FOOD SELF-SUFFICIENCY AND INTERNATIONAL GRAIN TRADE.

ABDEL SALAM, SALAH AHMED

FOOD SELF-SUFFICIENCY AND INTERNATIONAL GRAIN TRADE

THE UNIVERSITY OF ARIZONA M.S. 1983

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark __✓__.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background _____
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy __✓__
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages __✓__
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print __✓__
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Other _____

FOOD SELF-SUFFICIENCY AND INTERNATIONAL GRAIN TRADE

by

Salah Ahmed Abdel Salam

A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 8 3

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Saleh Abdelsalam

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Eric A. Monke

ERIC A. MONKE
Professor of Agricultural Economics

December 28, 1982
Date

ACKNOWLEDGMENTS

The author wishes to express sincere appreciation to his major professor Dr. Eric Monke for his valuable and friendly guidance through all the phases of this study.

Appreciation is extended to Dr. Jimmye S. Hillman and Dr. Roger Fox for reading the draft of the study and for their useful suggestions. Thanks also go to Dr. Don Heckerman and Dr. Oaxaca who discussed with the author some ideas that helped in formulating useful methods for the analysis.

Special appreciation is expressed to the Sudanese government and people for their financial support during this course.

A loving tribute go to my family in Sudan and to my wife for their encouragement and support in all times.

Thanks go to Anna McKew for typing the drafts of the study.

Lastly, I would like to extend my gratitude to all my professors and to my friends who helped me in any way.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

ABSTRACT

Many economists view international trade as a means for economic growth and development. Others, however believe that trade has detrimental effects on the economies of less developed countries (LDC's), and suggest that emphasis on food self-sufficiency is preferable to reliance on international grain trade.

A comparison between trade and food self-sufficiency policies is carried out in this study. Problems of balance of payments, quantity variability, and price instability were examined. The results show that 90 percent of 68 LDC's did not spend more than 20 percent of export earnings on food grain imports during the 1970-80 period. For the quantity variability and price instability tests, it was found that the majority of the largest importers would have experienced higher variability under self-sufficiency programs than they had depended on world grain markets during the 1961-80 period. These results suggest that, as far as these problems are concerned, most LDC's could achieve higher rates of development by following a policy of reliance on international grain trade rather than policies which emphasized food self-sufficiency.

CHAPTER 1

INTRODUCTION

Economists are increasingly concerned with problems in world grain markets. Better market performances could add to the world food security, and minimize the fear of a world-wide famine. The world food situation has been examined by many economists and organizations, usually to assess whether agricultural resources and technology can prevent and eliminate hunger. During the last three decades, with the exception of the 1972-74 crisis, food production grew faster than population growth. Table 1 shows the rates of increase in food production, population, per capita food production and trade. Between 1950 and 1980 world food production doubled, with the increase in the developing countries actually exceeding that of the developed countries. However, population increased in developing countries more than twice as fast as that of the developed world. Thus in developed countries, per capita food production increased by 50 percent, while in developing countries, per capita food production increased by only 20 percent. During the 1950s total world grain production increased at a 3.6 percent annual rate. Nearly 60 percent of that increase was due to an expansion in cultivated area in developing countries. In developed countries, most production increases were due to changes in yields, which grew at three times the rate of developing country yields. During the 1960s and 70s, however, more than 70 percent of the increase

Table 1. Total and compound annual rates of increase in food production, population, per capita food production and agricultural trade for selected periods.

Item and Region	1951-53 to 1978-80 Total Increase %	1951-53 to 1978-80 Annual Rate %	Compound Annual Rate of Increase 1951-53 to 1959-61	1959-61 to 1969-71	1969-71 to 1973-75	1973-75 to 1978-80
(1) Food Production	-					
World	102	2.6	3.3	2.5	2.1	2.1
Developed Countries	95	2.5	3.3	2.4	2.0	1.8
Developing Countries	117	2.9	3.0	2.9	2.8	3.1
(2) Population	-					
World	64	1.8	1.8	1.9	1.9	1.8
Developed Countries	33	1.1	1.3	1.1	0.9	0.8
Developing Countries	88	2.4	2.1	2.5	2.4	2.4
(3) Per Capita Food Production	-					
World	24	0.8	1.6	0.6	0.3	0.4
Developed Countries	27	1.4	2.0	1.3	1.1	0.8
Developing Countries	15	0.5	0.8	0.5	0.2	0.4
(4) Total Agric.	-					
Trade world	397	5.3	5.3	3.7	5.0	5.0
Developed Countries	NA	NA	NA	4.0	3.0	2.8
Developing Countries	NA	NA	NA	3.6	8.0	9.1

Source: Terry N. Barr "The World Food Situation and Global Grain Prospects", Science 214: 4525, (4 Dec. 1981).

in LDCs production resulted from increased yields rather than expansion in area. These yield increases resulted from increased use of fertilizers, adoption of higher yielding varieties, improved production practices and increased use of irrigation. During the 1970s, yields changed little in the developed world.

The production trend during the 1950-80 period suggests only a limited improvement in the per capita food consumption in developing countries. In fact, consumption has increased more rapidly due to the growth in food trade. Table 2 provides data for world trade over the period 1934-38 to 1980. LDC's were net exporters in the mid thirties but large importers forty years later. For example, in 1980, Asian countries imported 59 million metric tons (mt) of cereals, compared to only 17 million metric tons in 1960. Africa imported 13 million mt in 1980 compared to 2 million mt in 1960. Latin America's imports increased from 10 thousand in 1960 to 15 million mt in 1980 (FAO Trade Yearbook 1963, 1980). Most of the imports have come from North America where exports increased from 5 million tons in the mid thirties to 134 million tons in 1980. During the 1960's, according to the World Food Institute (1981), the annual average growth in total world grain trade was 3.7 million metric tons and increased to 10.2 million metric tons in the 1970's. This upward trend suggests a considerable increase in world trade by the end of the 1980's.

In spite of the tremendous increase in foodgrain imports, many LDC's have continued to use agricultural resources in the production of both cash crops and food crops. Some LDC's place more emphasis on cash

Table 2. World grain trade, 1934-38 to 1980 (million tons; + = export; - = import).

Region	1934-38	1948-52	1960	1970	1976	1980
North America	+ 5	+23	+39	+56	+96	+134
Latin America	+ 9	+ 1	-	+ 4	- 1	-15
W. Europe	-24	-22	-25	-30	-24	-11
E. Europe and USSR	+ 5	-	-	0	-31	-43
Africa	+ 1	-	- 2	- 5	- 7	-13
Asia	+ 2	- 6	-17	-37	-46	-59
Australia, New Zealand	- 3	+ 3	+ 6	+12	+11	+19

Source: S. J. Burki and T. J. Goering, - "A perspective on foodgrain situation in the poorest countries" World Bank Staff Workgin Paper No. 257. April (1977) p.6.

crops, and devote all or most agricultural resources for them. For example, Cuba, in 1980, harvested 227 thousand hectares of cereal crops, but 1400 thousand hectares of sugar cane. Ghana, in 1980, harvested 900 thousand hectares of cereals compared to 1200 thousand hectares of cocoa beans. Indonesia, in the same year, grew 12 million hectares of cereals besides producing 11 million mt of coconuts (FAO Production Yearbook, 1980).

Many factors account for differences in resource allocation. Some countries do not have the required resources for cereal production. Such resources include suitable soils, optimum climate, manpower, and technology. Other countries have high production costs compared to international prices. On the other hand, in spite of declining grain prices in world markets, countries like the United States, Canada, Argentina, and Australia continue to export grains. Decreases in costs of production in these countries have made it possible to produce grains cheaply compared to the rest of the world. Thus grain exporters are responding to their comparative advantage in international grain markets.

In spite of the comparative cost rationale, some economists argue that countries do not benefit from international grain trade. Those gains are eliminated by imperfections in international markets, such as grain export cartels. To maximize profits, a cartel would determine levels of output and prices, and thus hurt importing countries by reducing quantity and raising prices. Grain embargoes present a second argument against trade. In this case exporting countries

restrict international trade to penalize importing countries for political or economic reasons. This forces the importing country to seek other sources of supply, probably at higher costs. Third, balance of payments problems in many LDC's are attributed to international grain trade. Many people believe that LDC's spend a considerable portion of their foreign exchange earnings on food imports. If they can produce their own food, they would be better off. Variability in international prices and quantities is a final argument against trade. Price instability may affect LDC's development programs, and results in unexpected higher costs and deficits in balance of payments. Variability in quantities threatens food security, and may lead to political instability. For these reasons LDC's planners are examining alternatives development policies, such as food self-sufficiency. They believe that reliance on domestic production could eliminate the problems of food insecurity, deficits in the balance of payments, and instability in prices and quantities.

This study examines the empirical validity of these arguments against trade. Chapter II presents the theory of comparative advantage, the principal rationale for reliance on international trade as a means to increase incomes. Chapter III describes food self-sufficiency strategy and the argument against reliance on international trade. Chapter IV tests the validity of the complaints against grain trade. These include the role of grain imports in balance of payments deficits, the problem of variability in quantities available on world markets, and price instability. Foreign exchange expenditure on food in the large

LDC importers is compared to total export earnings in order to determine the percentage of export earnings spent on food imports. For the problem of quantity variability, comparisons are made between variability in world markets and domestic production with the use of coefficients of variation. Finally, instability in world prices is compared to hypothetical domestic price variability under conditions of self-sufficiency. A summary and conclusion are given in Chapter V.

CHAPTER II

THE CASE FOR TRADE

If each country could produce all goods and services, international economics would not be needed. However, each country has a limited capacity to produce, determined by its resource endowment and state of technology. To illustrate the effects of these limitations, Figure 1 shows the production possibilities curve. In the simple example here, the country (X) produces only two commodities, food and clothes. The curve is drawn concave to the origin indicating the law of increasing costs. "This shape embodies the assumption that the opportunity costs of obtaining an additional unit of a commodity increase as more of the commodity is produced." (Caves, 1977).

If (X) allocates all its resources in the production of food it will be able to produce OA of food and no clothes. If all resources were put in the production of clothes, OB of clothes will be produced. Any point along the curve represents a maximum combination of food and clothes that could be produced with the given level of resources. The negative slope indicates that some food production must be sacrificed to move from point C to point D, as resources are released from food production to the clothes industry. Any point below the curve represents a lower level of production that could be achieved without using all available resources, or by using resources in inefficient combinations. Any point above the curve cannot be achieved with the given resource endowment.

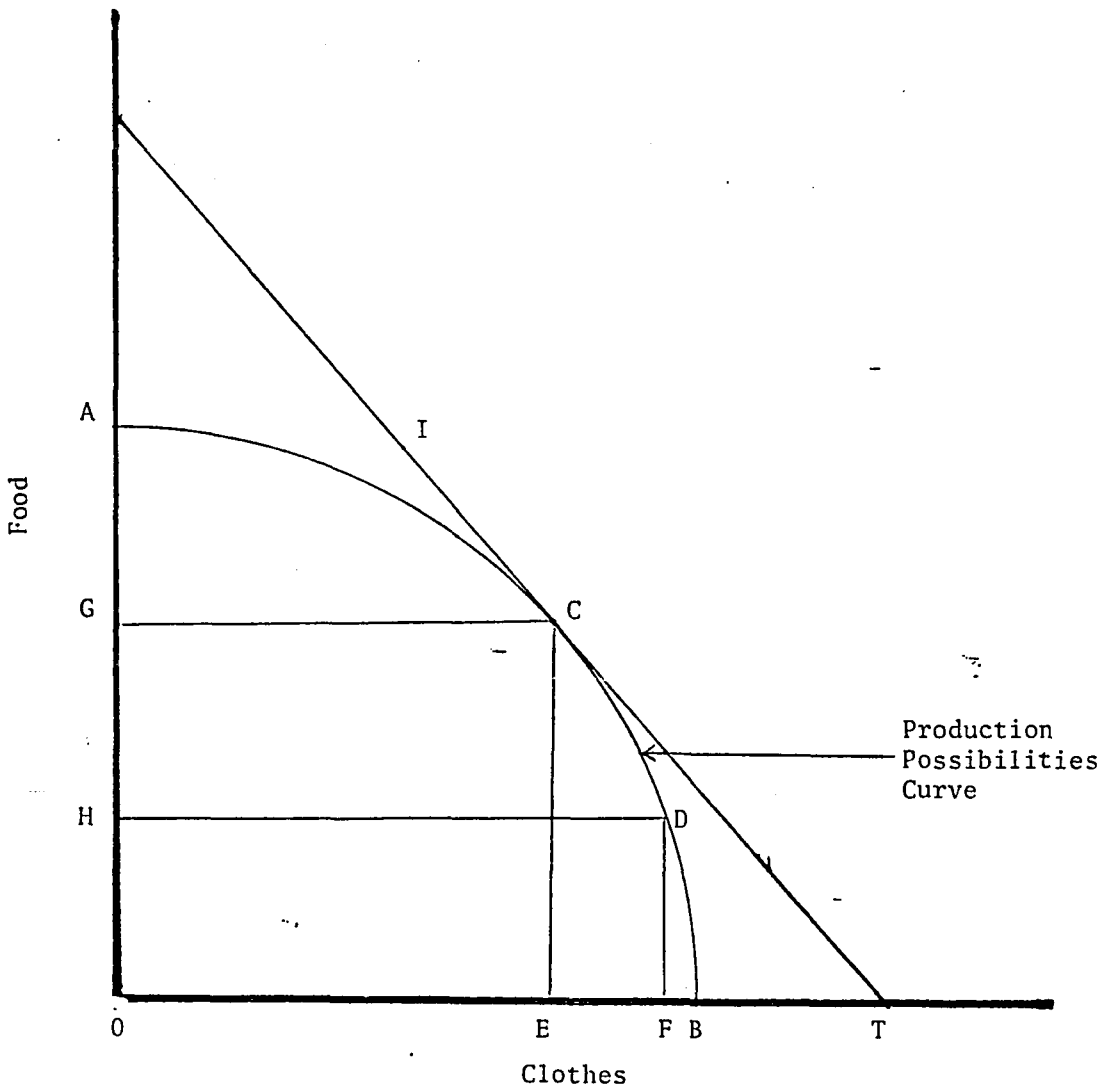

Figure 1 Production Possibilities Curve of Country (X)

In the absence of trade, the production possibilities curve represents the consumption possibilities. If trade is possible, however, this constraint is eliminated. Country (X) will maximize its income by producing at point C, where the negative of the price ratio (the slope of line TCI) equals the slope of the production possibilities curve. Hence the consumption possibilities schedule becomes line TCI. Thus many combinations of goods represented by points beyond the production possibilities curve can be consumed at these prices. The expansion of the consumption possibilities frontier is considered to be one of the gains from trade.

The gains from trade can also be demonstrated with the use of the budget constraint. Commodity prices are expressed in relative terms, i.e., the price of food is given in terms of yards of clothing per bushel, and the price of clothing is expressed in terms of bushels of food per one yard of clothing. If total expenditure is equal to total income for each individual, a budget line can be drawn to indicate potential trades of food for clothes at prevailing market prices. The slope of the budget line ACD = $\frac{DE}{EC}$, the relative price of clothing. Changes in prices change the slope of the budget line. For example, an increase in the food price makes the budget line flatter through point C (if C is chosen to be the choice of the consumer) i.e., more yards of clothes would have to be given up in exchange for one unit of food. Consumption is represented by indifference curves, and the individual maximizes welfare by consuming on the highest possible

indifference curve. This point is determined by a tangency between the budget line and any indifference curve. The consumer would like to consume more, but is limited by the budget constraint.

In Figure 2, two countries are represented by two consumers in each country. ACB and DCE represent two budget lines (or relative prices) in Egypt and Sudan, respectively. Given the preference map, point C is the highest attainable level of consumption in Egypt and point F is the highest attainable consumption in Sudan. If Egypt could trade with Sudan at prices shown by line DE, it could export GC units of clothing to Sudan and import FG units of food, hence improving welfare by moving to a higher indifference curve (Y_2). At the same time Sudan would benefit from trade (Figure 3). Point C represents the maximum attainable consumption level in Sudan according to the budget line $\overset{**}{DE}$ which is parallel to DE in Figure 2. Sudan would be willing to export CG units of food in order to obtain GF imports of clothing which would enable the community to consume at point F, which lies on a higher indifference curve. Hence different relative prices in two countries enable both countries to trade at a common intermediate price ratio, which leads to increased national income in both countries.

The amount of food Sudan must export in order to import clothing from Egypt can be determined by the offer curve of Sudan. The offer curve is a schedule indicating how much of one commodity is exported to finance various quantities of imports. Line OAR in Figure 4 represents the offer curve of Sudan. Point (A) shows vertically (distance AC) a quantity of imports of clothes and horizontally (distance OC) a

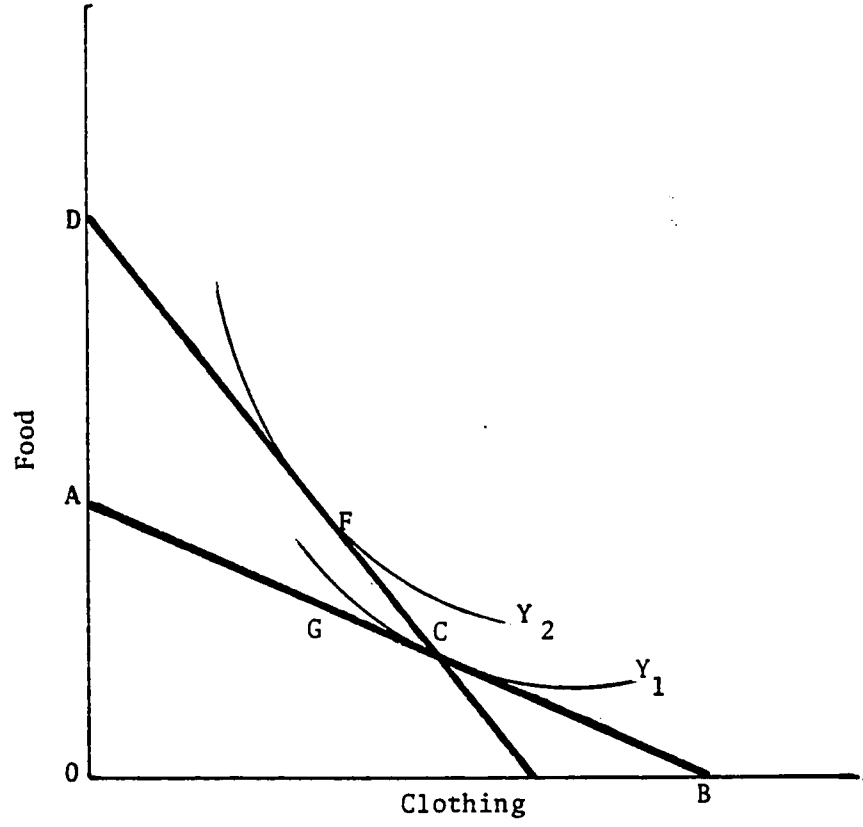

Figure 2 Benefits From Trade to Egypt

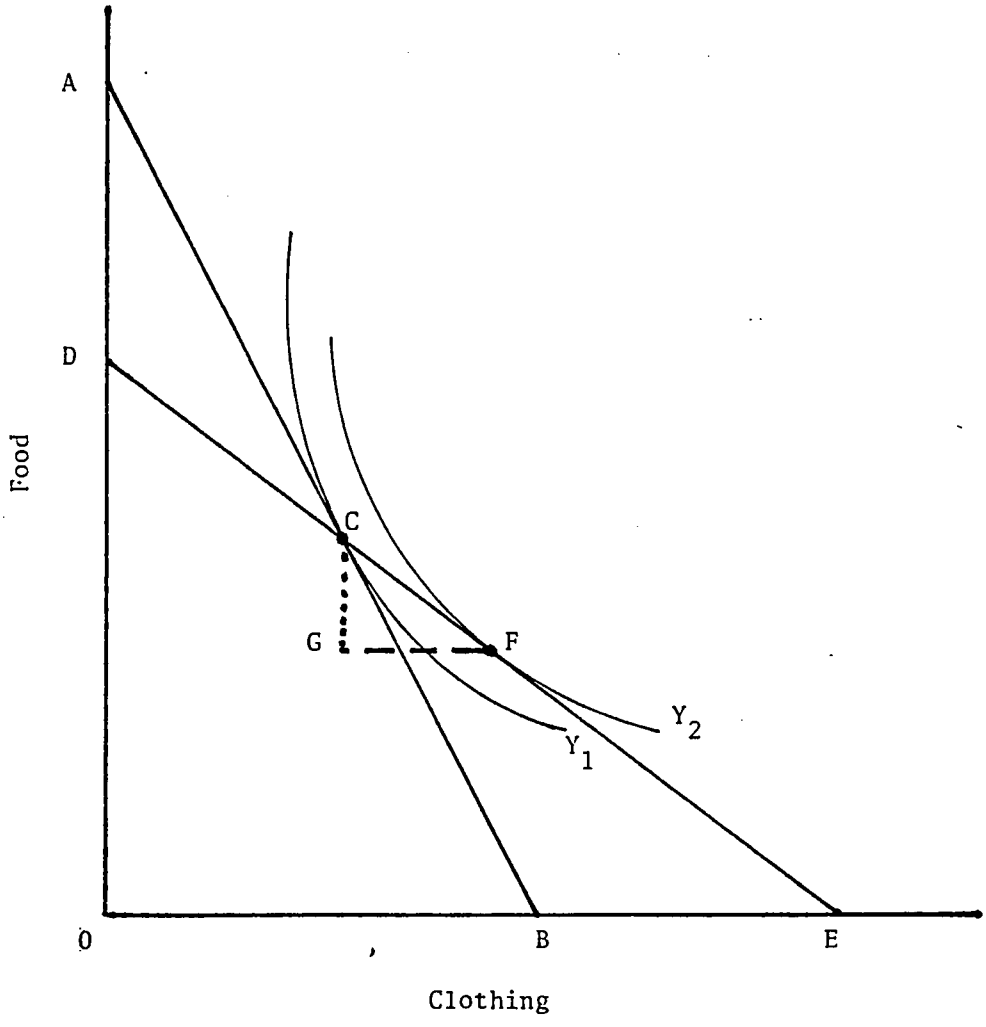

Figure 3 Benefits From Trade to Sudan

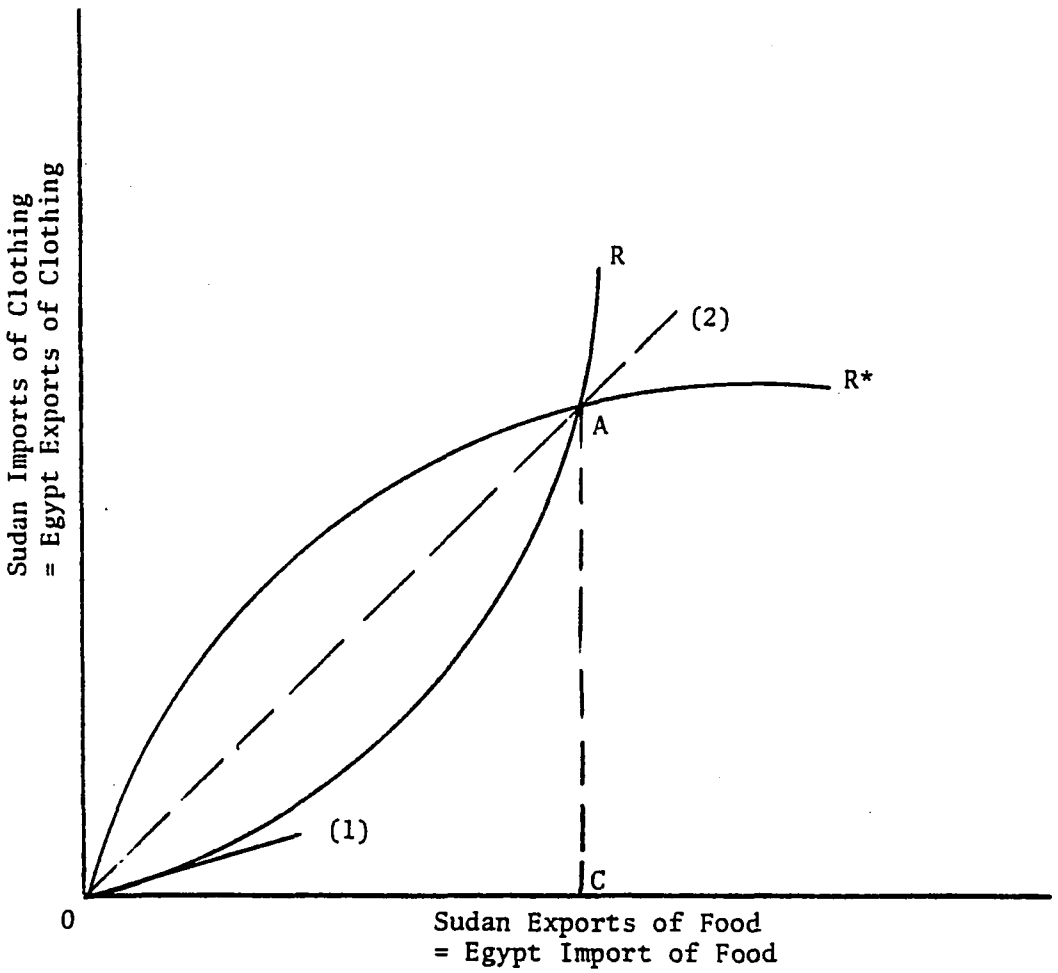

Figure 4 Sudan and Egypt Offer Curves

quantity of food offered for export. Indeed these have the same value because the slope of line (2) represent the relative price of food. With each such price ratio there is associated a net demand for clothes imports and an equivalently valued net export supply of food. Price line (1), tangent to the offer curve OAR at the origin, shows the price ratio at which Sudan chooses not to trade. Cruve OAR is the locus of all possible trading points, each associated with a different price.

It should be noted that as clothes become progressively cheaper, more clothes imports are demanded - the curve moves out (and up) as shown in Figure 4. However, Sudan need not continue to pay ever larger amounts of food to obtain these imports. As clothing becomes cheaper, greater quantities of imports are demanded. If clothing prices are low enough, the offer curve could bend back, indicating less food exports are required for more clothing imports. Information about the Egyptian offer curve is necessary to determine the price ratio of which Sudanese exports of food equal Egyptian demand. The two offer curves are indicated in Figure 4, where OA equals the price ratio at which the markets clear. Sudan exports OC units of food to obtain AC yards of clothing which equals Egypt export, i.e., Sudanese demand equals Egyptian supply of clothes and Sudanese export of food equals Egypt demand for food.

It is clear from the presentation above that trade is beneficial if relative prices abroad are different from those at home. Still, some individuals in the community are hurt by trade. Using the example of Egypt and Sudan, the losers are those who are net sellers of food in Egypt and clothes in Sudan. This is because international trade

lowers the relative prices of food in Egypt and clothes in Sudan. As shown in Figure 5, the individual budget line will rotate from the budget line (1) (under domestic prices) to the budget line (2) (under world prices), moving the producer from indifference curve (Y_1) to the lower one (Y_2). Thus consumption of this individual is reduced from G to H in Figure 5. Figure 1 suggests, however, that the gainers can compensate the losers and the country is still better off, since the aggregate consumption possibilities frontier is expanded beyond the production possibilities frontier.

Imperfections in International Trade

Economic theory explains the basic structure of international economy under the assumption of pure competition. However, this assumption is not always valid, due to regional groupings, monopolies and oligopolies, commodity agreements, tariffs, quotas, and cartels. The case of cartels will be used to show how imperfections affect the performance of international trade.

A cartel is an association of producers who determine levels of output and prices. General characteristics of a successful cartel include control of supply, blocked entry, downward-sloping demand functions and a single objective function. Schmitz and McCalla (1981) describe three principal issues for cartels - determination of conditions advantageous for collusion, organization for price setting and the distribution of production and rules for maintenance of the cartel. Resolution of the latter issue is particularly critical. Most models of cartels assume an objective function that maximizes profits,

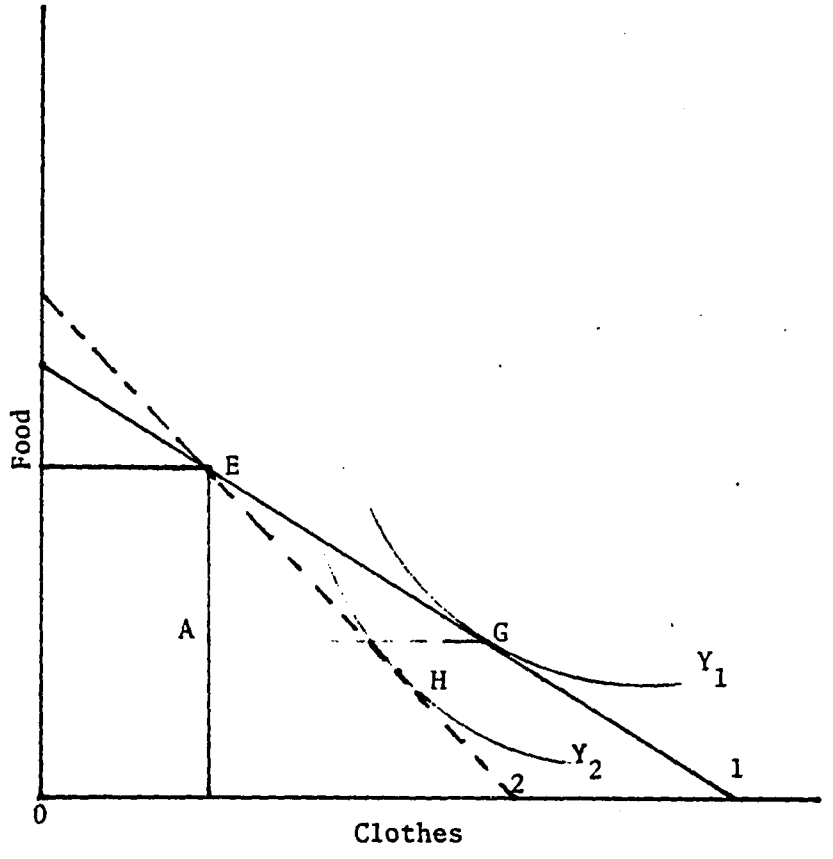

Figure 5 How International Trade can Hurt

and hence quantity adjusts to achieve an optimum price. Allocation of production among members takes place as a consequence of the price decision. Such allocations may not result in an acceptable distribution of gains if members have different cost structures, and thus the temptation to defect may be large. Since the defector can avoid supply restrictions, he is better off outside the cartel provided the cartel remains effective and members do not retaliate. But if defection is profitable for one member, it is often profitable for others, leading to the breakdown of the cartel.

The model of a grain cartel by Schmitz and McCalla differs from most cartel models in the inclusion of a demand function to take consideration of domestic consumer welfare. According to the theory of monopoly, an optimum quantity and therefore price must be set to maximize profits. A cartel for grain exporters would impose an export tax. The optimal export solution demonstrated in Figure 6 identifies the maximum gains from a government export cartel under the assumptions of free trade. Lines D_c and S_c represent the demand and supply curves respectively for the exporter for good X. D_D and S_D represent the demand and supply, for the importer, respectively. The importer excess demand curve is E_D, and the excess supply curve for the exporter is ES. The free trade price is PF.

In this model an export tax imposed by the government in the exporting country is computed by E_s, MR, and the marginal excess demand curve. The intersection determines PC to be the price in the importing country for both producers and consumers. P_d would be the price in the exporting country. Hence (abcd) is the tax revenue for the exporting

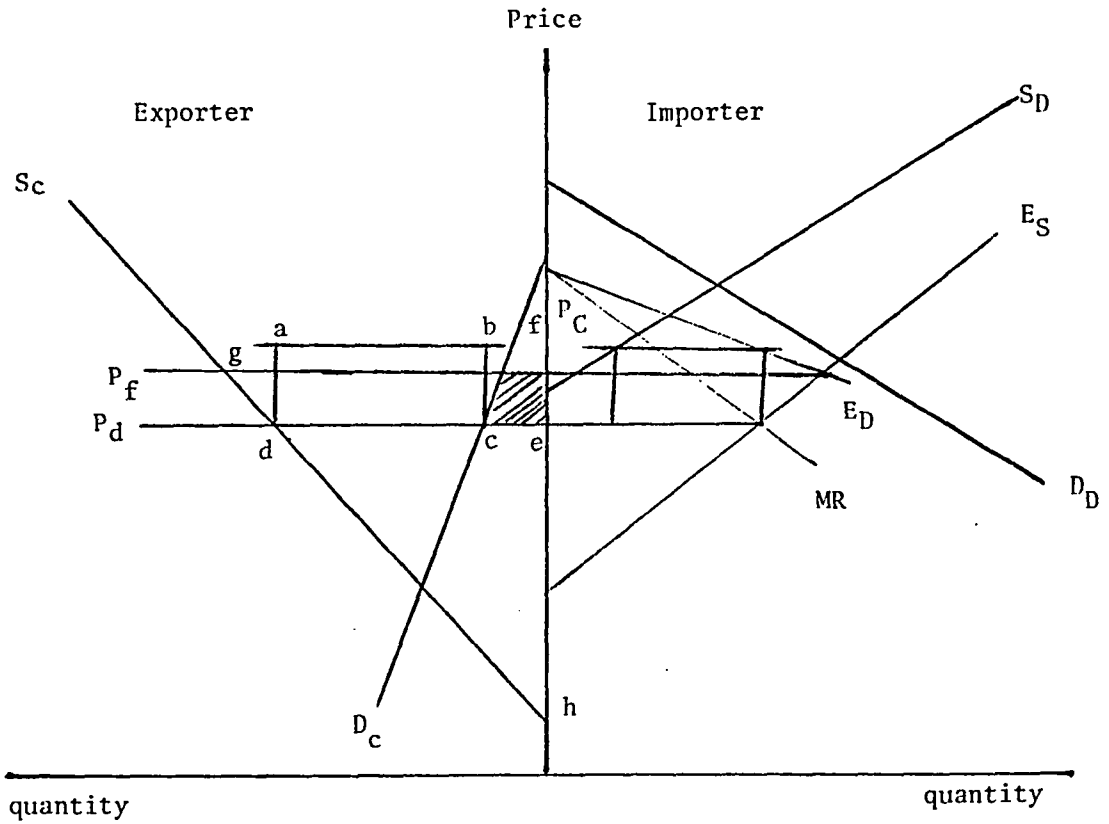

Figure 6 Optimum Government Export Cartel

government. Producers loss in economic rent is (defg), while the gain in the consumers surplus is the cross-hatched area. Thus the net gain to the exporters is the cross-hatched area plus (abcd) minus (defg). The difference is positive under the large country assumption used in this model. Producers can be made worse off, but society receives a net welfare gain due to the gain in tax (abcd) plus the gain to consumers in terms of lower prices.

A producer cartel concerned with maximization of returns to producers yields a different solution. This solution takes into account marginal revenue derived from the domestic demand curve D_c Because producers - in the absence of government intervention - could charge domestic consumers a higher price than P_d they will be able to maximize their own profits. If producers were able to discriminate among markets, they would arrive at a solution using marginal revenue curves corresponding separately to the excess demand and domestic demand curve. The solution is illustrated in Figure 7. For the importers, only excess demand is presented. The demand in the exporting region is D_d the domestic supply is S_d and the free trade price is P_f. In this solution there are two prices, one for importers and one for domestic consumers. Those prices are represented by P* and P_d, respectively. The free trade price is between these two prices whereas, in the government cartel, the free-trade price is above the home price. If the export tax revenue (area abcd in Figure 7) is given to producers, they will be better off than with free trade. Schmitz (1981) noted that in the above models of cartels, output has to be reduced in the exporting country. Thus a problem for cartels involves

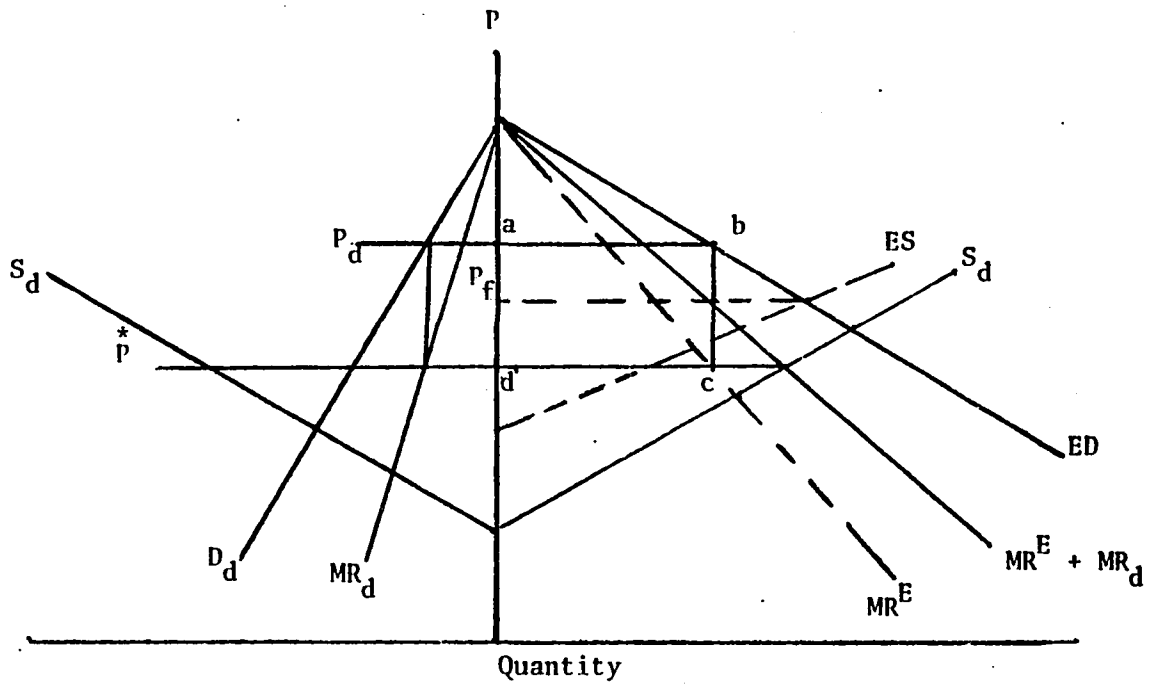

Figure 7 Optimal government Export Cartel and Optimal Producer Export Cartel Compared

distribution of the higher earnings to producers without stimulating increased production. Government could control prices to limit cartel power, but to provide incentives for the producers, the price would have to be above P_d in Figure 6.

In spite of the relatively higher prices imposed by international grain cartels, most LDC's continue to import foodgrains. This indicates that domestic marginal costs of production in importing countries are higher than world prices, even under the assumption of higher prices imposed by international grain cartels. Thus the argument against trade represented by grain cartels will not eliminate the gains from grain trade. Exporting countries can increase their profits, while importing countries will still benefit by saving the difference between domestic costs of grain production and world prices.

Optimum resource allocation is determined by cost structures and market prices. For grain exporting countries, low costs of production enable them to provide importers with grain supplies for relatively low prices. Grain importers are better off by importing grains rather than growing these crops. If cash cropping can provide foreign exchange for grain and other imports, then shifting resources from cash cropping into grain production may not be an attractive strategy. For example, if the net returns of one hectare grown under coffee in a certain country can provide more foreign exchange than the importation cost of what that hectare would produce if it was grown under wheat, it would not be economically feasible to shift resources from coffee into wheat production. This logic justifies dependency of grain

importers on world markets. Hillman (1981) presented FAO data for comparing the value per hectare for export crops and the import unit value per hectare for some grain crops in developing market economies. These data indicate that LDC's will experience a foreign exchange loss if they shift the same lands producing cash crops to domestic production of food crops (cereals). Table 3 shows export and import unit values per hectare of selected crops to LDC's. These figures provide only crude generalizations because of differences among countries in costs, environmental conditions and the assumption of static technology.

Thus developing countries through trade could provide foreign exchange to finance the importation of industrial raw materials, intermediate and capital goods, and food products. When prices of LDC's exports are favorable and world market demand is strong, trade seems clearly beneficial to growth and development. Kravis (1970) finds that LDC's trade expansion and GNP growth rates are positively and significantly related. According to Yeats (1977), Michaely (1977) has correlated the rate of change in exports as a percentage of national product against changes in per capita product for 41 developing countries over the period 1950 to 1973 and found a highly significant positive relation between the variables.

Table 3. Foreign exchange value of selected crops to developing countries.

	1963*	1975*
	Export unit values per hectare (U.S.$)[1]	
Coffee	320	769
Cocoa	127	436
Tea	1001	1197
Tobacco	719	1250
Sugar	352	1462[2]
	Import unit values per hectare (U.S.$)[3]	
Wheat	73	210
Rice	83	283
Barley	48	145
Maize	58	169

[1]Average export unit value multiplied by average yield in developing market.

[2]$1462 in 1972-74.

[3]Average import unit value multiplied by average yield in developing market economies.

Source: The Role of Export Cropping in Less Developed Countries. (Hillman, 1981).

CHAPTER III

THE CASE AGAINST TRADE AND THE ISSUE OF FOOD SELF-SUFFICIENCY

The theory of comparative advantage demonstrates that if every country specialized in production and export of goods in which it is a relatively low cost producer, then aggregate consumption and potential welfare of each trading country would be maximized. Hence free trade becomes an optimal policy. However, this implication cannot be applied to all trading countries. The optimum tariff argument demonstrates that a large trading country can increase its own welfare, albeit at the expense of the rest of the world, by distorting domestic prices away from the international terms of trade (Jabara and Thompson, 1980).

Another issue raised against the optimality of comparative advantage involves uncertainty. This issue is particularly important for necessities such as food, as national exporters may decrease export availabilities to increase prices, to maintain domestic availabilities, or to retaliate against potential importers for political reasons. An additional element of uncertainty involves prices. Jabara and Thompson (1980) argue that because prices of imported food grains are uncertain, many countries have adopted policies to distort internal prices away from the international terms of trade to increase their self-sufficiency ratios in food production. While some LDC's have

advocated international commodity programs to stabilize international prices, others have implemented import substitution programs and deliberately avoided following comparative advantage. Finally, it has been argued that many LDC's have to devote a considerable portion of their export earnings for food imports, and thus delay development programs and retard the rate of economic growth.

The substantial fluctuation in the international prices of cereals suggests uncertainty is important to both exporting and importing countries. Climatic factors contribute to price instability. Weather affects agriculture through rainfall or lack thereof temperature, daylength and the number of frost days. Some producing regions have considerable weather fluctuations that can have serious effects on production, for instance, rainfall postponing planting season, and early frosts which prevent crops from ripening. Economic factors also play an important role in the instability of grain markets. Uncertainty about input prices could affect producer behavior towards new technology. Government control over imports and fluctuations in foreign exchange availabilities add further to the uncertainty of input prices and availability.

International market price instability causes three principal problems. Price fluctuations in the international market are transmitted to domestic markets (unless there are some protective policy measures). This would hurt low income consumers by decreasing their real incomes. A shortage in supply in domestic markets could appear in response to high world prices. Second, reliable production plants in the producing country are more difficult since investment decisions

become more risky. Finally, high grain prices could aggravate balance of payment problems for importing countries. As a result, development programs may be delayed and other economic problems such as inflation, temporary unemployment and income decline would be expected. The alternative for consuming countries involves decreases in food imports, but such a policy could cause nutritional problems, and domestic food prices would inflate more than if import levels were maintained. In addition political problems might arise if the government fails to maintain food availabilities.

Grain embargoes represent a further argument against international trade. In this case food would be used as a weapon by food exporting countries against importing countries. If such a weapon can be used, importing countries would be unable to depend on trade as the main source of staple food. The recent U.S. grain embargo against the Soviet Union provides a useful basis for the evaluation of the potential of a grain embargo. On January 4, 1980, President Carter announced a decision to suspend delivery of all U.S. grain sales to the USSR in excess of the eight million tons guaranteed under the terms of the 1975 bilateral agreement. The purpose of the embargo was to punish the Soviet Union for its invasion of Afghanistan in December 1979. Because of very dry weather early in 1979, the Soviet grain harvest had fallen 48 million tons (21 percent) short of the production target (Paarlberg, 1980). In order to avoid a severe reduction in livestock herds, the Soviet Union planned to import 35 million tons in 1980. About 25 million tons were to be supplied by the United States. These conditions indicated that the U.S. grain embargo might be effective in forcing the

Soviets to either reduce their military budget or liquidate livestock herds and thus anger consumers.

Three conditions were needed for a successful embargo. First, the United States had to control the volume and direction of grain exports. This is not an easy task in the United States, which has no strong influence on exporting firms. Second, other countries and transnational corporations must be prevented from leaking the embargoed grain into the U.S.S.R. Other exporting countries should also be prevented from expanding or redirecting their own food exports to replace the U.S. supplies to U.S.S.R. Finally, the reduction in grain imports must have a large impact on total supply within the Soviet Union.

Initially, the United States controlled successfully its exports and prevented shipments from U.S. ports to the Soviet Union. These successes were at a growing cost to taxpayers, due to compensatory measures for grain producers and exporters. Some exporting firms had already purchased large quantities of grain for delivery to the Soviet Union. The USDA announced that the Commodity Credit Corporation (CCC) took ownership of 4.2 million tons of wheat and a million tons of corn, at a short run cost to the government of about two billion dollars. These quantities were kept from the market so as not to affect farm prices. The government temporarily isolated this embargoed grain from the market by "rolling forward" contracted port delivery dates. But by midsummer of 1980, most of the embargoed grain had been retendered into market channels.

Producers were concerned with the retendering process and its depressing effect on farm prices. At an immediate cost to taxpayers

of several billion dollars, the USDA increased loan prices for wheat and corn. Compensation for farm grain storage was increased as well. In spite of these measures, farm prices did not go up by the same proportion as production costs, and farm support for the embargo program began to disappear. In April 1980, the American Farm Bureau withdrew its support for the program. Moreover, grain producers viewed the embargo as more than a temporary loss of export opportunities. They doubted that the Soviet Union would plan to buy such large amounts of U.S. grain, even if given official permission. Producers thus expected to be compensated by the taxpayer not just this year, but also in the future for the permanent damage to export markets.

The international grain trading system continued and/or increased exports to the USSR despite diplomatic efforts of U.S. officials. Leakages came from different sources. A portion of the exported U.S. grain found its way indirectly to the Soviet Union after leaving U.S. ports, through Eastern Europe or transshipment by private multinational trading firms. Additional damage to the embargo was made by other grain exporting nations, such as Canada, Australia, France, Argentina, South Africa, and Thailand, who increased exports by drawing down surplus stocks. These countries also redirected grain exports away from traditional customers and toward the Soviet Union, encouraged by more attractive prices.

These leaks, together with shifts in trade, practically eliminated the value of the embargo. According to Paarlberg, the

USDA reported that the Soviet Union imported 31 million tons of grain in 1980, only 2.5 million tons less than it had planned to import prior to the embargo. Thus the embargo had failed to create the desired effect on the Soviet Union. During the first six months, if denied the Soviet Union access to imported grain, the Soviet Union might have been forced to conduct a distress slaughter of livestock. Such an action would have increased meat for consumption in the short run, but made it difficult to provide meat in the long run. But the inability of the U.S. to control world grain trade and the decision taken by the Soviet Union to draw grains out of its food reserves largely offset the U.S. embargo.

The embargo made the Soviet Union dependent on many suppliers for small quantities of grain, and increased the cost of imports. Thus the U.S. program did have some effect on the USSR. Another benefit of the embargo was the four million ton food reserve established to meet emergency needs in poor countries. But the embargo had also made it less likely for the Soviet Union to participate in a multilateral food reserve system.

This example suggests that exporting countries may not be able to control a successful grain embargo against importing countries. Leakages and changes in pattern of trade could offset grain embargoes, and thus importing countries would be able to obtain their needed imports through other sources and indirect ways. This leads to dismiss the grain embargoes argument against international grain trade.

Concerns over international grain trade have led to the suggestion of alternative approaches to achieve higher rates of

growth and development. The issue of food self-reliance has been raised as an alternative to increased dependence on international trade. Lappe and Collins (1977) are the foremost proponents of the self-sufficiency approach. Self-sufficiency means that each country should concentrate its efforts and resources first in food production. Only when food demand is satisfied, should trade play a role in economic development.

A considerable shift in resources towards the food production is necessary for a country to achieve food self-sufficiency. For successful programs of food self-sufficiency, a country should produce food grains before industrial crops like cotton and rubber. Livestock should not compete with people for food grains, but should be raised by individual households primarily on farm and household wastes. Only after meeting the basic needs of people could land be used for industrial crops and livestock.

According to Lappe and Collins, in most LDC's the agricultural sector is used for extracting wealth for urban people, contributing much more to the national income than it receives in investment. "Although agricultural production ordinarily generates most of the national product and foreign exchange, a recent survey found that, on the average, agriculture in underdeveloped countries receives only 11 percent of all investment" (Lappe and Collins, 1977). They suggest that resource allocations should increase production but not neglect the bottom portion of the population. Effective measures to achieve this objective include land reform programs. According to Lappe and Collins such programs will result in higher productivity, since small land

owners will feel more independent and confident, and thus maximize their production.

Agricultural exports should not be given priority, but should only develop after food needs are met. Lappe and Collins (1977) argue that this approach will allow trade to become "a healthy extension of domestic need instead of being determined strictly by foreign demand." This policy stance does not mean to eliminate all trade, even at the early stages of the food self-sufficiency program. Certain inputs must be provided which cannot be produced locally. But trade should take place only after testing all the possibilities of creating such items locally.

A small scale industrial network should grow to meet the needs for fertilizer, farming equipment and other simple manufactures. In this manner industry could develop as an organic outgrowth of the labor-intensive agriculture. This also increases the employment in the rural areas and stops rural-city migration. A key issue for the development of a self-reliance strategy is the availability of capital needed for the expansion of cultivated land and the introduction of new inputs to improve productivity. Lappe and Collins argue that LDC's could rely on the mobilization of unemployed and underemployed labor forces for improving the productivity of land, since most workers produce more than they consume. But the surplus produced is not available for workers but is controlled by landlords, money lenders, merchants, state bureaucrats and foreign corporations. If the surplus was controlled by the poor peasants, agricultural capital formation would be facilitated.

Capital needed for inputs could be minimized by producing some inputs locally. For example, capital spent on fertilizer imports could be minimized by using organic fertilizers to the maximum extent possible. Some farm equipment could be produced locally in suitable forms for the local environment. This could save some foreign exchange and provide new sources of rural employment.

Many of the concerns of Lappe and Collins do not depend necessarily on increased food production. Income distribution is one of the principal concerns of the food self-sufficiency group, and thus they recommend land reforms. Such reforms, however, do not require the production of food. Figure 8 shows how income could be maximized for the agricultural sector according to comparative advantage. Income maximization could be attained at any point along the curve AB, depending on the net profits gained from each crop. While the mass initiative argument may have potential to increase agricultural production, such increases would presumably include both food and cash crop production. Delays in trade development may hurt the agricultural sector, as many countries depend on agricultural exports as an important source of foreign exchange. Finally, the cost of self-sufficiency would be very high in many LDC's, since access to modern technology and costly inputs is necessary. Burki (1977) estimated a total investment of $25 billion is required to increase production by 45 million tons, an equivalent of $600 per metric ton. These costs are considerably higher than world prices.

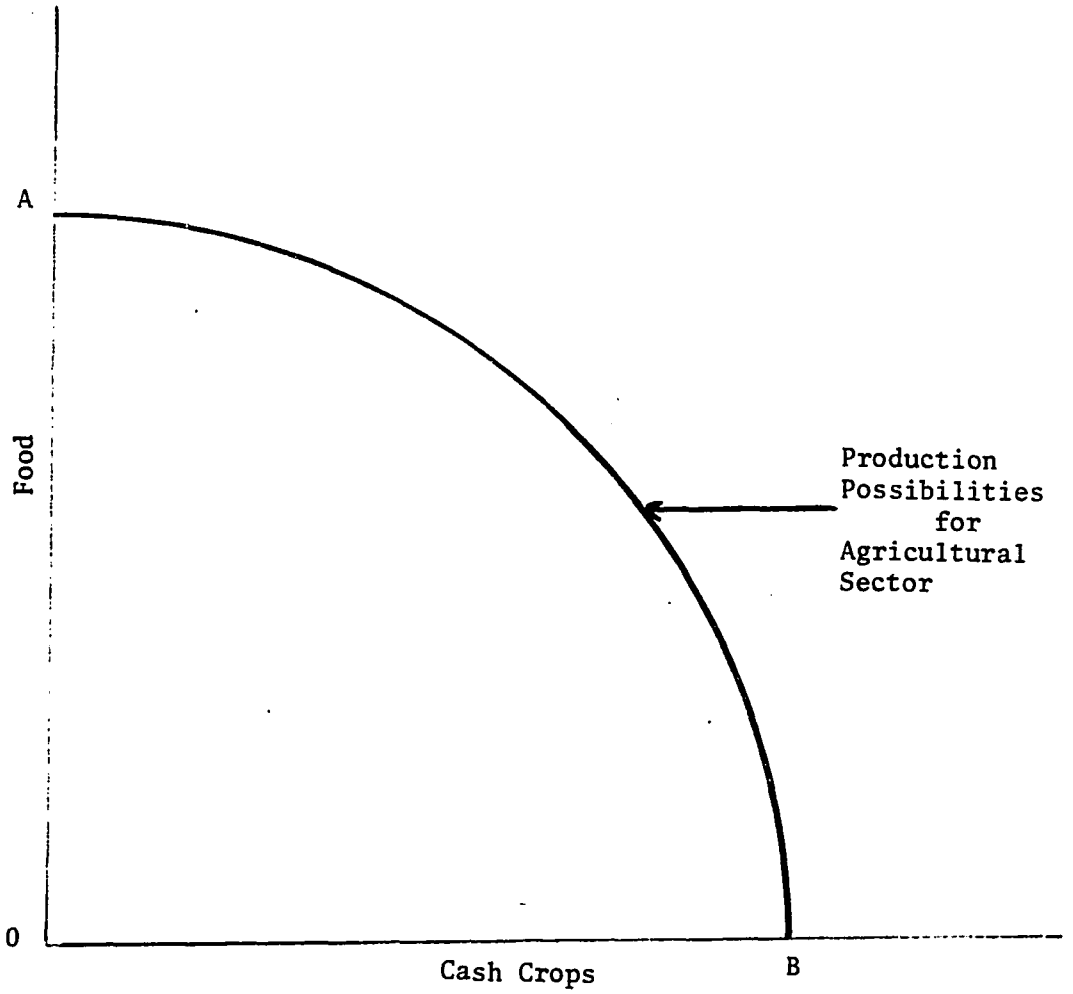

Figure 8 Income Maximizination In the Agricultural Sector

CHAPTER IV

EMPIRICAL EVALUATION OF THE ARGUMENTS AGAINST INTERNATIONAL GRAIN TRADE

In this chapter the validity of the arguments against international grain trade are evaluated. The cartels and grain embargoes arguments have been evaluated in Chapters II and III respectively. And as shown they do not present acceptable evidences against international grain trade, and therefore they have been dismissed leaving three problems to consider in this chapter. In the first part the contribution of food imports to deficits in the balance of payments is evaluated. Foreign exchange spent on cereal imports is compared to total export earnings in 68 less developed countries. The second test evaluates the quantity variability argument. Variability in world exports is compared to domestic production variability among the largest importers. Wheat, rice, and maize were used in the comparison. The third test compares instability in world prices to domestic prices instability in the sixteen largest importing countries. In this test hypothetical prices derived from yield data (for wheat, rice, and maize) were compared to world prices during the period 1961-1980.

Foreign Exchange and the Cost of Food Imports in LDCs

The literature on food security emphasizes foreign exchange constraints as a major determinant of food imports. Siamwalla and

Valdes (1980) suggest that "foreign exchange availability may be the most crucial factor determining whether or not a country can import enough food to stabilize food consumption." Because commodity export earnings are the main source of foreign exchange, some writers believe that the decision on imports in LDC's is influenced by export receipts (see Philip C. Abbot (1979)). This claim has been used to argue against reliance on international trade. Some LDC's believe that their primary exports prices are decreasing, but imports prices are increasing, resulting in a declining terms of trade. The result is a fall in foreign exchange reserves, which forces the country to either limit imports or to devalue. This situation would affect development programs as well as consumption by limiting the importation of capital goods.

This section focuses on the availability of foreign exchange for food importation; and compares the foodgrain import bill to the total foreign exchange earnings from exports over the period 1970-1980. Data was collected for all LDC's with imports of more than 500,000 metric tons of cereal in 1979.[1] The data for foreign exchange spent on foodgrain imports was collected from FAO Trade Yearbooks. The total export earnings data is given in Internatibnal Financial Statistics Yearbook of the International Monetary Fund. For most countries, the average exchange rate for the domestic currency in each year is used to convert domestic currency values to U.S. dollars. For a few countries, the values are already given in U.S. dollars.

---

1. Other LDC's with the same or more imports are excluded because data are not complete.

Table 1 in the Appendix shows the total export earnings and the cost of foodgrain imports for all selected countries. The ratios of foodgrain import costs to total export earnings and the average ratio for the eleven year period are given in Appendix Table 2. The ratio of foodgrain import costs compared to total export earnings was generally small. The average ratio for the whole period was less than 20% for 61 out of 68 countries, less than 15% for 56, less than 10% for 47 countries, and less than 5% for 29 countries. Almost 90% of the selected countries spent an average of 20% or less of total export earnings on foodgrain imports. The Yemen Arab Republic is the most extreme example of the foreign exchange problem. This country's food imports exceeded its export earnings. The deficit in the balance of payments due to food imports and other imports is offset by foreign aids, loans, and remittances coming from other Arab countries like Saudi Arabia and the United Arab Emirates.

Table 4 presents the results for the sixteen largest importers. Eleven countries spent less than 10 percent of their exports earnings on foodgrains and two spent between 10 and 15 percent. Average Egyptian expenditure on foodgrain imports amounted to 33 percent of export earnings. The alrgest ratio is found in Bangladesh, amounting to 72 percent. This amount is large for a poor crowded country like Bangladesh. Food self-sufficiency programs may be useful, provided that Bangladesh was capable of providing the needed inputs for production programs. The case for Egypt is somewhat different, since cereals compete with cotton for limited arable land. Cotton is the main cash crop and the government cannot sacrifice its area for less profitable

Table 4. Ratio of total foodgrain imports to total export earnings in the biggest sixteen importing countries among LDC's during 1970-1980.

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Average for the period
Algeria	.034	.061	.06	.056	.071	.094	.065	.059	.068	.059	.053	.062
Bangladesh	N.A.	N.A.	.610	.819	1.114	1.543	.671	.185	.474	.267	.815	.722
Brazil	.059	.047	.039	.051	.069	.044	.056	.026	.064	.078	.109	.058
Chile	.039	.060	.061	.083	.135	.088	.106	.035	.069	.057	.066	.073
China	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Egypt	.092	.206	.144	.153	.442	.523	.371	.399	.466	.421	.374	.326
India	.173	.119	.024	.176	.213	.296	.197	.034	.017	.020	.004	.116
Indonesia	.169	.141	.114	.177	.062	.056	.063	.067	.059	.045	.040	.090
Iran	.002	.027	.030	.025	.024	.027	.017	.020	.028	.024	.058	.026
Iraq	.009	.099	.020	.045	.040	.027	.022	.029	.039	.029	.024	.035
Korea Rp.	.292	.283	.174	.126	.137	.135	.055	.082	.038	.050	.061	.130
Mexico	.046	.012	.048	.20	.170	.206	.036	.072	.061	.057	.072	.089
Nigeria	.021	.020	.020	.016	.009	.013	.021	.033	.068	.024	.019	.024
Peru	.040	.061	.064	.104	.097	.141	.119	.094	.076	.058	N.A.	.085
Saudi Arabia	.029	.020	.015	.010	.005	.007	.007	.006	.012	.011	.010	.012
Venezuela	.023	.022	.022	.021	.022	.021	.032	.032	.027	.021	.026	.024

cereals. Moreover, even if the government transferred cotton area into cereals, Egypt would lose foreign exchange because the loss of foreign exchange from foregone cotton sales exceeds the foreign exchange gains from reduced imports of grain.

The results in Table 4 do not support the argument against trade. If a country like Mexico can import all its foodgrain needs for an average of 9 percent of its export earnings, it may not be acceptable to claim that Mexico is not able to provide foreign exchange for foodgrain imports. Brazil spent less than 6 percent, India about 12 percent, Indonesia only 9 percent. For the oil-producing countries, the results of Table 2 of the appendix suggest that foodgrain imports costs are insignificant. Less than 5 percent of export earnings in these countries was enough to pay for foodgrain imports. For the populated countries, with the exception of Bangladesh and Egypt, less than 20 percent of export earnings was enough for the foodgrain imports bill during the period in consideration. Even the year to year variation in the ratio was not large. During 1973-74 (the years of high world prices), with the exception of Bangladesh and Egypt, the highest ratio within the large importers was for India, which reached 21 percent in 1974.

Thus with respect to foreign exchange availability it might be better for many LDC's to import foodgrain if arable land is fully utilized. For the majority of the selected countries, self-sufficiency in food means the sacrifice of part or all of the arable land utilized under cash crops, and the shift of other resources to cereal production.

Foreign exchange would also be involved in cereal production, and shortages in foreign exchange may occur upon shifting arable land from cash crops into cereal production.

In Figures 9, 10, and 11, constant prices for wheat, rice, and maize are plotted over the period 1950 to 1980. The three crops show a declining trend in constant prices through the whole period with the exception of the 1972-74 crisis. This indicates that deterioration in terms of trade is not attributed to ceral imports. Rather, the terms of trade have improved with respect to cereals, increasing the net foreign exchange gains from the production of non-cereal crops.

Quantity Variability

Under unfavorable climatic conditions, international suppliers of foodgrains may fail to provide importing countries with their needs. Other circumstances like grain embargoes, grain cartels, and other trade imperfections could result in supply shortages. The above factors make importers feel that dependence on international trade for food supplies is risky in terms of quantity as well as price.

Whether world market variability is 'excessive' requires a comparison between world market variability and domestic production variability. The comparison made below assumes that expansion in area is feasible so that quantity variability will come only from yield variability. It should be noted that this assumption favors the position of food self-sufficiency, since most LDC's are not able to control acreage variability. The assumption also eliminates area variability due to climatic factors.

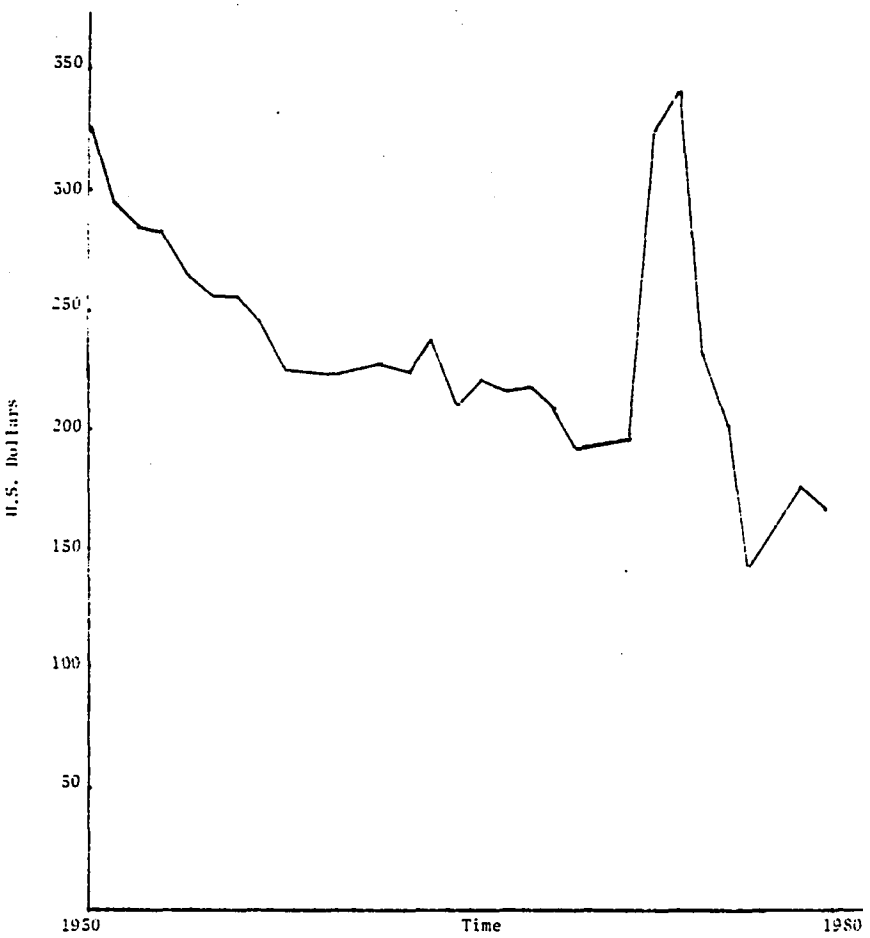

Figure 9. Wheat prices in constant dollars.

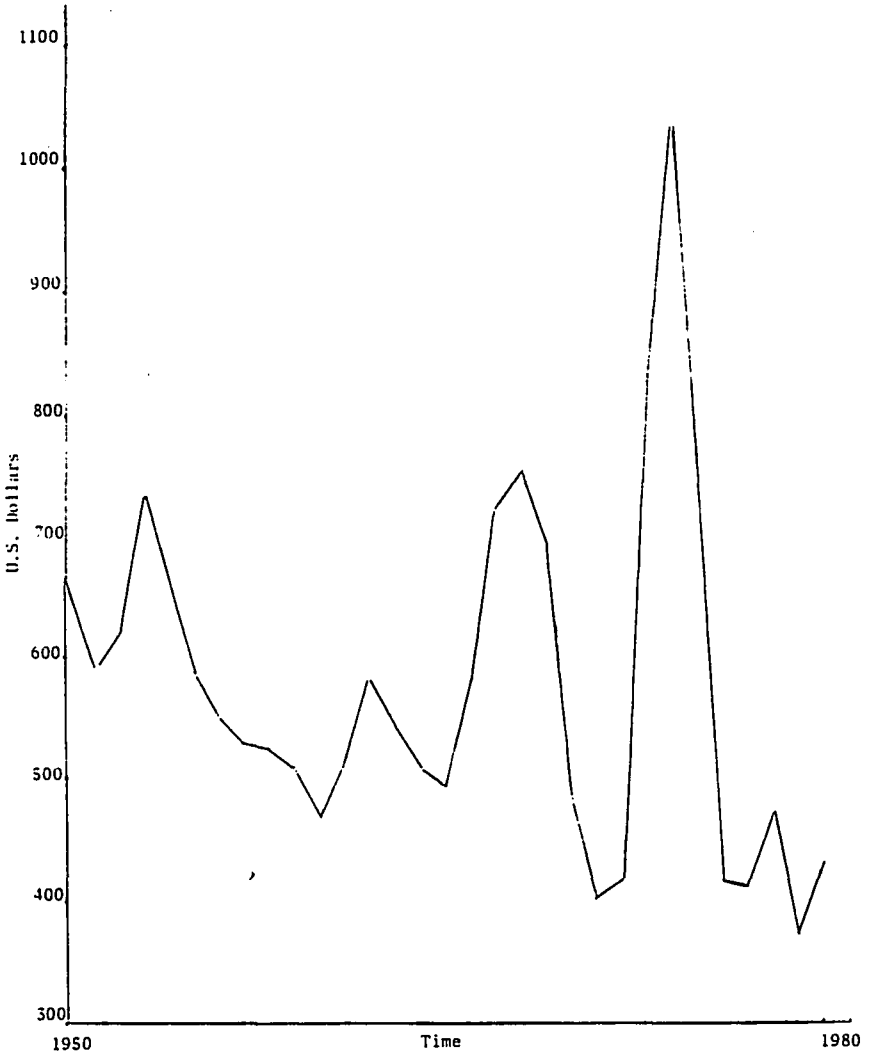

Figure 10. Rice prices in constant dollars.

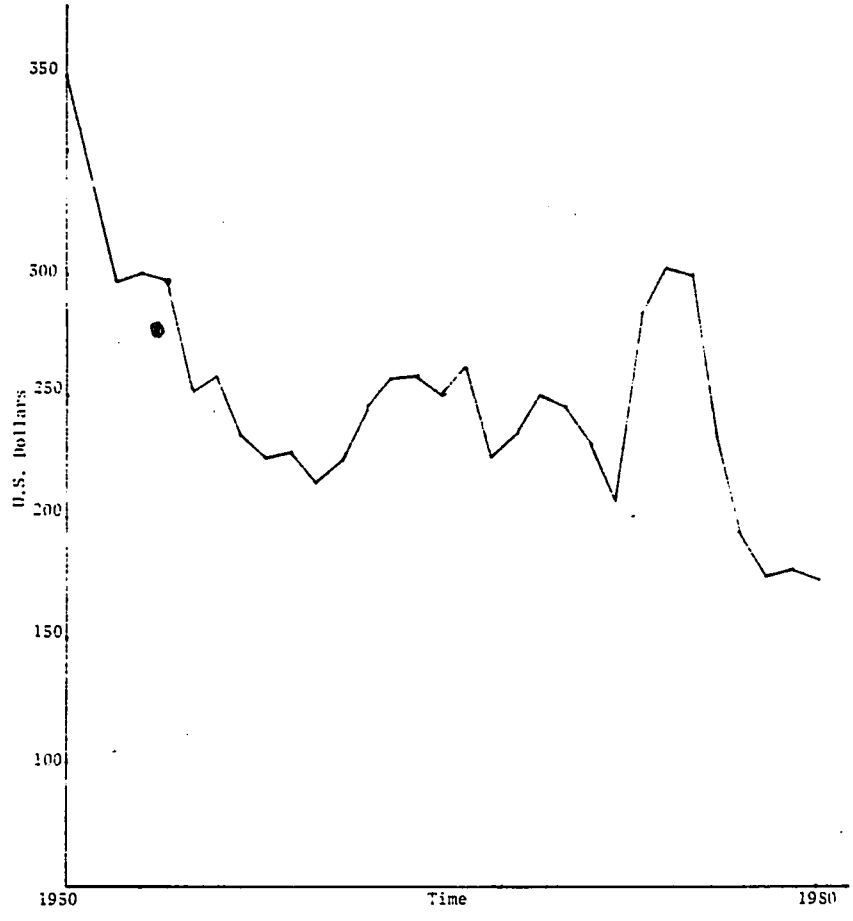

Figure 11. Maize prices in constant dollars.

Table 5. Coefficients of variation for quantity variability.

Country/World	Coefficient of Variation		
	Wheat	Rice	Maize
	0.113	0.104	0.151
Algeria	0.217	0.181	0.185
Bangladesh	0.279	0.055*	0.086*
Brazil	0.241	0.056*	0.082*
Chile	0.117	0.144	0.168
China	0.144	0.060*	0.050*
Egypt	0.074*	0.053*	0.100*
India	0.084*	0.087*	0.089*
Indonesia		0.062*	0.070*
Iran	0.105*	-	0.197
Iraq	0.357	0.201	0.225
Korea	0.157	0.116	0.317
Mexico	0.081*	0.070*	0.057*
Nigeria	0.166	0.186	0.175
Peru	0.122	0.044*	0.104*
Saudi Arabia	0.149	0.293	-
Venezuela	0.089*	0.133	0.120*

*Indicate values lower than world coefficient.

Variability of foodgrain in world markets is represented by variability in world wheat, rice, and maize exports. The data is taken from FAO Trade Yearbooks. Table 3 of the Appendix shows world exports for the three crops over the period 1961-1980. Domestic variability is represented by deviations from yield trends in the biggest LDC importers. Appendix Table 4 shows the yield data for wheat, rice, and maize in sixteen countries.[1] The data is taken from FAO Production Yearbooks covering the 1961-1980 period. It is to be noted that the accuracy of the data is questionable.

For the variability analysis, the yield data is compared with world exports. The implicit assumption underlying this comparison is that growth in population will be accommodated by an increase in the area cultivated. Variability is measured in terms of the deviation of yield from trend. The standard error and the mean are given in the regression analysis carried out for the data. The standard deviation of the regression is divided by the mean coefficient to determine the coefficient of variation. Small values for the coefficient of variation are preferable to large values, since large values indicate higher variability.

In Table 5 the coefficients of variation for world exports are compared to yield variability within each country for wheat, rice, and maize. The coefficient of variation for world wheat exports is 0.113. Only five out of fifteen countries had a coefficient less than that figure - Egypt, India, Iran, Mexico, and Venezuela. Thus in general,

---

1. Countries which spent $500 million or more on cereal imports in 1980 were selected in addition to India, Chile, Peru and Venezuela.

most countries would have experienced higher variability under self-sufficiency programs than from reliance on world exports. A reason for stable yields in Egypt is that all the arable and permanent cropping land in Egypt is under irrigation. In Mexico and India the use of improved varieties may be responsible for reduced variability. The effect of technology on variability remains controversial. Some argue that as yields approach zero, the range over which they can vary necessarily declines. Accordingly, yield increasing technology should then be associated with increasing variability from year to year, particularly if variability is measured in absolute terms. However, a comprehensive USDA study on corn yields over the period 1929-1962 concluded that through the use of better varieties and improved cultivation and fertilizer practices, variation in yield has been reduced in both good and bad weather (see Baker, page 4).

The coefficient of variation for world rice exports is 0.104. Eight out of the sixteen countries have smaller coefficients of variation than world exports. Of those eight, China Egypt, and India[1] are rice exporters, while Mexico was not a larger importer of rice. In 1980, for example, Mexico was not a larger importer of rice. In 1980, for example, Mexico imported only 5899 metric tons. Thus only four countries have yield potentials which suggest improvements for food self-sufficiency programs relative to reliance on world exports. Those four countries are Bangladesh, Brazil, Indonesia and Peru. The same eight countries who show lower variability in rice, plus

---

1. India has been a rice exproter since 1978.

Venezuela, have lesser variability in maize compared to world market variability. India is excluded, since it does not import maize.

To decide on the possibility of food self-sufficiency programs for rice and maize in these countries, the acreage expansion assumption is examined. Table 6 shows the area harvested under rice and maize in 1969/71 compared to 1980 in each of the concerned countries. Mexico, Venezuela, and Peru could be excluded, because of the acreage reduction experienced during this period. The area under maize has also been reduced in the case of Bangladesh. Countries like Bangladesh, Brazil, and Indonesia are potentially capable of maintaining smaller variability in rice than world markets. Brazil, China, Egypt, and Indonesia have the same advantage in maize. Only Egypt, India, and Mexico, show smaller variability - in the three crops - compared to world markets. Thus, food self-sufficiency programs bring more quantity stability in these countries than reliance on trade. India is almost self-sufficient in food grains. In Egypt and Mexico, in spite of their yield stability, resource endowments may jeopardize a successful self-sufficiency in foodgrain. As Hillman (1981) argues, "variability in output can be more severe when self-sufficiency levels are higher than warranted by natural resource endowments."

Price Instability

An empirical test is carried out to compare variability in world prices with variability in domestic prices in the largest importing LDC's under the assumption of self-sufficiency. Data for international constant prices for wheat, rice, and maize were collected

Table 6. Area harvested under rice and maize (1000 ha).

Country	Rice		Maize	
	1969/71	1980	1969/71	1980
Bangladesh	9842	10309	3	2
Brazil	4788	6208	10021	11438
China	31139	34181	16688	19037
Egypt	487	408	634	802
India	37677	40500	5794	5800
Indonesia	8158	9018	2667	2900
Mexico	152	163	7412	7249
Peru	130	96	373	320
Venezuela	120	223	606	458

Source: FAO Production Yearbook 1980, 1981 issues.

from the World Bank publication, Commodity and Price Trends. U.S. f.o.b. prices were used for wheat and maize, and rice prices were represented by Thailand f.o.b. prices. Appendix Table 5 lists these prices. The yield data used for the quantity variability test (Appendix Table 4) is used to create hypothetic domestic prices, because domestic prices are not available. Even if domestic prices were available, they would reflect the use of imported goods to stabilize prices.

The key element to predict the unknown domestic prices is elasticity of demand. However, elasticities of demand for each of the countries is not known. Therefore a range of values for the demand elasticity are assumed. These values enable the calculation of domestic prices using the following procedure.

$$\frac{\%\Delta Q}{\%\Delta P} = \Sigma_D \qquad (1)$$

where

$\%\Delta Q$ = percentage change in quantity demanded

$\%\Delta P$ = percentage change in price

Σ_D = price elasticity of demand. From equation (1):

$$\frac{\%\Delta Q}{\Sigma_D} = \%\Delta P \qquad (2)$$

Since

$$Q_t = Y_t \text{ X } A_t \qquad (3)$$

$$\Delta Q_t = \Delta Y_t \text{ X } A_t \qquad (4)$$

where

Q_t = quantity of production in time (t)

Y_t = yield in kg/hectare in time (t)

ΔQ_t = change in quantity in time (t)

ΔY_t = change in yield in time (t) in kg/ha

A_t = area (in hectare) under production in time (t)

From equations (3) and (4):

$$\frac{\Delta Q_t}{Q_t} = \frac{\Delta Y_t \times A_t}{Y_t \times A_t} = \frac{\Delta Y_t}{Y_t} \qquad (5)$$

$$\%\Delta Q_t = \frac{\Delta Q_t}{Q_t} \times 100 \qquad (6)$$

$$\text{and } \%\Delta P = \frac{\frac{\Delta Y_t}{Y_t} \times 100}{\Sigma \eta} \qquad (7)$$

Equation (7) provides a series of percentage changes in price using the yield data and demand elasticity. The values of (-.3) and (-.9) are assumed for demand elasticities for the three crops in each country. World prices in 1961 were taken as a starting point from which to project the effects of the computed percentage change in prices. This procedure yields negative price values in a few years. In these instances, world prices are substituted for the hypothetical price.

Regression analysis is applied to the world price data and to the created series of prices. Year to year price instability is measured in terms of the deviation of price from trend. The coefficient of variation is determined by dividing the standard deviation by the mean. When the coefficient of variation of the domestic price series

is higher than that of the world prices, that means world prices are more stable and vice versa.

Demand elasticities for foodgrains are usually low. Brandt and Goodwin (1980), in a comparison between two methods of estimating demand elasticities for several commodities, reported that the demand elasticity for cereals in Canada using time series methods equals -.2. Frisch (1959) in his scheme for computing direct and cross elasticities, for cereals in Canada, estimated demand elasticity for cereals as -.1275. Nasol (1971), estimated a range of -.23 to -.47 for demand elasticity for rice in the Phillipines, with a mode of -.3. According to these and other theoretical suggestions, demand elasticities for cereals in the countries under consideration is expected to be very low, since cereals are considered to be the major source of food in LDC's.

Under international trade, consumers can shift from one staple to another traded or domestically produced substitute. Under the assumption of self-sufficiency, however, substitution possibilities may be greatly reduced. According to the homogeneity condition, the sum of the own and cross-price elasticity equals the negative of the income elasticity. If cross-price elasticities approach zero, the own-price elasticity will equal the negative of the income elasticity. Timmer and Alderman (1979) estimated the average income elasticity for rice in Indonesia as .527, but they considered that figure substantially larger in absolute magnitude than most of the standard coefficients reported in the literature. Thus the range of values used for demand elasticities are reasonable to evaluate price instability under self-sufficiency programs.

Table 7 shows coefficients of variation of wheat prices for 15 countries. (Data for wheat yield in Indonesia is not available.) For the fifteen countries, domestic price instability is higher than world price instability if demand elasticities are -.3 or less. Nine of the countries require a range of elasticities of -.6 to -.9 to have price instability as low as that of the world markets. Three countries would need demand elasticity between -.3 and -.6 to achieve greater price stability. The remaining three countries require higher elasticities. In sum, twelve of the fifteen countries would be able to maintain price stability equal to that of the world markets only if the elasticity of domestic demand is higher than -.6.

Table 8 presents the results for rice and maize. Bangladesh, Brazil, China, Egypt, Mexico, and Peru demonstrate lower price instability for rice if demand elasticities were below (-.3). Egypt and China can be excluded, since they are net exporters of rice. Only four countries - Bangladesh, Brazil, Mexico, and Peru - appear potentially capable of maintaining price stability under self-sufficiency, even with low demand elasticities. For maize, no country shows coefficient of variation as low as that of world markets at demand elasticities equal to or less than (-.3). Only Indonesia and Peru could maintain price stability as world markets at elasticities close to (-.3).

Additional tests are provided for Egypt and India, to determine the critical elasticity value that would give the same price variability as that of world markets. For wheat, Table 9 shows a range of (-.3) to (-.5) for Egypt, and (-.6) to (-.9) for India. The results

Table 7. Coefficients of variation for wheat prices.

Country/World	Demand Elasticity			World
World	-.3	-.6	-.9	0.217
Algeria	0.410		0.292*	
Bangladesh	0.857	0.207	0.152	
Brazil	0.700	.564*	0.191	
Chile	0.770	.545*	0.191	
China	1.835	0.333*	0.170	
Egypt	0.313	0.143	0.093	
India	1.114	0.299*	0.163	
Iran	1.380	0.252*	0.139	
Iraq	0.659	0.429*	0.175	
R. of Korea	1.233	0.289*	0.194	
Mexico	1.039	0.272*	0.145	
Nigeria	0.357	0.197	0.141	
Peru	0.426	0.220*	0.144	
Saudi Arabia	0.492	0.361*	0.318*	
Venezuela	0.375	0.156	0.101	

Table 8. Coefficients of variation for rice and maize prices at demand elasticities of (-.3), (-.9).

Country/World	Rice		Maize	
	$\Sigma_D = -.3$	$\Sigma_D = -.9$	$\Sigma_D = -.3$	$\Sigma_D = -.9$
Algeria	0.702*	0.378*	0.616*	0.186*
Bangladesh	0.267	0.067	0.322*	0.097
Brazil	0.188	0.063	0.349*	0.087
Chile	0.405*	0.222	0.802*	0.275*
China	0.134	0.050	0.287*	0.062
Egypt	0.193	0.058	0.275*	0.266*
India	0.439*	0.101	0.667*	0.106
Indonesia	0.347*	0.083	0.184*	0.064
Iran			0.898*	0.168*
Iraq	0.773*	0.574*	0.609*	0.347*
Korea	0.887*	0.106	0.874*	0.364*
Mexico	0.298	0.109	0.300*	0.067
Nigeria	0.388*	0.356*	0.695*	0.305*
Peru	0.228	0.061	0.269*	0.091
Saudi Arabia	0.732*	0.412*		
Venezuela	0.840*	0.418*	0.384*	0.144
World	0.305		0.166	

*Values more than world coefficient of variation.

for Egypt are the most plausible, as self-sufficiency in wheat appears possible. Table 10 shows the acreage under wheat production in Egypt during the period 1960-1979, indicating that even in this case self-sufficiency appears a difficult proposition. Land availability is limited in Egypt, and wheat expansion would primarily replace cotton. The area under cotton production is almost the same as wheat (see Scobie, 1981, p.78). Yet even if the whole area of cotton was planted to wheat, Egypt would still need to import. India shows the potential for self-sufficiency in rice which has been achieved since 1978. For maize, both Egypt and India show larger figures for demand elasticities.

Another procedure is used to test for the effect of yield changes on domestic prices compared to world prices, and considers only the extent of increase or decrease in domestic prices compared to that of world market. The regression residuals are used as indicators for the change in price. The time series analysis gives both negative and positive deviations from the trend line (Figure 12). Negative deviations will result in higher prices while positive deviations indicate decreasing prices.

For wheat, rice, and maize, both negative and positive deviations in each of the fifteen countries were compared to the corresponding deviations in the world exports. In statistical form:

(a) $\frac{\Sigma -e_i/y}{n}$ when $e_i < 0$

and

(b) $\frac{\Sigma e_i/y}{n}$ when $e_i > 0$

Table 9. Coefficients of variation for different values of elasticity for Egypt and India.

Elasticity Values	Egypt			India		
	Wheat c.v.	Rice c.v.	Maize c.v.	Wheat c.v.	Rice c.v.	Maize c.v.
-.3	.313	.193	-	1.114	.439	.667
-.5	.175	.106	1.136	.409	.194	.236
-.6	.143	.088	.633	.299	.156	.179
-.9	.093	.058	.266	.163	.101	.106
-1.0	.085	-	-	-	-	-
-1.5	.054	-	.122	-	-	-
-2.0	-	-	.084	-	-	-
-3.0	.026	.018	.05	.038	-	.029
World coefficient of variation	0.217	0.305	0.166	0.217	0.305	0.166

Table 10. Egypt: Area cultivated under wheat 1960-1979.

	Area (1,000 hectares)
1960	612
1961	581
1962	611
1963	565
1964	544
1965	481
1966	542
1967	530
1968	602
1969	531
1970	551
1971	570
1972	523
1973	525
1974	576
1975	586
1976	586
1977	504
1978	580
1979	585

Source: FAO, Production Yearbook 1960-1979.

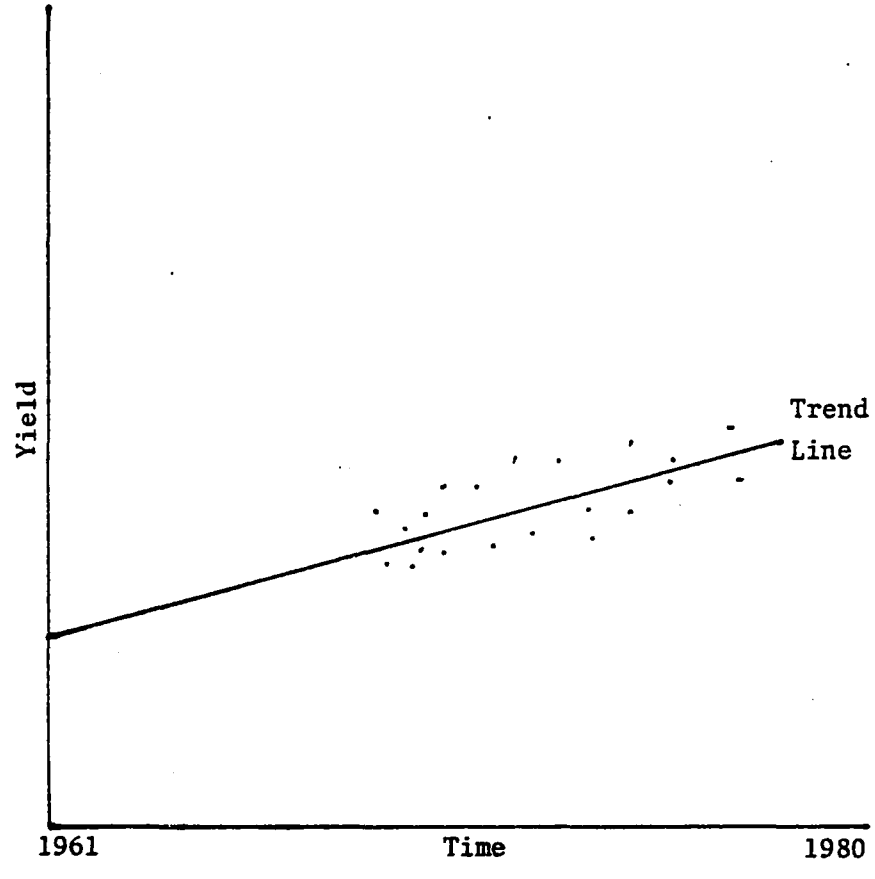

Figure 12 Yield Deviation From the Trend Level

where

$\Sigma -e_i$ = summation of the negative error terms

Σe_i = summation of the positive error terms

y = the fitted values in the trend line which in kg/hectare for the countries and in metric tons for the world exports.

n = number of years used for the analysis, i.e., n = 20.

Table 11 shows the negative and positive average deviations for wheat. According to the negative deviation column, only Egypt, Mexico and Venezuela show negative deviations less than that of the world supply. Accordingly twelve out of fifteen countries would have experienced higher prices than world market when prices were increasing due to shortfall in supply. When supplies were above the trend, however, seven countries would have had lower prices compared to world market.

From Table 12, seven countries show the possibility of maintaining lower prices than world markets in rice when yields were below the trend level. Egypt, China and India can be excluded because they are rice exporters. For the rest, the majority would have experienced higher prices compared to world market. For the positive deviation analysis, only six countries would have been able to maintain lower prices than the world, when supplies exceed their trend level.

For maize, according to the positive deviations column in Table 13, world prices would be lower during surplus years than prices in all countries except Korea. However, the negative deviations column in the same table suggests that eleven out of fifteen countries would

Table 11. Wheat yield. Negative and positive deviations from the trend level compared to world supply.

Country	Average % Negative Deviation	Average % Positive Deviation
World	3.9	4.5
Algeria	7.7*	7.8*
Bangladesh	9.0*	14.4*
Brazil	4.4*	9.5*
Chile	4.9*	4.4
China	4.9*	5.5*
Egypt	2.7	2.7
India	3.6	3.6
Iran	4.3*	4.3
Iraq	11.7*	11.6*
Korea	5.0*	5.0*
Mexico	3.0	2.8
Nigeria	5.8*	5.5
Peru	3.7	3.7
Saudi Arabia	4.9*	4.9*
Venezuela	3.3	3.3

*Indicates values more than world deviation in absolute terms.

Table 12. Rice yields negative and positive deviations from the trend line for 15 countries compared to world supply.

Country	Average % Negative Deviation	Average % Positive Deviation
World	3.6	3.7
Algeria	6.5*	6.9*
Bangladesh	2.2	2.2
Brazil	3.6	2.2
Chile	5.4*	5.4*
China	2.4	2.5
Egypt	2.0	2.0
India	3.4	3.4
Indonesia	2.5	2.7
Iraq	8.2*	7.6*
Korea	4.4*	4.4*
Mexico	2.6	2.6
Nigeria	7.2*	7.2*
Peru	1.7	1.7
Saudi Arabia	10.3*	10.3*
Venezuela	3.9*	4.0*

*Indicates value more than world deviation.

Table 13. Negative and positive deviations of maize yield in 15 countries compared to world supply.

Country	Average % Negative Deviation	Average % Positive Deviation
World	6.0	10.3
Algeria	6.8*	9.0
Bangladesh	3.5	3.5
Brazil	2.9	2.9
Chile	6.9*	6.8
China	1.9	1.6
Egypt	4.0	3.9
India	2.9	2.9
Indonesia	2.7	2.8
Iran	5.3	5.3
Iraq	6.7*	7.6
Korea	9.4*	50.0*
Mexico	2.0	2.0
Nigeria	5.6	4.6
Peru	3.9	3.9
Venezuela	4.4	4.5

*Indicates value more than world deviation.

be able to maintain lower prices compared to world markets when yields were below the trend level.

CHAPTER V

SUMMARY AND CONCLUSIONS

The theory of trade has been presented in Chapter II. It shows that through comparative advantage, trading countries can be better off. Pro-trade writers believe that export expansion provides capital, skills, and technology, and thus increases incomes. Opponents of trade argue that dependence on trade and international markets is harmful to many LDC's economies. Food self-sufficiency is suggested as an alternative policy. LDC's are believed to spend much of their foreign exchange on foodgrain imports, resulting in balance of payments problems. Another objection to trade is the insecurity caused by the variability of supply in the international markets. Shortfalls in quantity affect nutritional status, while instability in international prices makes it difficult for LDC's to plan for the future, and may delay development programs.

According to the results of this study, the cases raised against trade may decrease the gains from trade, but do not eliminate them. First, LDC's do not spend very much on foodgrain imports. The results also show that if those countries were self-sufficient in wheat, rice and maize during the period 1961-1980, the majority of them would have experienced higher quantity variability than world markets. Moreover, the positive deviations from trend in world supplies were higher than negative deviations on the average. In world markets, quantity

variability tended in the positive direction, which implies that world prices are decreasing rather than increasing over time. For price instability, the results do not support self-sufficiency as an alternative policy. Price instability under self-sufficiency would usually have been greater than that in world markets, especially for low values of demand elasticities. The analysis assumed that the acreage increase for foodgrains is proportional to population growth, a generous assumption which favors the self-sufficiency argument. If area fluctuations are allowed, self-sufficiency is even more unlikely to lead to improved price stability. In sum, most of the countries under consideration may achieve higher rates of development through trade rather than food self-sufficiency policy.

Therefore, developing countries' planners must find new policies to overcome the problems caused by international grain markets. Food security could be achieved by maximizing production through improved productivity rather than horizontal expansion at the expense of cash crops. Improved productivity could be achieved through all the policies suggested for self-sufficiency, including price policy, land tenure arrangements and others that could create real incentives for producers. Cash crops are of at least equal importance, since they present the main source of income and foreign exchange in most LDC's. Export sectors thus allow importation of capital goods and technology for the achievement of higher productivity in food crops as well as cash crops. In sum, the construction of an efficient import substitution policy must include cash crops as well as food crops.

APPENDIX A

FOREIGN EXCHANGE EARNINGS, FOOD IMPORTS, YIELDS, AND PRICES TABLES

Appendix Table 1. Total export earnings and food imports. (Millions U.S. $).

Country	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
	TEE[1]	FI[2]	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI
Africa																						
Algeria	1009	34.3	851	52.1	1306	78.5	1889	105	4687	332.9	4700	441.9	5202	337.9	5927	350.7	6345	434.9	8189	484.4	12409	663.7
Benin	33	N.A.	42	N.A.	36	N.A.	44	N.A.	43	2.8	32	2.7	38	6.7	31	11.5	26	4.9	N.A.	13.4	N.A.	17.3
Cameroon	232	8.6	207	7.6	221	7.7	367	9.1	496	19.6	450	16.2	511	14.6	704	23.6	805	26.7	1122	30.3	1375	32.9
Congo	31	1.8	40	2.5	52	2.8	88	4.6	187	11.7	179	15.9	182	16.6	185	10.2	118	11.6	510	15.3	N.A.	19.6
Egypt	762	70.1	789	162.6	825	119.2	1122	171.4	1516	670.2	1402	732.7	1522	564.2	1708	681.5	1737	808.8	1840	773.8	3047	1139.9
Ethiopia	122	5.9	126	4.1	167	0.9	241	3.3	269	1.0	240	0.6	280	3.3	332	23.5	279	16.9	418	12.7	425	69
Ghana	458	17.5	482	9.7	431	9.5	629	22.8	730	40.3	808	20.0	828	40.2	962	59.9	1059	65.3	N.A.	53.1	N.A.	63.7
Ivory Coast	469	15.4	457	11.0	553	15.3	857	38.7	1213	44.4	1188	13.9	1642	22.7	2154	61.5	2324	73.5	2514	101.2	N.A.	124.6
Liberia	236	10.8	247	8.8	270	7.4	324	13.5	400	17.4	394	16.5	457	16.9	448	22.7	486	25.9	537	31.8	601	38.8
Libya	28	28.8	2887	32.8	2477	22.2	3458	39.2	7129	138.8	6041	149.3	8306	139.5	9761	122.6	9503	139.2	15235	176.6	22579	188.5
Madagascar	145	4.6	147	9.5	166	8.9	201	5.8	243	40.9	302	35.2	276	35	338	27.6	387	52.3	394	53.2	N.A.	75
Mauritania	89	7.6	91	9.5	119	10.2	155	11.9	181	18.3	174	25.3	178	25.5	157	24.3	123	27.8	147	28.4	194	35.8
Mauritius	69	11.4	66	10.3	107	13.8	137	15.8	313	55.6	305	39.4	265	46.6	309	29.3	324	38.2	372	39.9	429	55.4
Morocco	488	29.4	502	56.0	643	36.1	912	127.8	1703	185.2	1539	277.1	1262	205.7	1301	169.9	1503	237.9	1869	271.3	2450	351.4
Nigeria	1240	26.5	1830	37.1	2178	44.0	3528	55.1	9692	91.1	7786	100.4	10088	211.6	11781	390.7	10527	715	17732	424.3	26761	509.2
Senegal	152	21.1	125	31.5	216	26.9	194	62.8	391	92.5	462	52.3	485	71.5	513	78.6	422	94.3	535	87.3	477	106.5
Somalia	31	5.9	35	7.2	43	10.9	54	15.0	62	13.7	89	31.5	95	21.9	63	30.2	107	41.6	111	51.8	141	81.2
South Africa	3354	32.9	3511	22.4	4201	16.6	6906	19.5	8770	51.1	8981	37.9	7975	36.2	9988	47.9	12875	43.0	18367	55.0	25684	66.4
Sudan	298	17.0	331	15.6	360	16.1	437	16.5	350	27.5	438	23.2	554	35.5	661	19.1	539	53.9	548	72.5	543	78.5
Tanzania	252	6.0	278	4.8	324	13.1	368	8.6	403	108.7	373	108.4	490	14.6	540	34.3	477	30.7	544	17.5	508	105.5
Tunisia	182	29.5	217	19.8	315	24.1	426	36.7	911	53.4	859	53.4	789	50.3	928	82.5	1125	106.3	1788	145.8	2201	174.2
Upper Volta	18	3.1	16	5.4	20	2.8	25	8.4	36	11.2	43	6.5	53	8.1	55	9.6	42	17.8	76	14.2	90	27.2
Zaire	781	19.3	687	17.5	738	17.5	1013	21.9	1381	58.9	864	69.7	926	89.1	988	67.0	931	83.0	1355	59.2	1626	89.8
Zambia	1001	8.9	679	33.5	758	12.8	1143	20.1	1407	13.4	810	21.2	1050	21.7	897	13.9	845	15.7	1376	38.9	1400	103.8

1/Total Export Earnings

2/Cereal Imports

Appendix Table 1, Continued.

Country	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI
C. America																						
Costa Rica	231	8.9	225	11.1	281	9.4	344	16.5	440	24.7	493	24.8	593	27.2	828	14.9	834	17.7	830	20.7	1002	38.8
Dominican RP	249	4.0	243	8.9	348	12.7	442	31.3	637	69.7	894	57.4	716	61.9	780	48.7	675	40.6	866	33.7	962	65.7
El-Salvador	236	4.0	243	5.5	302	4.5	358	18.2	462	17.0	531	14.9	743	24.3	972	20.5	848	24.8	1226	24.3	967	27.2
Guatemala	298	7.7	290	5.7	338	6.3	444	15	582	23.0	640	26.7	782	30.1	1182	17.4	1113	27.6	1270	30.2	1545	45.6
Haiti	43	4.6	48	5.1	44	5.5	54	11.9	79	18.2	80	19.3	124	28.1	149	36.8	152	30.5	185	37.8	N.A.	47.1
Honduras	181	5.2	194	4.6	210	5.0	261	6.0	289	10.6	295	23.0	400	18.1	513	11.9	607	19.2	732	24.2	756	34.3
Jamaica	340	26.0	345	27.4	375	32.4	390	46.5	604	78.8	759	80.8	630	77.6	768	54.0	796	71.1	818	80.1	965	102.6
Mexico	1403	64.2	1508	17.8	1699	82.0	2261	451.4	2987	507.3	2904	597.7	3469	123.8	4521	323.6	5958	364.9	8983	508.8	15578	1120
Panama	111	2.8	116	9.2	122	5.7	137	9.7	210	7.2	286	12.3	236	10.6	249	11.0	245	8.3	288	12.9	337	21.6
Trinidad etc.	482	14.5	527	16.0	556	15.9	698	21.5	2029	48.4	1787	51.5	2213	52.6	2180	40.6	2021	39.0	2608	52.8	3982	59.2
S. America																						
Bolivia	190	15.6	181	14.7	201	15.5	261	17.2	556	40.2	445	39.7	566	24.8	634	37.3	627	39.7	777	56.2	942	93.0
Brazil	2361	139.5	2907	135.5	3975	154.1	6175	315.7	7919	543.8	8462	373.6	10035	561.8	11814	311.9	12403	789	14605	1132.7	13344	1460
Chile	1249	48.7	997	59.4	855	52.4	1231	102.1	2481	334.7	1661	146.5	2083	220	2190	75.7	2408	167.3	3763	213.9	4818	320.3
Colombia	626	20.1	595	34.2	780	30.0	1010	79.0	1304	95.7	1452	59.8	1563	85.1	2188	78.2	N.A.	53.3	N.A.	126.9	N.A.	179.8
Ecuador	221	7.8	222	9.8	342	11.6	547	18.7	1134	34.4	988	55	1267	50.8	1216	37.6	1502	44.9	2153	64.9	2459	110.7
Guyana	136	4.1	150	4.3	147	4.4	135	7.5	271	11.9	364	12.6	279	17.5	259	10.3	296	8.6	293	11.8	389	16.1
Paraguay	63	4.4	64	3.8	85	3.7	124	9.9	166	11.0	174	4.6	179	9.1	274	5.6	253	4.9	299	8.3	310	11.1
Peru	1048	42.1	893	54.9	944	60.7	1050	109.1	1534	148.6	1280	180.8	1312	156.8	1668	156.8	1930	147.5	3589	209.4	N.A.	360.8
Suriname	136	3.1	165	2.4	171	2.3	179	4.5	190	4.4	242	5.5	276	5.4	310	7.8	411	7.4	444	8.3	514	7.8
Uruguay	233	N.A.	205	8.1	214	8.9	321	18.1	382	.2	383	0.7	546	2.0	607	1.4	688	18.7	788	37.4	1058	7.7
Venezuela	2599	59.6	3087	66.7	3126	69.6	4883	101.7	11071	239.7	8800	186.3	9300	294.2	9551	301.8	9187	249.5	14317	298.7	18772	91.8
Asia																						
Afghanistan	85	12.9	99	36.3	122	20.2	143	8.5	230	N A.	217	1.7	291	1.9	306	8	320	22.7	474	24.7	670	19
Bangladesh	N.A.	147	N.A.	104.5	262	160.0	357	292.4	347	387.1	307	473.6	401	268.7	476	88.0	549	260.2	667	177.7	759	618.8
Cyprus	108	11.5	115	7.4	134	10.3	173	50.0	151	27.1	152	20.5	258	29.5	326	30.0	341	33.4	453	47.3	532	55.7

Appendix Table 1, Continued.

Country	1970		1971		1972		1973		1974		1975		1976		1977		1978		1979		1980	
	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI	TEE	FI
Hong Kong	N.A.	79.1	N.A.	76.2	N.A.	88.5	N.A.	191.1	N.A.	235.4	N.A.	191.7	N.A.	165.7	N.A.	167.7	N.A.	191.0	N.A.	197.2	N.A.	241.7
India	2026	350.4	2034	242.2	2445	57.9	2918	514.5	3923	834.2	4398	1302	5549	1092	6378	218.6	6657	114.1	6945	137.2	5911	25.2
Indonesia	1108	187.3	1234	173.4	1777	202.4	3211	569.7	7426	461.9	7102	396.4	8547	537.7	10853	729.7	11643	686.1	15590	706.7	21908	865.9
Iran	2623	4.6	3826	102.8	3040	90.7	6182	151.5	21575	527.9	20212	551.5	23517	395.4	24259	475.8	22198	615.8	19872	479	13644	797.5
Iraq	847	7.8	1138	112.4	1108	22.0	1944	86.7	6600	266.3	8297	225.1	9271	201.7	9651	278.2	11061	432	21502	613	26351	640
Israel	778	83.9	958	84.9	1147	78.5	1449	142.9	1824	228.3	1941	268.4	2415	242.4	3083	218.4	3922	223.4	4553	282.8	5528	300.2
Jordan	34	15.5	32	16.6	47	23.5	73	27.4	155	37.7	153	32.2	207	67.3	249	73.5	297	74.1	402	110.8	574	101.2
Korea RP	835	243.5	1968	302.2	1624	281.8	3226	405.4	4460	611.7	5081	688.0	7715	424.3	5915	485.6	12718	482.8	15055	752.0	17505	1075
Kuwait	1693	17.1	2271	22.5	2557	22.7	3324	25.5	10330	37.6	86442	77.6	9829	64.0	9793	48.7	10414	74.2	18259	96.3	19967	130.1
Lebanon	192	38.3	247	37.1	377	34.2	608	58.9	1455	66.5	N.A.	99.8	N.A.	52.6	N.A.	90.0	N.A.	99.3	N.A.	121.6	N.A.	122.1
Mongolia	N.A.	9.3	N.A.	2.7	N.A.	4.8	N.A.	9.0	N.A.	5.3	N.A.	6.8	N.A.	10.9	N.A.	16.1	N.A.	9.5	N.A.	16	N.A.	14.2
Pakistan	397	10.9	467	15.6	646	50.8	954	106.5	1108	162.1	1052	223.4	1167	180.3	1188	66.7	1475	135.3	2056	354.0	2618	105.9
Philippines	1047	44.5	1098	73.6	1102	94.1	1798	109.9	2719	142.3	2267	156.2	2572	143.1	3150	102.5	3424	99.2	4533	115.3	5742	186.8
Saudi Arabia	2360	67.7	3477	68.3	4560	67.5	7684	77.5	31242	162.7	28005	199.5	36436	242	41207	230.1	37866	442.7	57620	616.5	102471	992.3
Singapore	1554	63.2	1762	56.5	2189	78.4	3645	109.8	5809	168.3	5380	143.3	6583	128.7	8236	155.8	10108	167.0	14234	230.6	19362	277.7
Sri Lanka	342	99.2	344	71.7	336	64.6	411	118.6	527	255.2	563	314.7	572	171.9	718	223.3	845	185.9	982	183.7	1079	187.4
Syria	203	44.0	207	68.3	299	29.8	351	29.9	78	100.2	930	78.5	1075	55.1	1070	82.0	1060	3.8	1644	106.6	2108	205.4
Thailand	710	5.9	831	5.6	1081	7.3	1563	11.7	2444	21.4	2208	14.8	2980	26.5	3490	13.5	4085	20.4	5298	25.2	6508	31.6
U.A. Emirates	510	N.A.	835	N.A.	1082	N.A.	1801	N.A.	6392	9.5	6970	16.5	8684	21	9636	43.4	9126	50.1	13634	116.4	20694	93.7
Yemen AR	3	8.2	4	7.5	4	8.7	8	14.2	13	36.3	10	57.3	7	96.2	11	40.2	6	76.4	13	68.5	N.A.	81.5
Yemen DR	135	17.8	95	7.7	96	9.7	100	13.6	227	39.9	171	23.6	177	23.9	180	27.7	221	60	248	39.3	N.A.	69.0

Appendix Table 2. The ratio of cereal import costs to the total export earnings for selected third world countries for the period 1970-1980.

Average	Country	70	71	72	73	74	75	76	77	78	79	80
	Africa											
.062	Algeria	.034	.061	.06	.056	.071	.094	.065	.059	.069	.059	.053
.177	Benin					.065	.084	.177	.368	.192		
.032	Cameroon	.037	.037	.035	.025	.04	.036	.029	.034	.033	.027	.024
.065	Congo	.058	.064	.053	.053	.062	.089	.091	.055	.099	.03	
.326	Egypt	.092	.206	.144	.153	.442	.523	.371	.399	.466	.421	.374
.040	Ethiopia	.048	.032	.006	.014	.004	.003	.012	.071	.06	.03	.162
.041	Ghana	.038	.020	.022	.036	.055	.025	.049	.062	.062	NA	NA
.029	Ivory Coast	.033	.024	.028	.045	.037	.012	.014	.029	.032	.040	NA
.046	Liberia	.046	.036	.028	.042	.043	.042	.037	.051	.053	.059	.065
.014	Libya	.010	.011	.009	.011	.019	.025	.017	.013	.015	.012	.008
.094	Madagascar	.032	.064	.054	.029	.168	.117	.127	.082	.135	.135	NA
.136	Mauritania	.086	.104	.086	.077	.101	.145	.143	.155	.226	.194	.184
.136	Mauritius	.165	.156	.128	.115	.177	.129	.176	.095	.118	.107	.129
.127	Morocco	.060	.112	.056	.140	.109	.180	.163	.131	.158	.145	.143
.024	Nigeria	.021	.020	.020	.016	.009	.013	.021	.033	.068	.024	.019
.191	Senegal	.139	.252	.125	.323	.237	.113	.147	.153	.223	.163	.223
.332	Somalia	.188	.209	.254	.277	.221	.356	.232	.480	.390	.467	.576
.005	South Africa	.010	.006	.004	.003	.006	.004	.005	.005	.003	.003	.003
.072	Sudan	.057	.047	.045	.038	.079	.053	.064	.029	.100	.132	.145
.097	Tanzania	.024	.017	.040	.023	.2695	.291	.030	.064	.064	.032	.208
.086	Tunisia	.162	.091	.076	.086	.059	.062	.064	.089	.094	.082	.079
.244	Upper Volta	.173	.341	.139	.336	.310	.149	.153	.173	.419	.186	.302
.052	Zaire	.025	.026	.024	.022	.043	.081	.096	.068	.089	.044	.055
.026	Zambia	.009	.049	.017	.018	.010	.026	.021	.015	.019	.028	.074

Table 2, Continued.

Average	Country	70	71	72	73	74	75	76	77	78	79	80
	Asia											
.099	Afghanistan	.151	.364	.165	.059	NA	.062	.007	.026	.071	.052	.028
.722	Bangladesh	NA	NA	.610	.819	1.114	1.543	.671	.185	.474	.267	.815
	China	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
.124	Cyprus	.106	.064	.077	.289	.181	.135	.114	.092	.098	.104	.105
.116	India	.173	.119	.024	.176	.213	.296	.197	.034	.017	.020	.004
.09	Indonesia	.169	.141	.114	.177	.062	.056	.063	.067	.059	.045	.040
.026	Iran	.002	.027	.030	.025	.024	.027	.017	.020	.028	.024	.058
.035	Iraq	.009	.099	.020	.045	.040	.027	.022	.029	.039	.029	.024
.088	Israel	.108	.089	.068	.099	.125	.138	.100	.071	.057	.062	.054
.329	Jordan	.455	.517	.495	.373	.243	.210	.325	.295	.250	.275	.176
.130	Korea RP	.292	.283	.174	.126	.137	.135	.055	.082	.038	.050	.061
.007	Kuwait	.010	.010	.009	.008	.004	.009	.007	.005	.007	.005	.007
.117	Lebanon	.200	.150	.091	.097	.046	NA	NA	NA	NA	NA	NA
.015	Oman	NA	NA	NA	NA	.013	.012	.001	.019	.026	.016	.007
.102	Pakistan	.028	.033	.079	.112	.146	.212	.155	.056	.092	.172	.040
.050	Philippines	.043	.067	.085	.061	.052	.069	.056	.033	.029	.025	.033
.012	Saudi Arabia	.029	.020	.015	.010	.005	.007	.007	.006	.012	.011	.010
.026	Singapore	.041	.032	.036	.030	.029	.027	.0195	.019	.017	.016	.014
.292	Srilanka	.290	.209	.192	.289	.484	.559	.301	.311	.221	.187	.174
.120	Syria	.217	.331	.100	.085	.128	.084	.051	.077	.079	.065	.097
.014	Thailand	.008	.007	.007	.007	.009	.007	.091	.004	.006	.009	.005
.004	U.A. Emirates	NA	NA	NA	NA	.001	.002	.002	.004	.006	.009	.005
4.898	Yemen AR	2.852	1.874	2.205	1.826	2.734	5.262	12.577	3.623	11.143	5.065	NA
.148	Yemen DR	.132	.081	.101	.136	.175	.138	.135	.153	.271	.158	NA

Table 2, Continued.

Average	Country	70	71	72	73	74	75	76	77	78	79	80
	Central America											
.039	Costa Rica	.039	.049	.033	.048	.056	.050	.046	.018	.021	.025	.039
.059	Dominican Republic	.016	.037	.037	.071	.110	.064	.086	.062	.062	.039	.068
.027	El-Salvador	.017	.023	.015	.051	.037	.028	.033	.021	.029	.020	.028
.028	Guatemala	.026	.020	.019	.034	.039	.042	.038	.015	.025	.024	.030
.190	Haiti	.107	.107	.123	.219	.229	.239	.226	.246	.201	.204	NA
.036	Honduras	.029	.024	.024	.023	.037	.078	.045	.023	.032	.033	.045
.098	Jamaica	.076	.079	.086	.119	.131	.106	.123	.070	.089	.098	.106
.089	Mexico	.046	.012	.048	.200	.170	.206	.036	.072	.061	.057	.072
.048	Panama	.026	.079	.046	.070	.034	.043	.045	.044	.034	.045	.064
.025	Trinidad etc.	.030	.030	.029	.031	.024	.029	.024	.019	.019	.020	.015
	South America											
.073	Bolivia	.082	.081	.077	.066	.072	.089	.044	.059	.063	.072	.099
.058	Brazil	.059	.047	.039	.051	.069	.044	.056	.026	.064	.078	.109
.073	Chile	.039	.060	.061	.083	.135	.088	.106	.035	.069	.057	.066
.051	Colombia	.032	.057	.038	.078	.073	.041	.054	.036	NA	NA	NA
.037	Ecuador	.035	.044	.034	.034	.030	.056	.040	.031	.030	.030	.030
.040	Guyana	.030	.029	.030	.055	.044	.035	.063	.040	.029	.040	.041
.045	Paraguay	.070	.059	.043	.080	.066	.026	.051	.020	.019	.028	.036
.085	Peru	.040	.061	.064	.104	.097	.141	.119	.094	.076	.058	NA
.020	Suriname	.023	.014	.014	.025	.023	.023	.019	.025	.018	.019	.015
.022	Uruguay	NA	.039	.042	.056	.0005	.002	.004	.002	.027	.047	.007
.024	Venezuela	.023	.022	.022	.021	.022	.021	.032	.032	.027	.021	.026

Appendix Table 3. World cereal exports 1961-1980 (MT).

Year	Wheat & Flour	Rice	Maize
1961	46,131,631	6,622,547	14,010,361
1962	44,866,696	6,436,989	19,919,364
1963	49,674,438	7,420,148	21,100,083
1964	59,193,751	7,856,490	22,302,124
1965	56,371,937	8,112,371	25,051,918
1966	62,737,335	7,840,073	25,813,851
1967	52,871,737	7,466,673	27,538,052
1968	53,266,523	6,879,379	28,844,082
1969	48,611,224	8,428,280	27,471,591
1970	57,144,623	8,820,692	29,432,055
1971	58,497,286	9,305,392	30,965,086
1972	64,941,833	9,055,787	37,395,667
1973	81,570,081	9,366,413	48,059,154
1974	65,367,454	8,783,659	49,654,576
1975	73,620,136	7,755,265	51,285,182
1976	68,938,078	8,992,618	62,027,177
1977	74,464,474	10,849,525	57,487,429
1978	84,868,232	9,685,852	68,754,443
1979	82,081,799	11,855,805	76,123,991
1980	99,374,867	12,712,791	79,779,833

Appendix Table 4. Yield data.

Wheat yield (kg/ha) (1961-1980).

Country/ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Algeria	406	804	833	532	606	425	633	681	603	625	634	837	493	546	450	710	434	581	555	551
Egypt	2470	2606	2642	2755	2644	2703	2451	2535	2405	2756	3041	3091	3502	3273	3472	3327	3335	3323	3177	3225
Nigeria	2667	2667	2667	2727	2727	3125	2857	2778	2857	3500	2333	2333	2000	2000	1440	1538	1556	1556	1500	1500
Mexico	1676	1946	2079	2056	2144	2218	2744	2539	2850	3066	2897	2660	3265	3602	3596	3761	3464	3666	3907	3362
Brazil	533	949	494	877	764	857	757	883	976	973	886	424	1104	1157	610	908	655	957	764	831
Chile	1340	1261	1512	1549	1535	1726	1675	1742	1634	1765	1881	1679	1399	1645	1461	1242	1942	1540	1776	1770
Peru	1003	994	997	959	958	912	934	831	914	920	882	1010	701	755	945	952	889	1054	1184	943
Venezuela	540	526	525	554	581	500	515	476	372	377	433	443	460	398	367	405	356	381	313	375
Bangladesh	574	636	607	601	647	646	809	758	796	874	886	904	756	897	926	1454	1621	1842	1866	2469
China	672	870	901	1000	960	952	1022	986	1040	1099	1140	1202	1254	1276	1367	1452	1286	1962	2139	1934
India	851	890	793	730	913	824	887	1103	1169	1209	1307	1380	1271	1172	1338	1410	1387	1480	1568	1437
Iran	844	810	726	709	912	996	1050	804	824	836	726	900	902	904	929	1073	1103	1018	1055	1091
Iraq	637	682	286	496	590	476	467	913	712	703	867	1544	828	820	601	875	811	608	503	722
Korea RP	2261	2015	1663	2117	1978	2062	2043	2191	2391	2261	2270	2371	2310	2034	2218	2223	1684	2089	3206	3286
Saudi Arabia	1412	1444	1350	1471	1479	1488	1500	1300	1500	1500	1230	1200	2000	1800	2126	1255	1740	2002	1765	1765

Appendix Table 4, Continued.

Rice yield (kg/ha) (1961-1981)

Country/ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Algeria	4551	4444	4404	3827	2911	2891	2665	3133	3407	1611	2650	2571	2006	2471	2759	2558	2472	1737	1747	1714
Egypt	5053	5840	5506	5040	5025	4727	5040	5110	5102	5427	5305	5208	5430	5068	5480	5077	5208	5422	5756	5752
Nigeria	793	1178	1210	1228	1228	1429	1468	1496	1255	1633	1706	1127	1221	1221	1717	1921	1991	1764	1245	1318
Mexico	2275	2158	2199	2070	2734	2373	2480	2440	2529	2682	2642	2452	2996	2707	2792	2907	3144	3312	3344	2846
Brazil	1699	1659	1542	1517	1641	1449	1583	1492	1384	1517	1384	1491	1495	1557	1428	1452	1501	1297	1395	1570
Chile	2721	2834	2570	2633	2911	2079	3006	2878	2268	3023	2461	3357	2964	2495	3338	3415	3384	3210	3849	2337
Peru	4093	4311	3707	4276	3878	3901	4325	3767	4046	4120	4012	4160	4095	4070	4383	4284	4251	4251	4376	4130
Venezuela	1380	1495	1779	1827	1902	1772	1951	2123	2056	1737	1359	2521	2671	2528	3196	2980	2991	3019	2995	3048
Bangladesh	1700	1530	1769	1707	1683	1583	1776	1745	1746	1686	1602	1572	1808	1729	1853	1784	1939	1938	1820	2032
China	2600	2784	2769	2849	2898	2866	2902	2876	2923	3074	3137	3118	3224	3266	3507	3518	3492	4095	4249	4163
India	1542	1396	1550	1617	1304	1295	1548	1613	1609	1685	1711	1605	1726	1567	1858	1637	1961	2069	1632	2049
Indonesia	1762	1786	1723	1763	1771	1775	1759	1852	1941	2361	2270	2259	2558	2632	2629	2784	2794	2887	2985	3187
Iran	2143	2833	2867	3077	3650	3750	4149	3816	2939	2789	3175	3158	3511	3450	3102	3404	3043	4063	4733	3833
Iraq	1073	1246	1330	1684	1571	1644	2190	3243	3000	2416	2812	2978	2449	2206	2026	3117	3138	3143	3545	2750
Korea RP	4148	3577	4397	4472	3963	4426	4055	3859	4662	4552	4631	4618	4954	5129	5324	5966	6862	6790	6392	4918
Saudi Arabia	1750	1767	2849	2500	2333	2364	2364	2364	2364	2364	2364	2364	2364	1000	1000	1000	3000	3000	3000	3000

Appendix Table 4, Continued.

Maize yield (kg/ha) (1961-1980)

Country/ Year	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Algeria	975	540	1072	1170	1100	819	1095	1144	1017	1024	1000	1000	1179	1351	1806	1279	1223	1081	1117	1400
Egypt	2401	2604	2582	2772	4070	3589	3451	3511	3783	3784	3657	3747	3605	3579	3617	3836	3674	3910	3714	4029
Nigeria	800	880	810	820	830	820	750	1150	1040	1040	739	829	437	754	752	837	833	904	901	931
Mexico	993	995	987	1133	1158	1119	1130	1167	1194	1219	1323	1338	1228	1268	1264	1182	1357	1520	1477	1529
Brazil	1312	1305	1309	1161	1381	1307	1383	1337	1315	1442	1339	1413	1424	1582	1562	1597	1632	1220	1442	1782
Chile	1954	2138	2087	2740	3079	3536	3928	3623	2632	3237	3355	3350	3403	3411	3594	2579	3075	2736	3752	3487
Peru	1377	1390	1419	1449	1627	1640	1636	1691	1607	1609	1649	1957	1433	1474	1751	1883	1805	1629	1850	1328
Venezuela	1079	1118	1008	1072	1128	1194	1028	1055	1046	1207	1214	1089	1035	1198	1291	1089	1561	1588	1634	1275
Bangladesh	799	738	772	753	753	837	837	941	941	941	861	718	849	888	902	897	841	799	773	773
China	2166	2471	2532	2586	2628	2628	2680	2680	2692	2761	2830	2714	2858	2870	2990	2999	2500	2790	2981	2980
India	957	992	995	1010	1005	964	1123	997	968	1279	900	1094	965	948	1203	1060	1051	1076	970	1103
Indonesia	927	1021	921	1034	943	984	930	983	942	961	992	1044	1075	1137	1187	1228	1224	1332	1390	1241
Iran	875	875	875	1000	1000	1050	1200	1200	1000	1000	1000	1000	1250	1500	2167	1143	1375	1395	1357	1429
Iraq	631	691	741	903	903	1066	1075	1127	1188	1204	1230	1770	1911	1785	2480	3168	2602	2927	2429	1857
Korea RP	679	680	649	809	809	796	1191	1486	1400	1454	1617	1518	1689	1654	1728	2194	2740	3246	4587	4600
Saudi Arabia	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	5176	5200	5500	5500	714	756	643	1624	1600	1600

Appendix Table 5. World export prices for wheat, maize and rice (in 1980 U.S. constant dollars).

Year	Wheat[1/]	Maize[2/]	Rice[3/]
1961	224.5	173.2	515.1
1962	228.6	196.2	583.2
1963	224.2	207.2	542.8
1964	237.3	208.2	513.8
1965	211.3	200	495.6
1966	221	211.4	580.8
1967	216.5	175.1	722.1
1968	218.7	183.9	755.1
1969	209.7	201.1	697.4
1970	191.9	196.6	484.9
1971	193.5	181.9	401.9
1972	195.8	158.6	416.4
1973	324.9	232.8	831.4
1974	341.0	252.9	1038.3
1975	231.4	200	607.2
1976	201.8	184.9	418.6
1977	144.7	144.4	412.4
1978	159.9	128.9	470.6
1979	174.6	129.1	373.4
1980	168.3	125.3	433.9

1/and 2/ According to U.S. fob prices.
3/According to Thailand fob prices.
Source: World Bank (Commodity Trade and Price Trend August 1981)

LITERATURE CITED

Abbot, P. C. 1979. Modeling international grain trade with government controlled markets. Amer. J. Agr. Econ. 61(1): 22-31.

Barr, Terry L. 1981. World food situation. Science 214 (4525): 1087-1095.

Brandt, J. A., and J. B. Goodwin. 1980. The impact of increasing food supply on human nutrition: Implication for commodity priorities in agricultural research and policy. Amer. J. Agr. Econ. 62(3): 589-590.

Burki, S. J., and T. J. Goering. 1977. A perspective on foodgrain situation in the poorest countries. World Bank Staff Working Paper No. 257.

Caves, R. E., and W. Jones. 1977. World Trade and Payments: An Introduction. 2nd ed. Boston: Little Brown. Chapters 2-3.

Food and Agriculture Organization of the United Nations (FAO) Production Yearbook. (1974, 75, 76, 77, 78, 79, 80, 81).

Food and Agriculture Organization of the United Nations (FAO. Trade Yearbook (1974, 75, 76, 77, 78, 79, 80).

Food and Agriculture Organization of the United Nations (FAO). 1974. The world food problem: Proposals for national and international actions. United Nations World Food Conference, item 9 of provisional agenda. 66-67. Rome.

Frich, R. 1959. A complete scheme for computing all direct and cross demand elasticities in a model with many sectors. Econometrica. 27: 177-196.

Green, R., Z. A. Hassan, and S. R. Janson. 1978. Alternative estimates of static and dynamics demand systems for Canada. Amer. J. Agr. Econ. 60: 93-107.

Hillman, J. S. 1981. The role of export cropping in less developed countries. Amer. J. Agr. Econ. 63(2): 375-383.

International Monetary Fund. International Financial Statistics. Monthly issues and Yearbooks (1978-1982).

Jabara, C. L., and R. L. Thompson. 1980. Agricultural comparative advantage under international price uncertainty: The case of Senegal. Amer. J. Agr. Econ. 62(2): 188-197.

Kravis, Irving. 1970. Trade as a handmaiden of growth: Similarities between the Nineteenth and Twentieth centuries. Econ. J. 80 (320): 850-70.

Lappe, F. M., J. Collins, and C. Fowler. 1977. Food First. Houghton Mifflin Company, Boston. 373-412.

Michaely, Michael. 1977. Exports and development: An empirical investigation. Journal of Development Economics 49-53.

Morton, K., and P. Tulloch. 1977. Trade and Developing Countries. Overseas Development Institute, London 332.

Nasol, R. L. "Demand Analysis for Rice in the Phillipines". J. Agr. Econ. and Development. 1(1971): 1-13.

Organization for Economic Co-operation and Development. 1976. Study of trends in world supply and demand of major agricultural commodities. Paris. Chapters 4,5.

Paarlberg, R. L. 1980. Lessons of the grain embargo. Foreign Affairs. 59(1): 144-162.

Schmitz, A., and A. F. McCalla. 1981. Analysis of imperfection in international trade: The case of grain export cartels. Imperfect Markets in Agricultural Trade. Mecalla, A. F., and T. E. Josling. ed. Allanheld, Osman and Co. Montclair. 69-84.

Schmitz, A., A. F. McCalla, D. O. Mitchell, and C. Carter. 1981. Grain Export Cartels. Ballinger Publishing Company, Cambridge, Massachusetts. 97-101.

Scobie, G. M. 1981. Government Policy and Food Imports: The case of wheat in Egypt. International Food Policy Research Institute.

Siamwalla, Ammar, and A. Valdes. 1980. Food insecurity in developing countries. Food Policy 265.

Timmer, P., and H. Alderman. 1979. Estimating consumption parameters for food policy analysis. Paper presented at the American Agricultural Economics Association. Summer meetings. Pullman, Washington 7.

United States Department of Agriculture. 1981. World indices of agriculture and food production. U.S.D.A. Economic Research Service: Statistical Bulletin No. 669, Washington, D.C.

World Bank. 1981. Commodity and Price Trend.

The World Food Institute. 1981. World food trade and U.S. agriculture, 1960-80. Iowa.

Yeats, A. J. 1979. Trade Barriers Facing Developing Countries. New York. 34.