | 337.3 | 227.1 |
| 21 | 186.9 | 171.7 |
| 24* | 228.3 | 183.4 |
| Lower soil number | | |
| 6 and 7 | 285.0 | 201.1 |
| 10 | 282.8 | 237.8 |
| 10D | 212.2 | 207.8 |
| 12 | 233.2 | 169.4 |
| Central soil number | | |
| 6 and 7 | 342.6 | 211.1 |
| 12 | 358.3 | 216.7 |
| 17 | 320.7 | 200.9 |
| North soil number | | |
| 6 and 7 | 416.7 | 261.2 |
| 12 | 395.8 | 245.3 |
| 17 | 322.8 | 207.0 |

*H24R not included since small farm units were assumed for this land resource for all solutions.

## OPTIMAL SOLUTIONS INVOLVING INCREMENTAL EXPANSION OF THE EXISTING LAND BASE OVER A 4-YEAR PERIOD

A series of model runs was made with increments of abandoned land, additional irrigation within individual farmer capability, and new land added to the resource base over a 4-year period, starting with 1974. Domestic consumption requirements for the various commodities included in the study were changed for each year to coorespond with changes in population. These solutions are shown in table 15.

For purposes of comparison, a run was made for 1974 with the existing land base and a set of assumptions corresponding to existing conditions in Vietnam. It was assumed that: (1) HYV rice was limited to 1 million hectares; (2) improved floating rice varieties were not available; (3) sorghum behind floating rice had not been developed; (4) pork and poultry products were not imported; (5) small-farm, commercial hog enterprises had not been developed; (6) tree crops, including rubber, tea, coffee, and coconuts, could not expand beyond the area occupied in the recent past, and rubber yield would correspond more nearly to that of the recent past than to improved yields previously used in the model; (7) pineapple would not have developed as an export crop; (8) domestic tobacco would not meet cigarette production requirements; (9) adjustments away from rice would be limited on existing cropland in the Coastal and Highland regions, and (10) adapted, commercial soybean varieties would not be available.

Assumptions relative to enterprise restrictions remained constant over the 4-year period except that, after the land resource expands, cotton would be permitted to enter solutions on one soil considered most suited for its production.

Assumptions with respect to expansion of the land resource are as follows:

1. Abandoned land: one-third of the abandoned land will be added to the land base during each of the first 3 years;

2. Irrigation: one-fourth of the additional irrigation that can be accomplished by individual farmers will be incorporated over each of the 4 years;

3. New land: one-fifth of the potential new land specified for each soil resource situation (appendix table 4) will be added during the first year. Implicitly, this assumes that about this proportion of potential new farm land in each area lies along existing roads and could be added without building additional roads. After the first year, one-third of the remaining potential new land is added to the land base each year. The particular areas to be brought in, after the first year, are not specified in advance; they are selected by the model.

With the existing land base and specified assumptions, the value of agricultural production for 1974 would be 227 billion piasters. Trade deficit for the commodities considered in the model would be 88 billion piasters. Imports

Table 15. Selected information from Vietnam Production Distribution Model with land resources added to existing land resource base in increments, 1974-1977

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - - Billion Piasters - - - - - - - - - | | | | |
| Farm income | 221.0 | 209.9 | 239.8 | 260.6 | 273.9 |
| Consumers' surplus | 6.2 | 46.5 | 47.9 | 49.4 | 46.3 |
| Total | 227.2 | 256.2 | 287.8 | 310.0 | 320.2 |
| Annual Foreign Exchange | | | | | |
| Commodity export | 11.8 | 18.2 | 59.3 | 81.7 | 92.0 |
| Commodity import | 75.9 | 41.1 | 35.5 | 32.4 | 31.8 |
| Annual inputs | 23.9 | 27.1 | 31.4 | 35.0 | 38.2 |
| Imports | 99.8 | 68.2 | 66.9 | 67.4 | 70.0 |
| Annual balance | -88.0 | -50.0 | -7.6 | 14.3 | 22.0 |
| Capital Investment (one-time requirement) | | | | | |
| Production | 3.1 | 7.1 | 16.6 | 25.7 | 36.4 |
| Distribution | 4.6 | 22.1 | 45.8 | 59.1 | 67.5 |
| Total | 7.7 | 29.2 | 62.4 | 84.8 | 103.9 |
| Foreign exchange | 3.5 | 19.2 | 39.7 | 55.7 | 68.1 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Exports | | | | | |
| Rice | | 21.5 | 433.6 | 474.1 | 394.0 |
| Corn | | | 137.8 | 566.6 | 946.3 |
| Sorghum | | | | 32.4 | 53.2 |
| Peanuts | | 7.9 | 103.7 | 338.9 | 412.3 |
| Peanut oil | | 15.5 | 43.0 | 25.4 | 40.8 |
| Rubber | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 |
| Bananas | | | 200.0 | 200.0 | 200.0 |
| Wheat bran | | 44.7 | 46.1 | 46.5 | 46.5 |
| Cottonseed meal | | | 3.1 | 6.5 | 6.5 |
| Cottonseed oil | | .5 | 2.0 | 2.4 | 2.4 |
| Duck feathers | .9 | 1.0 | 1.0 | 1.0 | 1.1 |
| Pork | | 5.0 | 5.0 | 5.0 | 5.0 |
| Chicken | | 1.4 | 1.4 | 1.4 | |
| Duck | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Chicken eggs | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Imports | | | | | |
| Rice | 269.6 | | | | |
| Corn | 117.8 | | | | |
| Soybean meal | 54.0 | | | | |
| Soybean oil | 30.4 | | | | |
| Raw sugar | 240.0 | 80.8 | | | |
| Sugar | 99.3 | 99.3 | 82.9 | 47.6 | 49.1 |
| Tobacco | 20.6 | 20.6 | 21.3 | 21.9 | 22.6 |
| Fiber | 7.9 | | | | |
| Flour | 62.9 | 68.1 | 70.1 | 75.2 | 81.7 |
| Wheat | 185.9 | 178.9 | 184.3 | 185.9 | 185.9 |
| Cotton | 33.0 | 30.9 | 26.1 | 25.5 | 26.6 |
| Beef | 11.3 | 11.3 | 11.0 | 6.8 | 2.1 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Crops | | | | | |
| Rice, nonfloating | 1986.2 | 2059.4 | 2133.4 | 2232.9 | 2247.0 |
| Rice, HYV* | 1000.0 | 1000.0 | 1000.0 | 1000.0 | 1000.0 |
| Rice, floating | 519.3 | 544.5 | 569.7 | 595.6 | 595.6 |
| Corn | 37.8 | 160.8 | 337.6 | 531.9 | 745.0 |
| Sorghum | 2.6 | 57.5 | 98.2 | 142.7 | 155.2 |
| Soybeans | | | 1.3 | 12.1 | 2.9 |
| Peanuts | 20.3 | 108.7 | 219.6 | 326.0 | 411.3 |
| Sugarcane | | 38.0 | 66.7 | 77.2 | 79.7 |
| Rubber | 72.2 | 72.2 | 72.3 | 74.0 | 74.2 |
| Tea | 5.7 | 5.6 | 5.7 | 5.8 | 6.0 |
| Coffee | 4.0 | 4.0 | 4.1 | 4.2 | 4.3 |
| Bananas | | | 8.9 | 8.9 | 8.9 |
| Jute | 1.0 | 6.4 | 7.5 | 7.6 | 7.9 |
| Kenaf | .3 | 2.9 | 2.1 | 2.3 | 2.3 |
| Cotton | | 3.7 | 13.7 | 16.5 | 16.5 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | | | | |
| Crop Production | | | | | |
| Paddy marketed | 1768.0 | 2271.7 | 3201.6 | 3446.6 | 3478.5 |
| Paddy home use | 3409.1 | 3419.4 | 3414.5 | 3418.9 | 3421.1 |
| Paddy fed | 1108.0 | 791.7 | 65.0 | 57.8 | 57.8 |
| Total paddy | 6285.1 | 6482.8 | 6681.1 | 6923.3 | 6957.4 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - - | | | | |
| Crop Production (Continued) | | | | | |
| Corn marketed | 53.7 | 199.0 | 455.2 | 890.8 | 1353.0 |
| Corn home fed | 44.7 | 187.5 | 422.9 | 465.4 | 461.0 |
| Total corn | 98.4 | 386.5 | 878.1 | 1356.2 | 1814.0 |
| Sorghum marketed | .4 | 14.4 | 23.9 | 54.3 | 77.2 |
| Sorghum home fed | 4.3 | 83.9 | 151.9 | 193.1 | 191.4 |
| Total sorghum | 4.7 | 98.3 | 175.8 | 247.4 | 268.6 |
| Soybeans | | | 1.4 | 14.9 | 5.3 |
| Peanuts | 37.5 | 203.8 | 407.2 | 602.7 | 746.0 |
| Sugarcane | | 1751.4 | 2939.8 | 3456.4 | 3560.6 |
| Rubber | 76.8 | 76.8 | 77.0 | 77.2 | 77.5 |
| Tea | 5.0 | 5.0 | 5.1 | 5.3 | 5.4 |
| Coffee | 4.7 | 4.7 | 4.9 | 5.0 | 5.2 |
| Bananas | | | 222.2 | 222.2 | 222.2 |
| Jute | 1.0 | 6.4 | 7.5 | 7.6 | 7.9 |
| Kenaf | .3 | 2.9 | 2.1 | 2.3 | 2.3 |
| Cotton | | 6.0 | 21.9 | 26.3 | 26.3 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Delta Crops | | | | | |
| Rice, nonfloating | 1237.8 | 1301.5 | 1366.4 | 1433.0 | 1438.3 |
| Rice, HYV* | 618.0 | 597.2 | 615.8 | 634.1 | 628.0 |
| Rice, floating | 519.3 | 544.5 | 569.7 | 595.6 | 595.6 |
| Peanuts | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Jute | .3 | 1.5 | 1.5 | 1.5 | 1.5 |
| Kenaf | .3 | .3 | .3 | .3 | .3 |
| Eastern Crops | | | | | |
| Rice | 181.4 | 190.8 | 198.0 | 226.8 | 232.0 |
| Rice, HYV* | 107.4 | 109.8 | 108.9 | 84.1 | 87.3 |
| Corn | 32.4 | 95.1 | 268.2 | 396.8 | 434.2 |
| Corn* | | 89.7 | 265.0 | 396.8 | 434.2 |
| Soybeans | | | | 8.2 | 2.3 |
| Soybeans* | | | | 5.5 | |
| Peanuts | 7.5 | 45.8 | 123.8 | 172.4 | 190.4 |
| Peanuts* | | 22.2 | 66.7 | 101.6 | 120.2 |
| Sugarcane | | 38.0 | 57.4 | 71.6 | 71.5 |
| Sugarcane* | | 12.1 | 51.4 | 65.9 | 65.7 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - - Thousand Hectares - - - - - - - - - | | | | |
| Eastern Crops (Continued) | | | | | |
| Rubber | 72.2 | 72.2 | 72.3 | 67.4 | 67.9 |
| Bananas | | | 8.9 | 8.9 | 8.9 |
| Jute | | 4.2 | 4.2 | 4.2 | 4.2 |
| Kenaf | | 2.6 | .8 | .8 | .8 |
| Lower Coastal Crops | | | | | |
| Rice | 105.0 | 105.0 | 107.1 | 111.2 | 114.7 |
| Rice, HYV* | 83.7 | 87.8 | 91.8 | 96.0 | 97.4 |
| Corn | | .2 | 1.9 | 7.9 | 7.9 |
| Corn* | | .1 | 1.4 | 6.8 | 6.8 |
| Sorghum | | 14.0 | 30.0 | 33.6 | 46.2 |
| Sorghum* | | 10.9 | 30.0 | 33.6 | 46.2 |
| Soybeans | | | 1.3 | 3.9 | .6 |
| Peanuts | .6 | 5.6 | 12.2 | 15.3 | 18.8 |
| Peanuts | | 1.2 | 1.4 | 4.6 | 8.0 |
| Jute | .7 | .7 | .7 | .7 | .7 |
| Cotton | | 3.7 | 13.7 | 16.5 | 16.5 |
| Cotton* | | 2.6 | 11.5 | 13.1 | 13.1 |
| Central Coastal Crops | | | | | |
| Rice | 193.0 | 193.0 | 193.0 | 193.0 | 193.0 |
| Rice, HYV* | 98.8 | 108.6 | 105.4 | 106.7 | 107.1 |
| Corn | | 3.2 | 1.8 | 7.8 | 7.8 |
| Corn* | | 1.7 | 1.1 | 5.5 | 5.5 |
| Sorghum | .5 | 19.8 | 25.1 | 50.9 | 50.8 |
| Sorghum* | | 6.9 | 9.7 | 28.3 | 28.3 |
| Peanuts | | | 4.2 | 17.1 | 17.1 |
| Peanuts* | | | 1.9 | 9.4 | 9.4 |
| Sugarcane | | | 4.4 | 4.4 | 4.4 |
| Jute | | | 1.1 | 1.2 | 1.5 |
| North Coastal Crops | | | | | |
| Rice | 199.0 | 199.0 | 199.0 | 199.0 | 199.0 |
| Rice, HYV* | 60.6 | 62.6 | 64.6 | 66.7 | 67.7 |
| Corn | | 10.2 | 14.1 | 25.7 | 24.0 |
| Corn* | | 3.9 | 2.6 | 13.0 | 13.0 |
| Sorghum | 2.2 | 20.6 | 43.0 | 58.2 | 58.2 |
| Sorghum* | | 6.5 | 21.1 | 28.8 | 28.8 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - - - Thousand Hectares - - - - - - - - - - | | | | |
| North Coastal Crops (Continued) | | | | | |
| Peanuts | | | 7.3 | 25.5 | 27.7 |
| Peanuts* | | | 2.1 | 10.3 | 10.3 |
| Highland Crops | | | | | |
| Rice | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| Rice, HYV* | 31.5 | 34.1 | 13.4 | 12.5 | 12.5 |
| Corn | 5.3 | 52.2 | 51.7 | 93.7 | 271.2 |
| Corn* | | 52.2 | 51.7 | 93.7 | 271.2 |
| Sorghum | | 3.0 | | | |
| Sorghum* | | 3.0 | | | |
| Peanuts | 5.2 | 50.3 | 65.1 | 88.7 | 150.4 |
| Peanuts* | | 18.0 | 16.6 | 29.4 | 91.1 |
| Sugarcane | | | 5.0 | 1.2 | 3.8 |
| Rubber | | | | 6.6 | 6.3 |
| Tea | 5.7 | 5.6 | 5.7 | 5.8 | 6.0 |
| Coffee | 4.0 | 4.0 | 4.1 | 4.2 | 4.3 |
| | - - - - - - - - - - - - Units - - - - - - - - - - - - | | | | |
| New Facility Requirement | | | | | |
| Tobacco processing | | | | | |
| East | | | .1 | .2 | .3 |
| Banana marketing | | | | | |
| East | | | 3.3 | 3.3 | 3.3 |
| Fiber processing | | | | | |
| East | | 2.0 | 2.0 | 2.1 | 2.3 |
| Rubber processing | | | | | |
| East | 16.8 | 16.8 | 17.0 | 11.4 | 11.8 |
| Highland | | | | 5.8 | 5.6 |
| Rice mill | | | | | |
| East | | | .9 | | 4.2 |
| Lower Coast | 3.4 | 6.2 | 7.6 | 9.2 | 9.9 |
| North Coast | | | 1.2 | 1.8 | 2.2 |
| Highland | | 5.4 | 3.3 | 2.8 | 2.8 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - - - - - - - | | Units | - - - - - - - - - - - - - - | |
| New Facility Requirement (Continued) | | | | | |
| Rice drying | | | | | |
| Delta | 52.6 | 52.6 | 52.6 | 52.6 | 52.6 |
| East | 12.1 | 10.1 | 10.6 | 13.5 | 13.5 |
| Grain storage | | | | | |
| Delta | | | 184.3 | 232.7 | 234.2 |
| East | | | 24.6 | 200.7 | 237.5 |
| Lower Coast | | | 5.4 | 19.4 | 30.0 |
| Highland | 9.8 | 34.1 | 27.5 | 55.2 | 180.8 |
| Threshing-Shelling | | | | | |
| East | 41.9 | 117.5 | 350.0 | 653.4 | 719.7 |
| Lower Coast | | 22.8 | 52.2 | 61.0 | 80.5 |
| Central Coast | .8 | 30.5 | 39.3 | 77.4 | 77.3 |
| North Coast | 3.5 | 34.0 | 71.5 | 95.1 | 94.8 |
| Highland | 6.9 | 65.5 | 60.8 | 147.7 | 501.9 |
| Feed mill | | | | | |
| Delta | .5 | .5 | .5 | .5 | .5 |
| East | | | 3.1 | | |
| Lower Coast | .9 | .6 | .7 | .6 | .6 |
| Central Coast | .2 | .2 | .2 | 2.0 | .4 |
| North Coast | 8.2 | 1.0 | 1.0 | 1.0 | 1.0 |
| Highland | .7 | 8.4 | 11.5 | 15.0 | 21.2 |
| Oil mill | | | | | |
| Delta | .2 | .2 | .2 | .2 | .2 |
| East | .2 | 1.4 | 2.3 | .6 | .1 |
| Lower Coast | ** | .1 | .4 | .6 | .4 |
| Central Coast | | | .1 | .4 | .4 |
| North Coast | | | .2 | .1 | |
| Highland | .2 | 1.5 | 1.9 | 2.7 | 4.1 |
| Sugar mill | | | | | |
| East | | | 4.2 | 5.6 | 5.6 |
| Highland | | | .4 | .1 | .3 |
| Sugar refinery | | | | | |
| Central Coast | | | .2 | .2 | .2 |
| Highland | | | .2 | ** | .1 |

(Continued)

Table 15. (Continued)

| Item | Existing land base 1/ | With land resources added 2/ | | | |
|---|---|---|---|---|---|
| | | 1974 | 1975 | 1976 | 1977 |
| | - - - - - - - - - - - - - - Units - - - - - - - - - - - - - - | | | | |
| New Facility Requirement | | | | | |
| Cotton gin | | | | | |
| Lower Coast | | .8 | 2.9 | 3.5 | 3.5 |

1/ Consumption requirements based on 1974 population.

2/ Consumption requirements based on projected population for year shown. Land resources for each year consist of existing base plus:

(for 1974) one-third of abandoned land, one-fourth of irrigation improvements, and one-fifth of new land;

(for 1975) two-thirds of abandoned land, one-half of irrigation improvements, and 46.7 percent of new land;

(for 1976) all abandoned land, three-fourths of irrigation improvements, and 73.4 percent of new land; and

(for 1977) all abandoned land, all irrigation improvements, and all new land.

*Included in total above. For all crops except HYV Rice, this symbol indicates plantings on new land.

**Less than .05.

would include 297,000 M.T. of rice, 118,000 M.T. of corn, 54,000 M.T. of oil meal, 30,000 M.T. of vegetable oil, and about 340,000 M.T. of sugar. Optimum resource allocation would result in production of about 6.3 million M.T. of paddy, of which 1.1 million M.T. would be fed to livestock. An aggregate of about 150,000 ha would be used for crops other than rice. Most of this land would be used for rubber, corn, and peanuts.

With the first increment of land resources added for 1974, the value of production would increase 29 billion piasters and the trade deficit would be reduced 38 billion piasters. Imports of rice, corn, oil meal, and vegetable oil would be eliminated. Imports of sugar would be reduced sharply. Paddy production would increase about 200,000 M.T. and paddy used for livestock would decrease about 300,000 M.T. Almost 500,000 M.T. of feed grain would be produced, but pressures would still exist on feed supplies. Peanut production would increase substantially, especially in the Eastern and Highland regions. Most of the peanuts would be milled, primarily to obtain the meal.

The addition of the second increment of land resources (1975) would cause total value of output to increase by about 32 billion piasters. The trade deficit would be reduced about 42 billion piasters. New capital investment requirements associated with this increment would amount to about 33 billion piasters. There would be further reductions in sugar and cotton imports. Substantial quantities of rice, corn, peanuts, and peanut oil would be exported. Banana production occurs and bananas are exported. Paddy production would be increased by about 200,000 M.T. and the amount of paddy fed to livestock would be reduced by about 600,000 M.T. New land entering the resource base would include the major portions of soils E14, L10, and C12, and all of N12. New land in the Eastern region would go into corn, peanuts, and sugarcane. In the Lower Coastal region, new land would be used for sorghum and cotton. In the Central and North Coastal regions, additional new land would be used for sorghum production.

The addition of the third increment of land resources (1976) would increase income about 24 billion piasters and trade balance by about 22 billion piasters. The trade balance would become positive. Total new capital investment requirements would increase about 22 billion piasters. Feed grain and peanut exports would increase appreciably. Increased paddy production of about 250,000 M.T. would largely satisfy increased consumption requirements. Corn and peanut production would show large increases, with most of the increase moving into export. Areas of new land that come into the resource base include the remainder of soil E14, L10, and C12; all of E15, E19, E22, L6-7, L12, C6-7, C17, N6-7, and N17; and part of H19. Sugarcane production would increase on new land in the Eastern region. Most of the new land in the Eastern and Highland regions would be used for corn and peanuts. In the Coastal areas, sorghum and peanuts would occupy most of the additional land area.

Value of agricultural output would increase about 10 billion piasters when the last increment (1977) of additional land resource is incorporated into the land base. The trade balance would increase about 8 billion piasters. Requirements for new investment capital would increase about 19 billion piasters. Feed grain exports would increase about 400,000 M.T. and there would be some increase in export of peanuts. Paddy production would increase slightly, but rice exports

would decline because of increased consumption requirements. New land entering the resource base would include the remainder of soil H19 and all of soils E8, E12, L10D, H12, H14, H21, and H24.

The sequence in which new land enters the resource base would be entirely a reflection of the marginal value added by each soil resource, once it is in operation. These solutions do not consider infrastructure costs associated with getting the land into operation, except that the first increment added is assumed to require less infrastructure development because of existing roads. There would, in fact, be wide differences in input requirements for clearing various soil resources. The H19 and H21 soils which enter the base last, for example, would be much easier to clear than most of the H14 soil resource that comes in first. If this factor were taken into account, it could alter the sequence in which soil resources are brought into the land base. This consideration could be of more or less importance, depending upon whether development occurred by natural process, with little government assistance in land clearing, or in connection with an accelerated program involving large land clearing projects.

In the model solutions, abandoned land would enter the land base in constant increments, i.e., the third increment would be identical to the first in terms of composition and quality. The fact is, of course, that there are large variations in the productivity of abandoned cropland. It is logical that previous operators returning to abandoned land would return to the better land first. In fact, some efforts may be required, in terms of land reform and adjustment in farm size, to induce resettlement on some of the less productive abandoned soil resources. Much of this land was previously farmed in plots too small to provide an adequate family living.

The series of solutions in this section is not intended to imply that solution results are likely to be attained over the time sequence shown. Problems involved in settlement, clearing, infrastructure development, and development of distribution systems and facilities obviously would be enormous. These solutions do imply and elaborate one possible development path. They provide information on potential production capacity of, and supply response from, the resources associated with that particular development path.

Partial Integer Solution, 1977: In a previous section, it was noted that distribution facilities enter solutions in fractional units in contrast to the whole units of reality. For the 1977 solution, only, the requirement was imposed that oil mills, sugar mills, sugar refineries, and cotton gins exist only in whole units. A comparison of this solution with the previous 1977 solution, including only items of information that changed, is shown in table 16.

With the partial integer solution, fractional units of oil mills in five regions would be replaced by one mill in the Lower Coastal region and four mills in the Highland region. The fractional sugar mill in the Highland region would be eliminated and there would be six instead of 5.6 sugar mills in the Eastern region. New sugar refinery capacity would be eliminated. There would be four cotton gins in the Lower Coastal region instead of 3.5 from the previous solution.

The effects of these particular changes on the optimum solution are relatively minor. Income and the trade balance would be reduced about .4 and 1.3

billion piasters, respectively. Most of the trade balance change would result from increased import of sugar. There would be numerous small changes in production patterns and commodity mix. Many of these changes are far removed from the particular crops or regions associated with specific processing facilities that were changed. For example, area in HYV rice would expand in the Delta region. This simply emphasizes, once again, that interrelationships in the agricultural economy are highly complex and that a slight change in a variable can have far reaching and unanticipated results.

Table 16. Effect on 1977 solution of requiring oilseed, sugar, and cotton processing facilities to enter solution in whole numbers. (Comparison includes items that changed from Table 15)

| Item | 1977 solution with resources added | |
|---|---|---|
| | From table 15 | Integer requirement for specified processing facilities |
| | - - - - - - - - Billion Piasters - - - - - - - - - - | |
| Farm income | 273.9 | 273.5 |
| Consumers' surplus | 46.3 | 46.3 |
| Total | 320.2 | 319.8 |
| Annual Foreign Exchange | | |
| Commodity export | 92.0 | 92.5 |
| Commodity import | 31.8 | 33.7 |
| Annual inputs | 38.2 | 38.1 |
| Imports | 70.0 | 71.8 |
| Annual balance | 22.0 | 20.7 |
| Capital Investment (one-time requirement) | | |
| Production | 36.4 | 36.2 |
| Distribution | 67.5 | 67.6 |
| Total | 103.9 | 103.8 |
| Foreign exchange | 68.1 | 68.2 |
| | - - - - - - - Thousand Metric Tons - - - - - - - - | |
| Exports | | |
| Rice | 394.0 | 400.4 |
| Corn | 946.3 | 964.8 |
| Sorghum | 53.2 | 56.7 |
| Peanuts | 412.3 | 418.0 |
| Peanut oil | 40.8 | 36.4 |
| Imports | | |
| Sugar | 49.1 | 81.7 |
| | - - - - - - - - Thousand Hectares - - - - - - - - - | |
| Crops | | |
| Rice, nonfloating | 2247.0 | 2248.3 |
| Corn | 745.0 | 745.7 |
| Sorghum | 155.2 | 171.4 |
| Soybeans | 2.9 | 4.0 |

(Continued)

Table 16. (Continued)

| Item | 1977 solution with resources added | |
|---|---|---|
| | From table 15 | Integer requirement for specified processing facilities |
| | - - - - - - - - Thousand Hectares - - - - - - - - | |
| Crops (Continued) | | |
| Peanuts | 411.3 | 405.3 |
| Sugarcane | 79.7 | 74.0 |
| | - - - - - - - - Thousand Metric Tons - - - - - - - - | |
| Crop Production | | |
| Paddy marketed | 3478.5 | 3481.0 |
| Paddy home use | 3421.1 | 3430.3 |
| Total paddy | 6957.4 | 6969.3 |
| Corn marketed | 1353.0 | 1351.6 |
| Corn home fed | 461.0 | 462.0 |
| Total corn | 1814.0 | 1813.6 |
| Sorghum marketed | 77.2 | 84.3 |
| Sorghum home fed | 191.4 | 214.2 |
| Total sorghum | 286.6 | 298.5 |
| Soybeans | 5.3 | 4.3 |
| Peanuts | 746.0 | 737.8 |
| Sugarcane | 3560.6 | 3190.0 |
| | - - - - - - - - Thousand Hectares - - - - - - - - | |
| Delta Crops | | |
| Rice, HYV* | 628.0 | 619.0 |
| Eastern Crops | | |
| Rice | 232.0 | 237.3 |
| Rice, HYV* | 87.3 | 92.6 |
| Corn | 434.2 | 430.9 |
| Corn* | 434.2 | 430.9 |
| Sorghum | | 2.0 |
| Soybeans | 2.3 | |
| Peanuts | 190.4 | 189.2 |
| Peanuts* | 120.2 | 118.0 |
| Sugarcane | 71.5 | 74.0 |
| Sugarcane* | 65.7 | 71.2 |

(Continued)

Table 16. (Continued)

| Item | 1977 solution with resources added | |
|---|---|---|
| | From table 15 | Integer requirement for specified processing facilities |
| | - - - - - - - - Thousand Hectares - - - - - - - - | |
| Lower Coastal Crops | | |
| Rice | 114.7 | 110.6 |
| Rice, HYV* | 97.4 | 96.7 |
| Soybeans | .6 | 4.0 |
| Peanuts | 18.8 | 19.5 |
| Central Coastal Crops | | |
| Rice, HYV* | 107.1 | 111.5 |
| Sorghum | 50.8 | 65.0 |
| Peanuts | 17.1 | 11.7 |
| Sugarcane | 4.4 | |
| North Coastal Crops | | |
| Corn | 24.0 | 25.6 |
| Peanuts | 27.7 | 26.1 |
| Highland Crops | | |
| Corn | 271.2 | 273.5 |
| Corn* | 271.2 | 273.5 |
| Peanuts | 150.4 | 151.9 |
| Peanuts* | 91.1 | 92.5 |
| Sugarcane | 3.8 | |
| Sugarcane* | 3.8 | |
| | - - - - - - - - - - - - Units - - - - - - - - - - - - | |
| New Facility Requirement | | |
| Rice mill | | |
| East | 4.2 | 6.0 |
| Lower Coast | 9.9 | 9.4 |
| Rice drying | | |
| East | 13.5 | 15.7 |
| Grain storage | | |
| East | 237.5 | 241.2 |
| Lower Coast | 30.0 | 20.7 |
| Highland | 180.8 | 185.0 |

(Continued)

Table 16. (Continued)

| Item | 1977 solution with resources added | |
|---|---|---|
| | From table 15 | Integer requirement for specified processing facilities |
| | Units | |
| New Facility Requirement | | |
| Threshing-Shelling | | |
| East | 719.7 | 718.4 |
| Central Coast | 77.3 | 99.2 |
| North Coast | 94.8 | 95.1 |
| Highland | 501.9 | 507.1 |
| Feed mill | | |
| Central Coast | .4 | .2 |
| Highland | 21.2 | 19.6 |
| Oil mill | | |
| Delta | .2 | |
| East | .1 | |
| Lower Coast | .4 | 1.0 |
| Central Coast | .4 | |
| Highland | 4.1 | 4.0 |
| Sugar mill | | |
| East | 5.6 | 6.0 |
| Highland | .3 | |
| Sugar refinery | | |
| Central Coast | .2 | |
| Highland | .1 | |
| Cotton gin | | |
| Lower Coast | 3.5 | 4.0 |

*If indented, included in total above. Except for HYV Rice this symbol indicates new land.

# APPENDIX A. DISCUSSION OF GENERAL PROCEDURES

The preceding analysis was based on the use of a linear programming model. No significance should be attached to the use of this particular technique. It is merely an efficient computational device with a capability for simultaneous treatment of a large number of variables.

In an economic framework, a supply response or production capacity analysis involves the optimum allocation of scarce resources to attain an economic objective. Regardless of the completeness or formality of the analysis, there are certain minimum information requirements, including: specification and quantification of available resources, specification of physical input-output relationships relative to the use of these resources, and attachment of costs and prices to the input-output quantities. In a developed and stable economy, the assumption is implicit that available price relationships represent a developed and stable distribution system for inputs and commodities, and can effectively guide resource allocation.

Price and marketing relationships as they exist in Vietnam cannot be taken as given for the purpose of this analysis. The following discussion will touch on some of the problems and limitations associated with these and other information requirements in connection with procedures used in the study.

## Prices

A meaningful supply response or production capacity analysis requires the use of prices that reflect relevant relationships between the prices of various agricultural commodities, and between prices of these commodities and prices of inputs required for their production. Differential distortions in individual prices caused by wartime conditions, shortages, and government policies (intended to either stimulate or discourage production and/or consumption of various commodities) make current and recent historical price relationships virtually useless for developing and projecting returns to alternative production possibilities.

Most agricultural commodities are in a deficit supply position in Vietnam. Their prices are influenced to varying degrees by import policies and foreign aid. Depending on the degree to which production plus imports satisfies domestic demand, and on import restrictions and tax policies, individual commodity prices from farm to retail may vary from levels that reflect some reasonable relationships to import prices to levels that far exceed any reasonable relationship to supply cost from any source. For example, rice prices tend to fall into the first category and corn prices reflect the second situation. With few exceptions in Vietnam, if domestic production of individual agricultural commodities increased, particularly as production approached a level that would satisfy domestic requirements, prices would fall. However, the relative decrease would differ considerably for different commodities; i.e., existing prices do not bear a rational economic relationship to one another except within the very artificial situation that exists at the present time. Given the traditional land resource base, existing technology, and present conditions, these price distortions may have little impact on supply response. In fact, given these conditions, there is no supply response problem and little point in a supply response analysis.

This study assumes, of course, that change can occur. There is no basis for an economic analysis unless it is assumed that the relationship between prices and supply costs plays a normal role in allocating resources, and that optimum resource allocation is an appropriate objective. It then becomes a technical requirement, in a comprehensive analysis of this kind, that the initial prices used bear a reasonably rational relationship to one another. Farm prices existing in Vietnam do not meet this requirement; therefore, an alternative set of prices was developed for use in the study. Individual prices are varied in the course of the analysis. And policy makers may find it expedient to deviate, in pursuit of other than economic objectives, from prices that result in optimum resource allocation. Conscious variation of individual prices from objectively established levels should provide insight into the economic penalty to be paid for such deviation.

The initial set of prices used in this analysis is based on procurement of supplies from the cheapest source. When a commodity is in a deficit supply position, Vietnam has the alternative of importing. Without restrictions or taxes, the price to a wholesaler should reflect import price, plus freight, plus transfer costs involved in getting the commodity into the wholesaler's hands. If the commodity can be imported without restrictions, producer's prices should reflect wholesaler costs minus transportation, processing, and marketing margins necessary to move the commodity from the producer to the wholesaler.

When a commodity moves into a surplus position Vietnam has the alternative of exporting. In this case, the price in the wholesaler's hands should be the export price less the margin required to load the commodity free on board. Again, the producer price should reflect the wholesale price less transportation, marketing, and processing margins.

All commodity prices used in this analysis are based on the price in the wholesaler's warehouse, whether production is at a deficit or a surplus level. No explicit farm prices are specified. Similarly, prices of fertilizer and chemicals reflect import prices plus the marketing margin necessary to get inputs in producer's hands.

Specific commodity prices used in this analysis are shown in appendix table 1. These prices generally reflect world price relationships during the period 1956-70, 1/ with some adjustment for emerging trends. Some individual commodity prices were adjusted for other reasons. For example, the FAO price series for pork is based on selected high quality cuts. This price was adjusted downward to reflect a carcass price. Sugar price was also adjusted downward. Vietnam has traditionally taken its sugar from the world residual market at prices usually substantially below FAO world unit values, which are strongly influenced by U.S. quotas, and this market presumably will remain the best alternative source of sugar for the country. Although the sugar price used in this report is below the FAO average unit value for the 1956-70 period, it is sharply higher than the price that Vietnam has historically paid for sugar, relative to prices of other commodities, in recognition of increasing world demand for sugar and increasing costs of processing sugar. The price used may be slightly high in terms of long-run price relationships, but the nature of the market does not permit a more refined projection.

1/ See State of Food and Agriculture, 1971, FAO, p. 175.

Appendix Table 1. Prices used in Vietnam production-distribution analysis 1/

| Item | Export price 2/ | Import price 2/ |
|---|---|---|
| | - - - Thousand Piasters Per Metric Ton - - - | |
| Pork | 298.0 | 375.1 |
| Chicken | 268.0 | 341.8 |
| Duck | 224.0 | |
| Beef | 300.0 | 377.3 |
| Chicken egg | 215.6 | 296.4 |
| Duck egg | 182.8 | |
| Rice | 53.3 | 67.4 |
| Broken rice | 37.5 | |
| Rice bran | 20.0 | |
| Corn | 22.8 | 40.7* |
| Sorghum | 21.6 | |
| Wheat | 25.7 | 37.1 |
| Flour | | 46.2 |
| Wheat bran | 20.0 | |
| Peanuts | 50.8 | |
| Peanut meal | 32.0 | |
| Peanut oil | 131.0 | |
| Soybeans | 41.6 | |
| Soybean meal | 34.3 | 53.5* |
| Soybean oil | 103.0 | 122.1 |
| Cottonseed meal | 31.2 | |
| Cottonseed oil | 119.0 | |
| Coconut | 18.0 | |
| Copra | 67.3 | |
| Coconut oil | 111.0 | |
| Coconut meal | 22.3 | |
| Rubber | 165.6 | |
| Bananas | 36.2 | |
| Coffee | 309.0 | |
| Tea | 370.0 | |
| Pineapple | 16.0 | |
| Duck feathers | 482.4 | |
| Raw sugar | 40.0 | 58.4 |
| Sugar | 50.0 | 64.2 |
| Cotton | 240.0 | 272.8 |
| Jute and Kenaf fiber | 85.3 | 102.6 |
| Tobacco | | 581.9 |

(Continued)

Appendix Table 1. (Continued)

| Item | Input price |
|---|---|
| | Thousand Piasters Per Metric Ton |
| Input items | |
| Endrin | 3,500.8 |
| Methyl parathion | 323.2 |
| Malathion | 384.0 |
| BHC | 187.6 |
| DDT | 322.4 |
| Sevin wp | 1,021.6 |
| 16-16-8 | 49.3 |
| Urea | 44.2 |
| Limestone | 4.4 |
| Gasoline 3/ | 72.0 |

1/ All price relationships in this report reflect a piaster:dollar ratio of 400:1.

2/ Commodities in wholesaler's hands except those marked with an * (see below). Input items at prices to farmers less inter-area transportation costs.

3/ Per thousand gallons.

*In feed millers' hands. Extra marketing charges assessed to make comparable with domestically produced feed in feed millers' hands.

The coffee price used, based on FAO unit values, may be high. The coffee historically produced in Vietnam has not been of a quality commensurate with this price level on world markets. The use of this price reflects an implicit assumption that Vietnam can produce the type and quality of coffee demanded by importing countries. At lower coffee prices, rubber and tea would substitute for coffee in the analysis.

Benchmark world unit values were not available for some commodities included in the analysis, e.g., coconut and pineapple. Prices were computed for these commodities from a variety of sources, prominently including price series from Hong Kong and Singapore.

It is emphasized that study results are affected by price relationships and not by the absolute level of prices used. An exchange rate of 400 piasters: US$1 was used in this analysis. If a different exchange rate were used, i.e., if all prices were changed in proportion, the study results would remain unchanged with respect to quantity and mix of output.

## Geographic Area Delineation

For the purpose of this analysis, Vietnam was divided into six production-marketing regions (see frontispiece).

Given soil resources occur in widely separated geographic areas of Vietnam. For example, alluvial soils are found in every region of the country. Availability of marketing and processing facilities for given products vary considerably for different locations. Likewise, the cost of moving commodities to potential consuming areas may differ for the same soil resource in different areas. In addition, production potential may differ for identical soil resource areas because of variation in climatic or other conditions.

The regions generally correspond to statistical reporting areas, except that the Coastal Lowlands were divided into three regions as indicated. Output expectations differ within the Coastal Lowlands because of differences in climatic factors, primarily rainfall and related flood problems. From a production standpoint, the floating rice, double transplant, and single transplant areas of the Delta were considered separately. However, production from the Delta subareas was fed into a common Delta market.

## Marketing and Processing

Since explicit farm prices are not used, it is necessary to quantify margins involved in transferring commodities from producers to wholesalers. Margins are stated for each commodity through each stage during which it retains a particular identity. For example, a milling margin is stated for paddy rice. After milling, paddy loses its identity and becomes rice, broken rice, and bran. From this point, there are separate marketing margins for the three products to reflect charges involved in moving them from mills into wholesalers' warehouses, within the production marketing area. If paddy is to be used in commercial feed, there is no milling margin and the marketing margin reflects charges for getting

the product into the feed miller's hands. For each commodity included in the analysis, there are separate processing and/or marketing margins, as appropriate, for each potential end use and for each joint product generated during the distribution process.

An additional reason for specifically including distribution in the analysis is that the supply-response problem in Vietnam is complicated by differences in availability and adequacy of commercial market outlets for various agricultural commodities. There are no existing processing facilities or marketing channels for some commodities that could be produced in Vietnam. Other commodities have been produced primarily for home and local consumption and have very rudimentary marketing systems. From a production standpoint, some of these commodities might have good development potentials. But there is no point in considering production capacity for such commodities unless effective marketing capacities can be made available economically. Thus, a determination of the economic potential of agricultural commodities in Vietnam, relative to other commodities, must include simultaneous consideration of production and marketing relationships.

Existing processing capacity for each commodity requiring processing was estimated for each production-marketing region (appendix table 2). Capital requirements for adding given standard units of additional processing capacity were also estimated (appendix table 3).

## Production

Productivity and relative availability of various resources are key elements in an analysis of optimum resource allocation. Assumptions and procedures used in developing coefficients and constraints for major resources are outlined below.

Capital: Available information does not permit the quantification of capital, either as a gross entity or delineated by type, as a scarce resource. Therefore, capital is generated as a requirement for each of the situations examined. For development planning purposes, this procedure serves a useful purpose, since capital represents the major external input required for agricultural development. The procedure generates the general magnitude of capital required to maximize returns to other resources. For some solutions, arbitrary limitations are placed on capital availability to determine the impact on income and other variables.

Labor: Labor restraints are imposed on the basis of the labor supply contained in the family labor force (estimated to be equivalent to 2.6 workers). Labor requirements are established for individual enterprises on the basis of their relationship to the family labor supply during peak periods, normally harvesting. In traditional farming areas, larger farms are permitted to hire labor for rice production.

For new land, the same kind of family labor supply-enterprise labor requirements are established, but hired labor is not permitted. The impact of varying the land/labor ratio is reflected by varying farm size in some situations.

Appendix Table 2. Estimated existing capacity of processing and marketing facilities by region

| Item | Region | | | | | |
|---|---|---|---|---|---|---|
| | Delta | Eastern | Lower | Central | North | Highland |
| | - - - - - - - - - - - - - - - - - - Metric Tons - - - - - - - - - - - - - - - - - - | | | | | |
| Rice mill | 5,360,000 | 520,000 | 280,000 | 460,000 | 265,000 | 75,000 |
| Grain storage | 1,400,000 | 600,000 | 90,000 | 30,000 | 195,000 | 30,000 |
| Sugar mill | | 400,000 | | 200,000 | | |
| Sugar refinery | | 290,000 | | | | |
| Flour mill | | 185,900 | | | | |
| Feed mill | 27,560 | 179,400 | 2,600 | 6,500 | 3,120 | 520 |
| Rubber processing | | 50,000 | | | | |
| Tobacco processing | | 20,000 | | | | |
| Kenaf-Jute processing | | 4,500 | | | | |
| Tea processing | | | | | | 5,500 |
| Pork processing* | 191,000 | 142,000 | 38,500 | 46,000 | 69,500 | 26,500 |
| Beef processing* | 54,500 | 40,500 | 11,000 | 13,000 | 20,000 | 7,500 |

*Live weight.

Appendix Table 3. Capital required for additional units of processing and marketing facilities specified in Vietnam production-distribution model

| Item | Investment per unit | Capacity per unit |
|---|---|---|
| | Million Piasters | Metric Tons |
| Rice mill | 92.0 | 10,400 |
| Grain storage facility | 27.2 | 3,000 |
| Thresher-sheller | 4.8 | 1,000 |
| Soybean mill | 1,041.0 | 30,000 |
| Peanut mill | 1,075.0 | 57,000 |
| Cottonseed mill | 1,045.0 | 35,000 |
| Coconut oil mill | 1,050.0 | 45,000 |
| Rice drying facility | 11.2 | 3,000 |
| Sugar mill | 4,200.0 | 450,000 |
| Sugar refinery | 1,800.0 | 100,000 |
| Cotton gin | 356.0 | 7,500 |
| Flour mill | 840.0 | 74,100 |
| Rubber processing | 64.0 | 1,000 |
| Kenaf-Jute processing | 160.0 | 2,500 |
| Tobacco processing | 440.0 | 10,000 |
| Tea processing | 62.0 | 250 |
| Feed mill | 71.0 | 13,000 |
| Pork processing | 73.0 | 22,000* |
| Beef processing | 60.5 | 20,000* |
| Export rice processing | 92.0 | 104,000 |
| Export pork processing | 156.0 | 44,000* |
| Export poultry processing | 60.0 | 25,000* |
| Export beef processing | 128.0 | 40,000* |
| Export egg processing | 9.1 | 28,800 |

*Live weight.

Implicitly, it is assumed that, nationally, labor will not represent a scarce agricultural resource over the planning period considered in this analysis. Indeed, given peacetime conditions, labor is likely to be an abundant resource. The proportions in which labor is combined with other resources can have a significant impact on national agricultural income and individual farm family incomes. These proportions are established at the level of the individual farm, based primarily on the family in Vietnam, and the labor restraints in the model were designed to reflect this situation as realistically as possible.

Land: There has been little attention given in Vietnam to classification of land resources with attendant consideration of enterprise adaptability and differences in output expectations. For the purposes of this study, it was necessary to delineate land resource situations, i.e., to separate the total land resource into broad areas between which productivity can be expected to differ and within which natural conditions tend to favor relative homogeneity in production patterns and productivity of specific enterprises. Soil differences as defined by Moorman, 1/ climatic conditions, and problem situations such as flooding and salinity, provided the basis for initial groupings. Enterprices adapted to the various groups were then listed and preliminary enterprise output expectations were estimated on the basis of production data from provinces with large amounts of given soil resources, from field contacts, and from transposition from similar areas in those instances where there was no production experience in a given area. The amount of existing farm area in each soil resource area was estimated on the basis of province statistics, correlation of soil map with pictomaps showing cleared areas, and ground reconnaissance. The amount of potential cropland in each area was estimated from a correlation of soil maps with topographic information from topographic maps and follow-up aerial reconnaissance. Accessibility and availability of roads was also considered; this factor resulted in substantial down-grading of estimates of potential cropland in some areas. The amount of abandoned land in each soil resource area was estimated from aerial reconnaissance. Existing and potential irrigated land was estimated from historical production data, irrigation project information, maps, and aerial reconnaissance. All estimates were on the basis of land resource areas; political and administrative boundaries were not considered. Land resource delineations used in this analysis are shown in appendix table 4.

Input-output Relationships: Physical input-output relationships among enterprises, by soil resources, are among the more critical coefficients in this analysis.

Preliminary output expectations for individual crops in the various soil resource areas developed concurrently with the soil resource delineation were refined, and corresponding input information was developed, in consultation with production specialists from the Vietnam Ministry of Agriculture and Land Development.

Information was developed for rice at "traditional" and "recommended" levels of technology, with the two levels being related to the use or nonuse of high-yielding varieties and an associated higher level of inputs. Initially, budget information was also developed for other enterprises at two levels of technology.

1/ Moorman, F. R., Republic of Vietnam General Soil Map, National Geographic Service of Vietnam, Dalat, 1961.

Appendix Table 4. Farm land resources in Vietnam with various land resource bases, by production marketing regions, 1972 1/ 2/ 3/

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustments 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | Delta Single-Transplant Area (including salt-intrusion area) | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 20,000 | 20,000 | 25,000 | |
| Soil 1B | 10,000 | 10,000 | 15,000 | |
| Soil 3 | 1,200 | 1,200 | 7,800 | |
| Supplemental irrigated (soil 1) 6/ | 103,200 | 103,200 | 140,200 | |
| Nonirrigated (no water problem) | | | | |
| Soil 1 | 476,500 | 528,400 | 579,400 | |
| Soil 3 | 29,600 | 82,600 | 104,600 | |
| Soil 4 | 4,800 | 13,400 | 13,400 | |
| Nonirrigated (water depth problem) | 149,700 | 185,600 | 59,000 | |
| | | Delta Double-Transplant Area | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 8,200 | 8,200 | 20,300 | |
| Soil 1B | 5,000 | 5,000 | 10,100 | |
| Nonirrigated | | | | |
| Soil 1 | 232,500 | 242,600 | 242,600 | |
| Soil 3 | 42,600 | 52,400 | 52,400 | |
| Soil 4 | 1,400 | 4,800 | 4,800 | |

(Continued)

Appendix Table 4. (Continued)

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustments 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | Delta Flood Rice Area | | |
| Full irrigated (soil 1) 5/ | 9,600 | 9,600 | 13,400 | |
| Nonirrigated | | | | |
| Soil 1 | 214,600 | 222,800 | 222,800 | |
| Soil 3 | 283,300 | 299,500 | 299,500 | |
| Soil 4 | 21,400 | 73,300 | 73,300 | |
| Soil 15 | 15,800 | 24,700 | 24,700 | |
| | | Eastern Region | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 6,500 | 6,500 | 12,700 | |
| Soil 1B | 2,500 | 2,500 | 5,200 | |
| Soil 3 | 8,400 | 8,400 | 19,000 | |
| Supplemental irrigated 6/ | | | | |
| Soil 1A | 10,000 | 10,000 | 10,000 | |
| Soil 1B | 3,300 | 3,300 | 3,300 | |
| Soil 3 | 13,000 | 13,000 | 13,000 | |
| Nonirrigated | | | | |
| Soil 1A | 36,500 | 54,800 | 54,800 | |
| Soil 1B | 1,400 | 4,100 | 4,100 | |
| Soil 3 | 63,200 | 73,700 | 73,700 | |
| Soil 4 | 2,400 | 23,400 | 23,400 | |
| Soil 8 | --- | --- | --- | 32,900 |
| Soil 12 | --- | 6,300 | 6,300 | 30,000 |
| Soil 14 7/ | 38,900 | 54,900 | 54,900 | 410,000 |
| Soil 15 | 9,400 | 19,000 | 19,000 | 31,000 |
| Soil 19 | 59,600 | 69,000 | 69,000 | 106,000 |
| Soil 22 | 4,200 | 4,200 | 4,200 | 10,200 |

(Continued)

Appendix Table 4. (Continued)

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustments 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | | Highland Region | |
| Full irrigated 5/ | | | | |
| Soil 1A | 4,900 | 4,900 | 4,900 | |
| Soil 1B | 1,800 | 1,800 | 1,800 | |
| Nonirrigated | | | | |
| Soil 1A | 10,700 | 18,500 | 18,500 | |
| Soil 1B | 7,400 | 7,400 | 7,400 | |
| Soil 12 | 4,200 | 11,600 | 11,600 | 24,600 |
| Soil 14 8/ | 11,600 | 36,500 | 36,500 | 63,800 |
| Soil 19 | 17,200 | 22,300 | 22,300 | 135,000 |
| Soil 21 9/ | 17,350 | 19,350 | 19,350 | 127,000 |
| Soil 24 | 12,600 | 17,900 | 17,900 | 15,640 |
| Soil 24B (limited to tree crops) | --- | --- | --- | 23,460 |

(Continued)

Appendix Table 4. (Continued)

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustments 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | Lower Coastal Region | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 8,000 | 8,000 | 11,500 | |
| Soil 1B | 6,000 | 6,000 | 8,100 | |
| Good supplemental irrigated 12/ | | | | |
| Soil 1A | 5,900 | 5,900 | 5,900 | |
| Soil 1B | 2,000 | 2,000 | 2,000 | |
| Poor supplemental irrigated 10/ 12/ | | | | |
| Soil 1A | 12,000 | 13,900 | 10,400 | |
| Soil 1B | 1,000 | 2,000 | 1,000 | |
| Poor rain-fed crop (Soil 1A) 11/ | 9,000 | 9,000 | 9,000 | |
| Good rain-fed crop | | | | |
| Soil 1A | 39,500 | 44,900 | 41,400 | |
| Soil 1B | 8,300 | 11,000 | 8,900 | |
| Soil 6 and 7 | 600 | 2,200 | 2,200 | 1,000 |
| Soil 10 | --- | 3,400 | 3,400 | 43,500 |
| Soil 10L (limited rainfall) | --- | --- | --- | 20,000 |
| Soil 12 13/ | - - | 5,300 | 5,300 | 9,500 |
| Soil 14 | --- | 2,600 | 2,600 | --- |

(Continued)

Appendix Table 4. (Continued)

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustments 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | Central Coastal Region | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 10,000 | 10,000 | 12,100 | |
| Soil 1B | 5,000 | 5,000 | 5,000 | |
| Good supplemental irrigated 12/ | | | | |
| Soil 1A | 19,700 | 19,700 | 19,700 | |
| Soil 1B | 9,000 | 9,000 | 9,000 | |
| Soil 17 | 7,544 | 7,544 | 7,544 | |
| Poor supplemental irrigated 10/ 12/ | | | | |
| Soil 1A | 24,500 | 34,000 | 32,700 | |
| Soil 1B | 9,400 | 10,200 | 10,200 | |
| Soil 17 | 6,700 | 10,700 | 10,700 | |
| Poor rain-fed crop 11/ | | | | |
| Soil 1A | 22,100 | 25,000 | 25,000 | |
| Soil 1B | 11,900 | 13,000 | 13,000 | |
| Soil 17 | 2,800 | 9,000 | 9,000 | |
| Good rain-fed crop | | | | |
| Soil 1A | 24,800 | 26,800 | 24,700 | |
| Soil 1B | 15,300 | 15,300 | 15,300 | |
| Soil 17 | 9,300 | 11,300 | 11,300 | 24,000 |
| Soil 6 and 7 | --- | 4,600 | 4,600 | 8,500 |
| Soil 12 14/ | --- | 8,400 | 8,400 | 10,700 |

(Continued)

Appendix Table 4. (Continued)

| Land situation | Existing cropland 1971 | Including abandoned cropland | Including abandoned and water adjustment 4/ | Previously unused land could be cultivated |
|---|---|---|---|---|
| | | Northern Coastal Region | | |
| Full irrigated 5/ | | | | |
| Soil 1A | 3,000 | 3,000 | 5,800 | |
| Soil 1B | 2,000 | 2,000 | 3,300 | |
| Good supplemental irrigated 12/ | | | | |
| Soil 1A | 13,600 | 13,600 | 13,600 | |
| Soil 1B | 5,400 | 5,400 | 5,400 | |
| Soil 17 | 4,800 | 4,800 | 6,500 | |
| Poor supplemental irrigated 10/ 12/ | | | | |
| Soil 1A | 29,200 | 35,600 | 32,800 | |
| Soil 1B | 9,900 | 11,100 | 9,800 | |
| Soil 17 | 10,400 | 11,600 | 11,600 | |
| Poor rain-fed crop 11/ | | | | |
| Soil 1A | 40,000 | 43,800 | 43,800 | |
| Soil 1B | 8,700 | 10,000 | 10,000 | |
| Soil 17 | 11,950 | 14,150 | 14,150 | |
| Good rain-fed crop | | | | |
| Soil 1A | 22,300 | 25,300 | 22,500 | |
| Soil 1B | 9,300 | 9,300 | 8,000 | |
| Soil 17 | 12,000 | 12,000 | 12,000 | 13,400 |
| Soil 6 and 7 | --- | 19,000 | 19,000 | 19,500 |
| Soil 12 15/ | 7,200 | 29,450 | 29,450 | 19,200 |

For footnotes see the following page.

Footnotes for Appendix Table 4.

1/ Does not include land in excluded crops (appendix table 6).

2/ Soil numbers as delineated by Moorman, op. cit.

3/ Cadastral; cropland totals in solutions exceed total cadastral land because of double-cropping.

4/ Construction and rebuilding of salt-intrusion barriers, and additions to irrigation from current projects and individual farmer efforts.

5/ Sufficient water to complete at least one rice crop cycle during the dry season.

6/ Sufficient water to finish a second rice crop started in the wet season.

7/ Also includes soil 13.

8/ Includes soils 13, 14, 16, and 17.

9/ Includes soils 20, 21, and 23.

10/ Severely reduced yields because of insufficient water.

11/ Severely reduced yields because of flood conditions during growing season.

12/ Crops harvested March and April. May be first or second crop; therefore may follow poor rain-fed or good rain-fed crop or may be planted on land where flood conditions prevent growing a crop during the rainy season.

13/ Includes soils 8 and 12.

14/ Includes soils 12, 14, and 19.

15/ Includes soils 8, 12, and 19.

*Soil types were not delineated. Most of the soils remaining in this category after water adjustments are types 3 and 4. Most of those which move to a higher category after water adjustments are type 1, although some type 3 is included.

However, traditional production practices for most other crops, with the exception of horticultural crops, have involved the use of few, if any, technical inputs such as fertilizer. It became clear that the use of fertilizer and/or chemical inputs would pay to the extent that there was no mathematical chance of the lower input levels entering the program at any reasonable level of price relationships. Additionally, if agriculture is to develop, it will do so along commercial (as opposed to self-sufficient) lines. It is hardly conceivable that commercial development of the enterprises included in the analysis will occur without some improvement in technology. Therefore, the "traditional" level budgets were dropped for enterprises other than rice. A partial exception was made in the case of peanuts where two levels of technology, based on the use or nonuse of lime, were retained.

Input levels used for all crops are somewhat lower than recommended rates, and output levels for all crops other than rice are considered to be conservative. All input-output levels reflect technology that is currently available. There is no assumption, for example, that a highly improved new variety of some crop might be developed. A partial exception is that improved floating rice varieties, currently being tested in Thailand, are permitted as an alternative on some of the land in the floating and double-transplant areas. Also, some variety adaptation work would be necessary to obtain the soybean yields assumed, since adapted oilseed varieties are not now used. This would require some time, but is technically feasible and not speculative.

Output levels used generally do not approach experimental levels. The selection of realistic input-output levels for planning purposes obviously poses a sensitive problem, especially for crops that have not been produced in an area on an extensive or commercial basis. Output levels that approach experimental results are invariably unrealistic for developing countries. Those used in this study are generally considered to be in line with results in comparable areas under comparable conditions, where production is on a substantial scale. They are believed to be generally appropriate to the level of technical inputs used. Enterprises that can compete for resources at the input-output levels used can be considered to have realistic development potential.

Output levels used are not considered to be maximum attainable yields in Vietnam. Individual farmers can be expected to exceed these levels in the short run. They are considered to be feasible attainable yields for large groups of farmers over the planning period under consideration. Input-output levels would need to be reexamined for an analysis extending beyond 1980, assuming that development occurred during the interim period.

Poultry enterprises were included in the analysis at three levels: home livestock, existing commercial, and future commercial. The same three levels, plus a small commercial enterprise, were included for hogs. Home livestock enterprises require only feed inputs. The distinction between existing and future commercial enterprises is that existing facilities are considered fixed; costs associated with their facility investment are therefore considered fixed and irrelevant to production decisions over the planning period. The small commercial hog enterprise uses family labor and less elaborate facilities than the large, commercial enterprises.

Beef production and power are considered as joint products from cattle and water buffalo. In addition, beef cattle operations as proposed by a previous beef cattle study team 2/ are permitted as potential alternative activities in the analysis.

## Transportation Between Areas

A supply-demand point was chosen for each of the six production-marketing regions. For example, Can Tho in the Delta region and Da Nang in the Northern Coastal region are considered to be supply-demand points for their respective regions. Transportation margins were developed for transferring each commodity between supply-demand points. In the model, for example, Delta rice becomes Northern rice with the assessment of the appropriate transportation margin.

## Domestic Consumption Requirements

Total domestic consumption requirements for each end-use commodity included in this analysis are specified, either by production-marketing region or for the country as a whole. These requirements are based on an estimated per capita consumption rate and estimated population figures for each area. Estimated per capita consumption rates are shown in appendix table 5. As with prices, per capita consumption rates for individual commodities obviously have been modified and distorted by shortages, policies, and restrictions related to wartime conditions. The consumption rates used are, to a large extent, judgment estimates. Estimated consumption rates for some commodities, such as sugar and vegetable oil, reflect an assumption that recent increases in per capita consumption will be maintained. Implicitly, consumption levels used in this analysis assume that there will not be a substantial reduction in disposable income during the planning period.

## Excluded Land Resources

Slightly less than 10 percent of the traditional land resource base was excluded from the analysis, appendix table 6. This excluded land reflects use by crops that: (1) were not included in the study, such as fruits and vegetables; or (2) were included in the study as commercial crops, as in the case of corn, soybeans, and peanuts, but have traditionally been used in Vietnam primarily as human food crops.

It was necessary to exclude horticultural enterprises from the analysis because of insufficient data. Neither production nor consumption estimates for individual horticultural commodities can be developed from information currently available in Vietnam. Similar difficulties exist with respect to establishing prices for these individual commodities. As indicated previously, these data are essential for establishing competitive relationships in a supply analysis. Study team members were unanimously of the opinion that these crops do not offer

2/ Vietnam Beef Cattle Development Project, University of Minnesota Team, April 1971.

Appendix Table 5. Per capita consumption rates used in Vietnam production-distribution model

| Item | Per capita consumption |
|---|---|
| | Kilograms |
| Pork 1/ | 15.0 |
| Chicken 1/ | 3.9 |
| Duck 1/ | 2.3 |
| Chicken egg | 1.6 |
| Duck egg | .5 |
| Beef 1/ | 3.5 |
| Rice | 156.0 |
| Vegetable oil | 2.0 |
| Sugar | 16.0 |
| Flour | 10.0 |
| Rubber 2/ | .33 |
| Tea 2/ | .24 |
| Coffee 2/ | .23 |
| Tobacco 2/ | 1.0 |
| Jute and Kenaf fiber 2/ | .45 |
| Cotton 2/ | 1.6 |

1/ Live weight.

2/ Total consumption requirements for these commodities are specified in the model on a national basis; all others are specified by production-marketing region.

Appendix Table 6. Farm land excluded from Vietnam production-distribution analysis

| Region | Hectares |
|---|---|
| Delta | |
| Single transplant (including salt intrusion area) | 57,400 |
| Double transplant | 14,100 |
| Floating rice | 28,800 |
| Eastern | 59,100 |
| Highland | 21,400 |
| Lower coastal lowlands | 21,500 |
| Central coastal lowlands | 39,620 |
| North coastal lowlands | 31,500 |
| Total | 273,420 |

much potential for short or intermediate run economic development. However, resources should be devoted to developing information that would permit their inclusion in any future analysis that is made.

The aggregate area devoted to the two categories of crops defined above has remained relatively constant through the years, although there have been shifts in area devoted to individual crops. Commodities have not been exported or imported. It is assumed that the quantities produced are approximately those needed, that they will be produced in the future, and that most of the aggregate area involved is not available for much shift or adjustment. This would certainly be a valid assumption for home garden and fruit plots and for other items produced for home consumption. It might be less valid for some crops produced for sale. However, the proportion of the total excluded area available for adjustment is considered to be small, with a negligible potential impact on the study results.

If export markets could be developed for fruit and vegetable crops, there would be a certain increase in the area devoted to their production. On an area basis, given markets, this group of enterprises categorically would yield higher returns than the enterprises included in the analysis. Again, however, a large increase in output of these commodities could occur on relatively small land areas, and therefore such development would have little effect on the major thrust of conclusions from this study.

## Time Period

This analysis assumes a planning-development period extending to 1980. This date has no particular significance. Clearly, time is required to make adjustments affecting supply response or production capacity. Some adjustments can be made relatively quickly, while others require a long development period. The time span selected appeared to be about the longest period that would be required to increase supply from immediate expanded planting for any of the enterprises included in the analysis. Obviously, expansion of the magnitude indicated for tree crops in some of the solutions could not occur within an 8-year period. The returns from these crops--rubber, for example--are amortized over the expected life of the trees. Therefore, solutions that include large plantings of these crops overstate their impact on income and foreign exchange for the year 1980. They do not overstate their returns to the agricultural economy over time, and this procedure properly reflects allocation of resources to these enterprises as of 1980.

## General Operation of the Model

Separate enterprise activities were developed for each soil resource situation in each production-marketing region, or subarea. Separate marketing and processing activities were developed for each commodity for each of the production-marketing regions. Separate transportation activities were developed for each commodity from each region to all appropriate regions. Separate consumption activities were developed for each commodity, by regions or for the country. Export and import activities were developed for each commodity as appropriate. The model consisted of about 1,700 rows and 2,200 columns (activities).

The model requires that domestic consumption be satisfied in each production-marketing area for each commodity that has a regional consumption requirement, and on a country basis for other commodities. These requirements can be satisfied by production within the area, by production from other areas after movement through the transportation system and assessment of transportation margins, or by imports into the country. Commodities used in domestic consumption are valued at the import price as defined previously, i.e., at import prices plus appropriate margins.

Conversely, production of a given commodity in a given area travels through the distribution system for that area to the area supply-demand point. From there it may be used to satisfy area consumption requirements, it may move through inter-area transportation to satisfy consumption requirements in other areas, or it may move into export. If the commodity moves into export channels, it is valued at the export price as defined previously. Intermediate products, e.g., products used in commercial feed, are not explicitly valued. Their values are reflected in values of end products. Domestic consumption requirements are not explicitly stated for intermediate products. These requirements are derived by the model on the basis of requirements for the end product.

Rice consumed on farms is withheld from the distribution system, except for a requirement that it be milled, and is not assessed marketing margins. This rice is priced and its value is reflected in agricultural income. Similarly, grain products used for home livestock production do not move into the distribution system. All other commodities included in the analysis move through the distribution system.

The model, then, satisfies domestic consumption requirements from the cheapest source; it moves commodities from production to consumption and export; and it implicitly prices commodities at the farm level. The objective function is national maximization of farmers' net income, with given constraints on land resources, processing and marketing capacity, and specified limitations on expansion of these capacities. Simultaneously, it maximizes agricultural income in each production-marketing area and land resource area. Information is generated, of course, on the mix and quantity of farm products that maximizes income. From this information, approximate income levels to typical farms in each of the land resource situations can be estimated. Commodities used in domestic consumption are valued according to their supply position as defined previously (i.e., at import price, if deficit, or export price, if surplus, plus appropriate margins).



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