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Staff Paper Series

STAFF PAPER P71-20

NOVEMBER 1971

THE GREEN REVOLUTION: ITS IMPACT ON TRADE AND  
AGRICULTURAL POLICY IN DEVELOPED NATIONS

by

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Staff Paper P71-20

November 1971

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Staff Papers are published without formal review within  
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Introduction

The dramatic upward sweep in food grain production among several nations in South and Southeast Asia has gripped the attention and the imagination of statesmen and scholars all over the world. Almost every economic aspect of this revolution is open for debate and disagreement. But there is at least one area of general agreement: it is that the new agricultural technologies have pushed several less-developed former food grain importers to self-sufficiency in the 1960's and probably will do the same with other nations well into the 1970's. This thrust in productivity is already having important repercussions on the agriculture and the agricultural policy of the developed, temperate zone nations which produce and export food grains to world markets.<sup>1/</sup>

The international trade aspects of this so-called Green Revolution bring the interests of developed nations and less-developed nations into

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\* Paper presented at the Japan Economic Research Center Conference on Agriculture and Economic Development held in Tokyo and Hakone, September 6-10, 1971.

direct clash, at least in the short run. This clash occurs on three levels. First, rapidly growing food grain output in some less-developed nations means less opportunity for both commercial and concessional exports of food grains to these nations by grain-producing developed nations. Second, it means that at least a few previously deficit nations may become regular or intermittent sellers on international wheat and rice markets. This will intensify already stiff competition and downward price pressures in a shrinking world market already plagued by protectionism and surpluses among its richer participants. Third, less-developed nations which depend heavily on food grain exports will face glutted world markets and may have to compete intensively for sales with subsidized grain from wealthy exporters. Thailand, in particular, faces this third problem with rice.

The major objective of this paper is to discuss the nature and extent of these problems. The analysis is complicated by concurrent agricultural policy developments, also associated with self-sufficiency, now going on in developed food grain importing nations such as Japan and the member nations of the European Economic Community.<sup>2/</sup>

The main focus is on the agricultural problems and policies of the developed nations as they react to increased grain production in the less-developed world, especially in South and Southeast Asia. In particular, we argue that the agricultural trade and policy problems confronting the wealthier nations will be intensified, in the short run, by the production successes of the Green Revolution. Moreover, we suggest that as agricultural policy problems intensify, especially with food grains, political pressures will

grow for increased protection for producers in both import and export nations.

The data suggest that up to now the new seeds and new technologies have been most widespread in wheat production with rice in second place. (1, 3, 4, 6, 7, 23) Emphasis in this paper is on international wheat markets. Wheat is the food grain most closely related to agricultural policy problems in the United States, Canada, Australia, and Western Europe.<sup>3/</sup> The rice policy problems in Japan parallel very closely to the wheat policy problems of the EEC, and both sets of problems are intensified by mounting wheat and rice self-sufficiency among the less-developed nations.

The future time horizon of our discussion is rather vague. There are simply too many unknowns to accommodate precision. Generally speaking, we refer to the period spanning the 1960's and extending through the 1970's. Beyond, say 1980, no one can predict reasonably.

The biological, technical, and economic aspects of the Green Revolution within the nations moving toward self-sufficiency receive scant attention. This topic is best left in other hands. However, some comments later in the paper concerning possible future policy moves by developed nations hinge on assumptions about the nature and direction of changes in marketing and economic organization within developing nations. At the moment, it is enough to say that food grain self-sufficiency is a fact for several nations and is likely to occur very soon for several others. Let us now briefly assess the status of agricultural problems and policies in the developed world, especially regarding food grains.

### Agricultural Problems and Policy in Developed Nations

The basic agricultural problems reflected in the food grain sectors of the United States, Canada, Australia, the European Community, and, to a large extent, Japan have many similarities. A partial list of these problems includes:

- (1) excess production capacity (or supplies) at current internal price levels
- (2) constant political pressure to maintain or increase farm incomes
- (3) pressure to maintain or expand export outlets (both commercial and non-commercial) in order to alleviate domestic grain surpluses and to earn foreign exchange.

Attempts to deal with these problems and others, have produced a series of complex commodity programs for food grains and other agricultural products. Specific policy objectives and program details naturally differ from nation to nation.<sup>4/</sup> Each set of programs is designed to attain the broad policy goals of individual nations and to advance the interests of controlling political forces.

#### Policy Goals

Policy goals and priorities depend upon the immediacy of particular problems and upon political pressures exerted within nations and from external sources. For example, food grain policy goals in the United States involve supply restraint, farm income protection, export expansion, and government cost reduction. Both humanitarian and surplus disposal goals are evident in the establishment and operation of the Public Law 480

concessional export program in which food grains, mainly wheat, wheat flour, and rice have formed the bulk of the shipments to food-short nations.

Food grain policy goals in Canada and Australia, especially for wheat, are broadly similar to one another. (21, 29) Both nations have been historic export producers at approximately world prices. Farm incomes traditionally have been reasonably comparable to non-farm incomes in each country so no strong pressures have developed to redistribute income to food grain producers from elsewhere in the economy. Both nations rely importantly on agricultural exports to finance internal economic growth. Consequently, policy goals stress export expansion and development. Until recently, shielding producers from wide income fluctuations caused by weather and external price variation also was a major policy objective. At the moment, supply control and farm income protection are emerging as major policy goals in both Canada and Australia in the face of food grain surpluses and low prices in world market.

The broad agricultural policy goals for the EEC as specified in the 1957 Treaty of Rome involve (1) increasing agricultural productivity, (2) insuring a fair standard of living for the rural population, (3) stabilizing markets, (4) assuring regular supplies, and (5) maintaining reasonable consumer prices. However, during the decade of the Community's active life, emphasis has focused on protecting and raising farm income through market prices and on guaranteeing domestic food supplies by means of greater self-sufficiency. Priority has been given to production and marketing goals within the Community. Agricultural trade policy, for



both imports and exports, has been designed to serve internal price and production objectives despite vigorous and often bitter protests from non-member nations.

Apparent policy goals for food grains in Japan currently parallel those for the EEC rather closely, with rice the staple rather than wheat. (15, 21, 26, 29) Income protection for farmers and rice self-sufficiency for the country seem to be the major goals. Like the European Community, Japan recently has emerged as a surplus food grain producer. Also similar to the EEC, Japanese agricultural policy is now moving toward finding export outlets for excess food grains and exploring methods of production restraint.

### Policy Tools

The specific programs and mechanisms used by these developed nations in attempting to cope with their food grain problems naturally differ. Each of these developed countries is fortunate enough to be able to afford agricultural programs which, to some extent, transfer income from the non-farm sector to the farm sector. This transfer may come from consumers via high prices, from taxpayers via direct payments or export subsidies, or via some combination of the two. Less-developed nations which face agricultural problems usually cannot afford these income-transfer luxuries.

The principal policy tools employed for food grains may be classified into seven categories on the basis of their operational details.

- (1) price supports or guarantees
- (2) direct income payments
- (3) production controls

- (4) import controls
- (5) export subsidies
- (6) market discrimination between domestic and export outlets
- (7) concessional export or domestic disposal programs

Individual country or commodity programs typically involve the use of two or more of these tools simultaneously. For example, the availability of wheat price supports to individual U.S. farmers is contingent upon their compliance with acreage controls. Export subsidies by the EEC together with import controls are the Community's principal means of executing market discrimination between domestic and export outlets for wheat.

Some form of price supports or guarantees is common to each of the developed food grain producers under consideration here. Presently, some form of production control is being practiced in the United States, Canada, Australia, and Japan. Until recently, the United States was the only major exporter to attempt output restraint through administrative mechanisms. All of these wealthier suppliers protect domestic markets by means of import controls and subsidize exports either directly or indirectly. All of them support wheat for food at higher internal prices than wheat for feed.

Domestic marketing is handled by private firms in the United States and, to a large extent, in the European Community but is the responsibility of governmental or quasi-governmental boards in Canada, Australia, and Japan. In Japan, rice is sold to consumers at lower prices than paid to farmers (for equivalent quantities). The financial loss is sustained by the Food Agency of Ministry of Agriculture and Forestry which handles all internal

marketing. Each of these developed nations now operates some form of concessional export sales or donation program to the less-developed world. These programs are discussed in a separate section.

Canada. The Canadian Wheat Board guarantees floor prices for a given quantity of wheat annually based on expected market needs. This floor price is reflected in an initial payment made to producers by the Board. Some production control is achieved in two ways. First, delivery quotas assigned to individual producers restrict the quantities which can be marketed in given time periods; hence, surplus production is backed up on farms. Second, beginning in 1970, a program of land diversion payments and grain delivery quotas linked to acreage diversion into forage and fallow was begun. Changes are occurring in Canadian grain policy at this time, but future policy will probably continue to emphasize output limitation and acreage diversion. (11, 31)

No direct export subsidies are paid, but imports are controlled by tariffs. Since mid-1969, wheat for domestic food use has been sold by the Board at prices higher than for exports or feed use.

Australia. The Australian Wheat Board supports prices to producers through a two-price scheme generally similar to the Canadian method. A "home consumption" price applies to domestic food wheat. A lower "guaranteed price" applies to domestic feed wheat and a fixed quantity of export wheat. (5, 11, 29, 36) When export and domestic receipts are lower than needed to sustain the guarantees, funds are drawn from stabilization reserves secured from wheat export duties and from general

government funds. No direct production controls are imposed, but beginning in 1969, production has been discouraged by limited delivery quotas which force over-quota output to be held on farms or disposed of by illegal means. Import tariffs are applied to help maintain internal prices.

United States. A two-price scheme together with output restraint in wheat summarizes the complex United States program. Although U.S. grain marketing and processing is in private hands, higher prices for domestic food wheat are sustained by a tax paid by processors on each bushel of wheat milled for domestic use. Feed wheat and export wheat move at prices closely linked to world levels. Heavy export subsidies for wheat were a prominent feature of U.S. policy in the 1950's but now are used only incidentally.

The two-price character of the current programs is also reflected at the farm level by means of price support payments made on the domestic share of the national wheat base acreage. These price support payments are partially financed by the domestic processing tax and partly by direct government appropriation. Individual eligibility for these payments, for price support loans, and for other program benefits is contingent upon participation in voluntary acreage restraint programs tied to production history. The potential back flow of wheat imports to the higher priced domestic market is controlled by strict import quotas, in place since the 1930's.

Rice policy in the United States merits brief mention. As the Green Revolution gathers momentum in rice, U.S. policy will become increasingly more critical and controversial. The United States produces only about

2-3 percent of the world's rice, mainly in Arkansas, Louisiana, Texas and California. However, the nation's exports average about 30 percent of world rice trade. This is because only 3-4 percent of global rice output moves into international exchange, while the U.S. exports some 50-60 percent of its production.

Farm prices of rice are supported by non-recourse loans at levels generally higher than current world prices. Exports are encouraged by export subsidies and by P.L. 480 concessional shipments which account for over half of total exports. (37) Some output restraint at the supported prices is accomplished by means of historically-based acreage allotments and marketing quotas. The current situation of low world prices and large supplies of rice in other exporting nations like Thailand may force the United States into a major revision of its policy.

In the meantime, the Secretary of Agriculture has announced acreage allotment and price support reductions to the legal minimum under current legislation for the 1972 crop year. In his August 6, 1971 announcement he declared it his firm intention to make U.S. rice generally competitive in world markets.

The European Community and Japan. At almost any relevant world price levels, the EEC would undoubtedly be a large net importer of wheat. However, very high internal price supports, no controls on internal output, and effective controls on imports have recently pushed the Community to wheat self-sufficiency and beyond.<sup>5/</sup> Price supports are offered to farmers through the Guarantee Section of the Agricultural Guidance and Guarantee Funds. (2) Variable import levies which capture

the daily difference between c.i.f. world prices and internal target prices effectively insulate domestic producers from international competition. Export subsidies, which operate much like variable import levies in reverse, move excess supplies onto world markets when output exceeds internal demand at the guaranteed price targets.

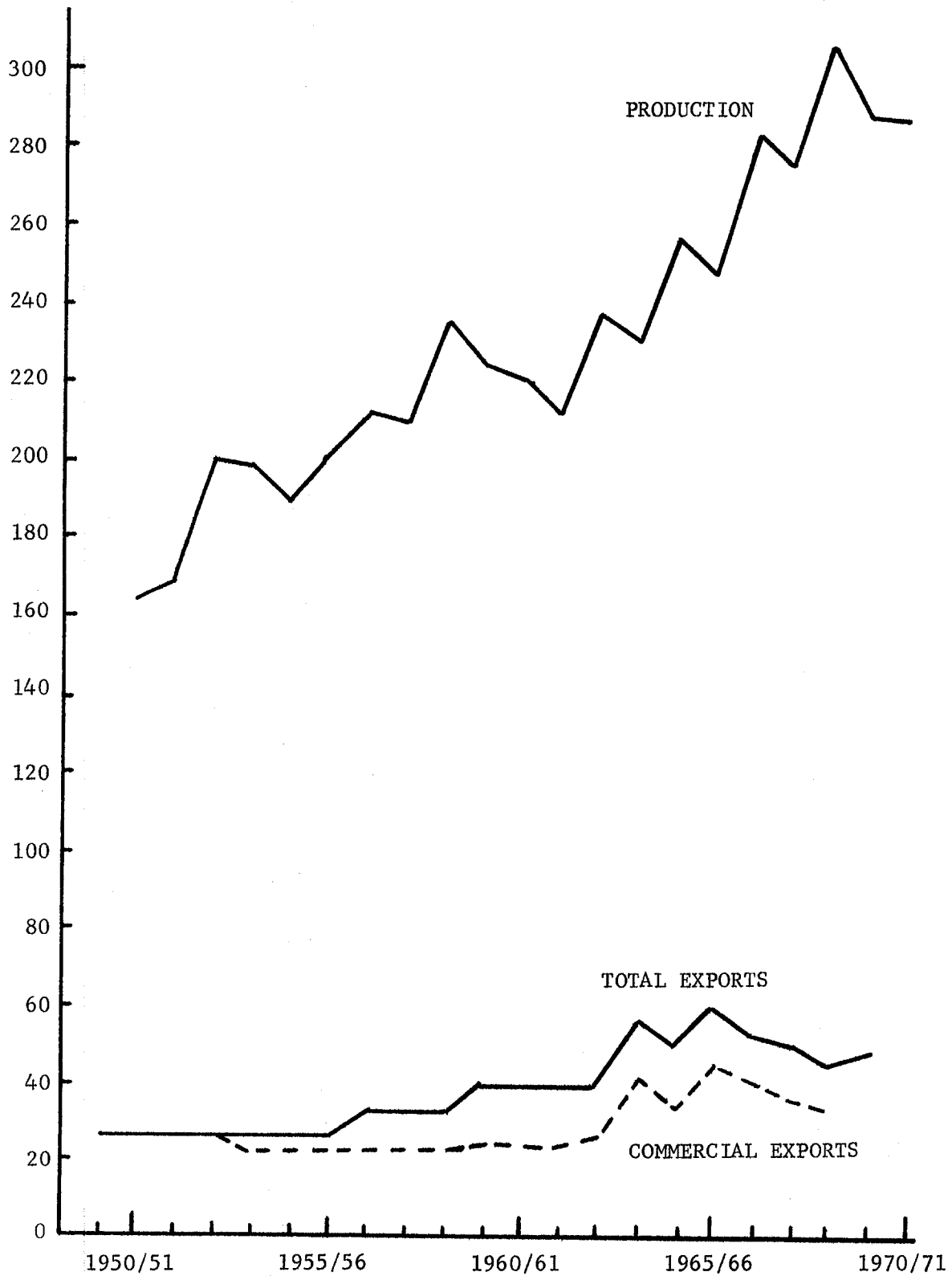
Much the same description fits the current Japanese case with respect to rice. High internal prices to farmers are protected by controlled imports and price guarantees provided by the Food Agency of the Ministry of Agriculture and Forestry, which also controls marketing. But Japanese rice policy differs from EEC grain policy in two important ways. First, the Food Agency sells rice on consumer markets at a loss in order to keep the retail price of rice lower than otherwise would be true. Second, as rice self-sufficiency has been attained and surpassed in recent years, production control has been instituted through payments to farmers for paddy diversion and enterprise diversification. A program of concessional exports and food aid assistance in rice also has been started based on large carryover stocks.

#### World Production and Trade: Wheat

Keeping in mind this summary of food grain policies and programs in the developed world, let us turn to the emerging situation in the world wheat market, a market strongly influenced by the Green Revolution. A detailed statistical analysis of world wheat trade is not attempted here. An overview of the aggregate situation is given in figure 1 and table 1,<sup>6/</sup> Figures 2-5 emphasize individual trends in the major developed wheat producing nations.

FIGURE 1. WHEAT: WORLD PRODUCTION AND EXPORTS

Million Metric Tons



About one-sixth of world wheat production enters international trade channels each year.<sup>7/</sup> Variations in production are not reflected fully in trade volume fluctuations. Stocks are drawn down or accumulated and domestic feed utilization varies so that trade volumes remain fairly stable. This was especially true in the 1950's and early 1960's. Purely commercial sales accounted for two-thirds to three-fourths of total exports during the 1960's. The remainder were special transactions such as direct food aid, barter sales, and long-term credit sales.

Notice the irregular but persistent increase in world wheat production, particularly since about 1961/62, figure 1. When compared with the slow increase and recent fall in world exports, the conclusion of mounting self-sufficiency around the world is virtually inescapable. Even non-commercial or concessional exports have remained relatively stable or dwindled. The pressure of these developments has not been shared equally around the world. The United States, Canada, Australia, and the EEC together account for about one-third of the world's wheat production but three-fourths or more of recent global exports. Since less than one-fourth of world wheat movement is from one developed nation to another, less-developed countries provide important outlets for excess supplies from developed producers, table 1.

During the past decade, production increased in the EEC, Australia, and the United States, but not as fast as world output expanded. Some recently published production indexes by FAO show that cereal output (excluding rice) increased by about 19 percent during the 1960-70 period in the areas of the world containing most of the developed nations. In



the rest of the world, cereal output expanded by 37 percent. (10, May 1971) Thus, the most rapid output expansion occurred among the less-developed importing nations, placing pressure on world markets. This pressure occurs (1) as former importers reduce their takings of both commercial and concessional grains and these displaced supplies seek alternative outlets, and (2) as former importers export food grains produced either in excess of domestic demand or in excess of their domestic market's ability to distribute them internally. (6)

Little or no growth in domestic food use for wheat can be expected among major exporters; population growth only partly offsets declining per capita consumption associated with generally negative income elasticities. Some expansion in feed use is possible at low prices, but, in the United States at least, this adds economic and political pressure to domestic supply constraints in operation for feed grains.

The 1964-66 international flow of wheat and wheat flour, classified by the economic status of trading nations, is shown in table 1. (These patterns are still approximately correct.) The largest single movement is from developed to less-developed countries. This is the segment of the market where most of the pressure caused by self-sufficiency first appears.

The heavy movement of wheat and flour from developed to centrally planned nations reflects commercial exports from Canada and Australia to the People's Republic of China (Mainland China) and to the USSR. Up to now, it has been especially difficult for western observers to assess trends and developments in Chinese agriculture. In addition,

Table 1: International Trade Flows for Wheat and Wheat Flour, 1964-66;  
in percent of total.

Exporter	Importer			Total
	DVD	CP	LDC	
	(percent)			
DVD	23.7	26.7	35.4	85.8
CP	0	3.5	1.0	4.5
LDC	2.3	4.1	3.3	9.7
TOTAL	26.0	34.3	39.7	100.0*

\* (57,412 thousand metric tons)

DVD = Developed nations<sup>a/</sup>

CP = Centrally planned (communist) nations<sup>a/</sup>

LDC = Less-developed nations<sup>a/</sup>

<sup>a/</sup> See text footnote 1/.

Source: U.S. Department of Agriculture

international commercial dealings of centrally planned nations are often unpredictable even when economic information is relatively good. Nevertheless, it is safe to assume that the technological forces driving other Asian nations toward food grain self-sufficiency are now at work or soon will be on the huge Chinese mainland. This would further impede food grain exports from developed nations.

### The Developed Nations

The individual country charts each tell a separate story. Among the most interesting is the Canadian experience, figure 2. Aside from the significant variability in production, notice the massive drop in acreage and output in 1970-71. A stringent acreage diversion program, known as "Operation LIFT", was responsible for this 50 percent slash in output in a single season.<sup>8/</sup> Wheat exports appear to have fallen to a level consistent with the experience of the early 1960's, before the severe world grain shortages which developed in the middle 1960's.

A somewhat similar picture is reflected in the Australian chart, figure 3. The recent policy changes occasioned by mounting inventories, also resulted in an unprecedented cut in acreage. The production response also was large but generally similar in magnitude to the weather-induced fluctuations in output in the 1964-68 period. Prior to the acreage cut at the end of the 1960's, Australian wheat growers had expanded wheat acreage more than farmers in the other major wheat exporting nations.

The story differs a bit in the United States, figure 4. The changes in wheat acreage and output in recent years are not unprecedented, although the substantial decreases in the late 1960's reflect tightened acreage

FIGURE 2. WHEAT: CANADIAN AREA SEEDED, PRODUCTION AND GROSS EXPORTS

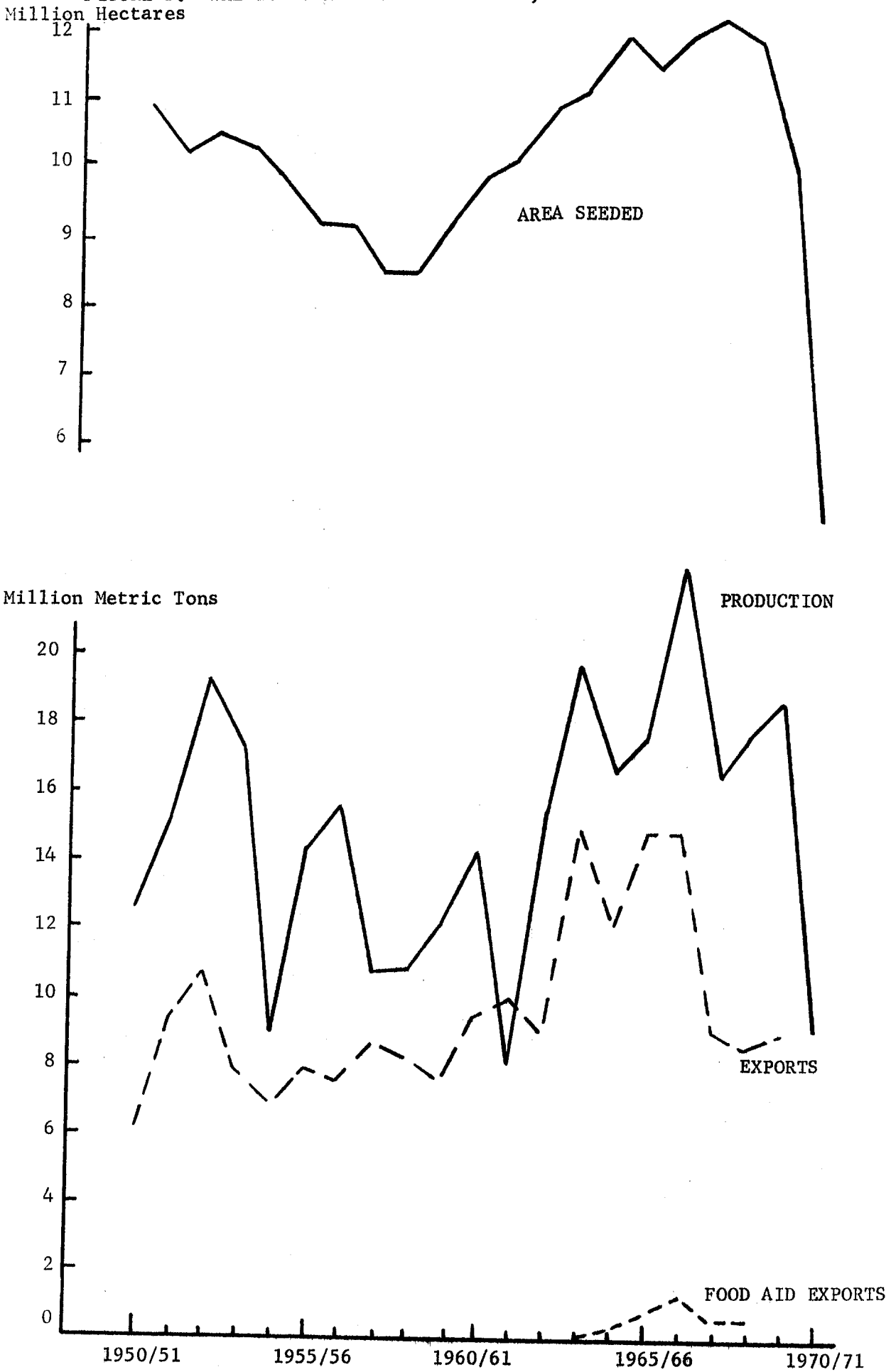
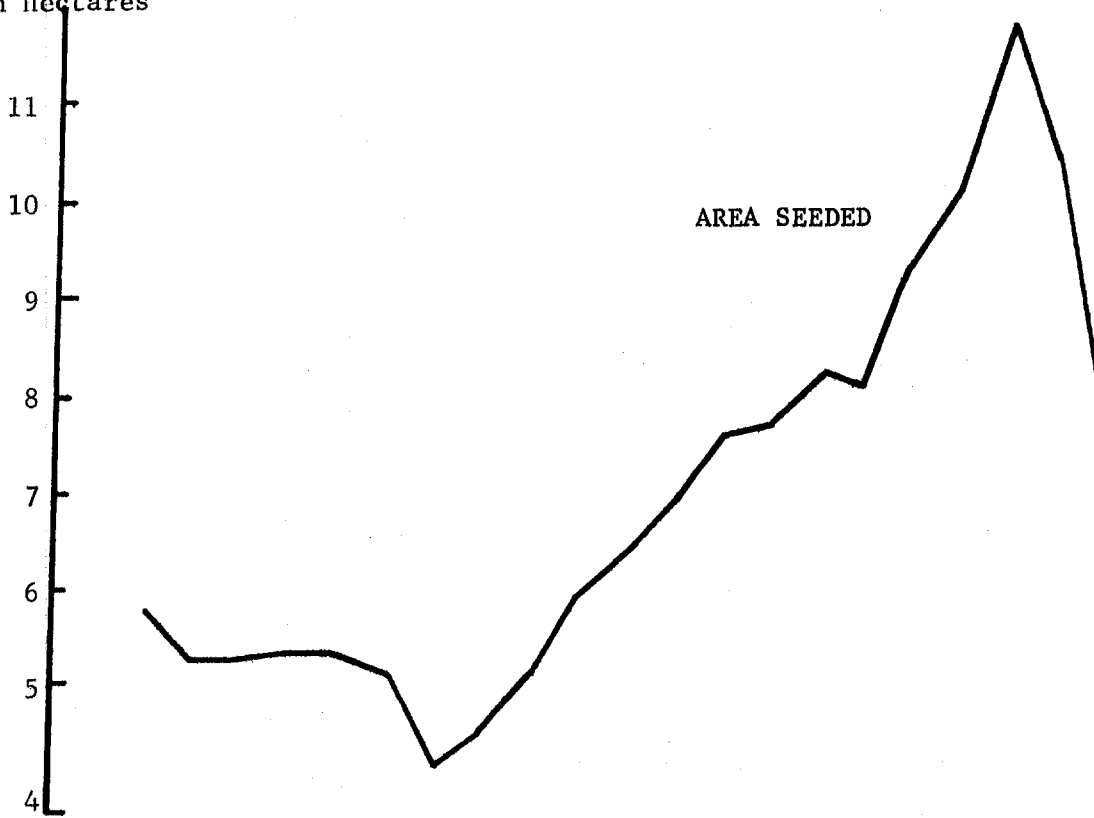


FIGURE 3. WHEAT: AUSTRALIA AND NEW ZEALAND AREA SEEDED, PRODUCTION, AND GROSS EXPORTS

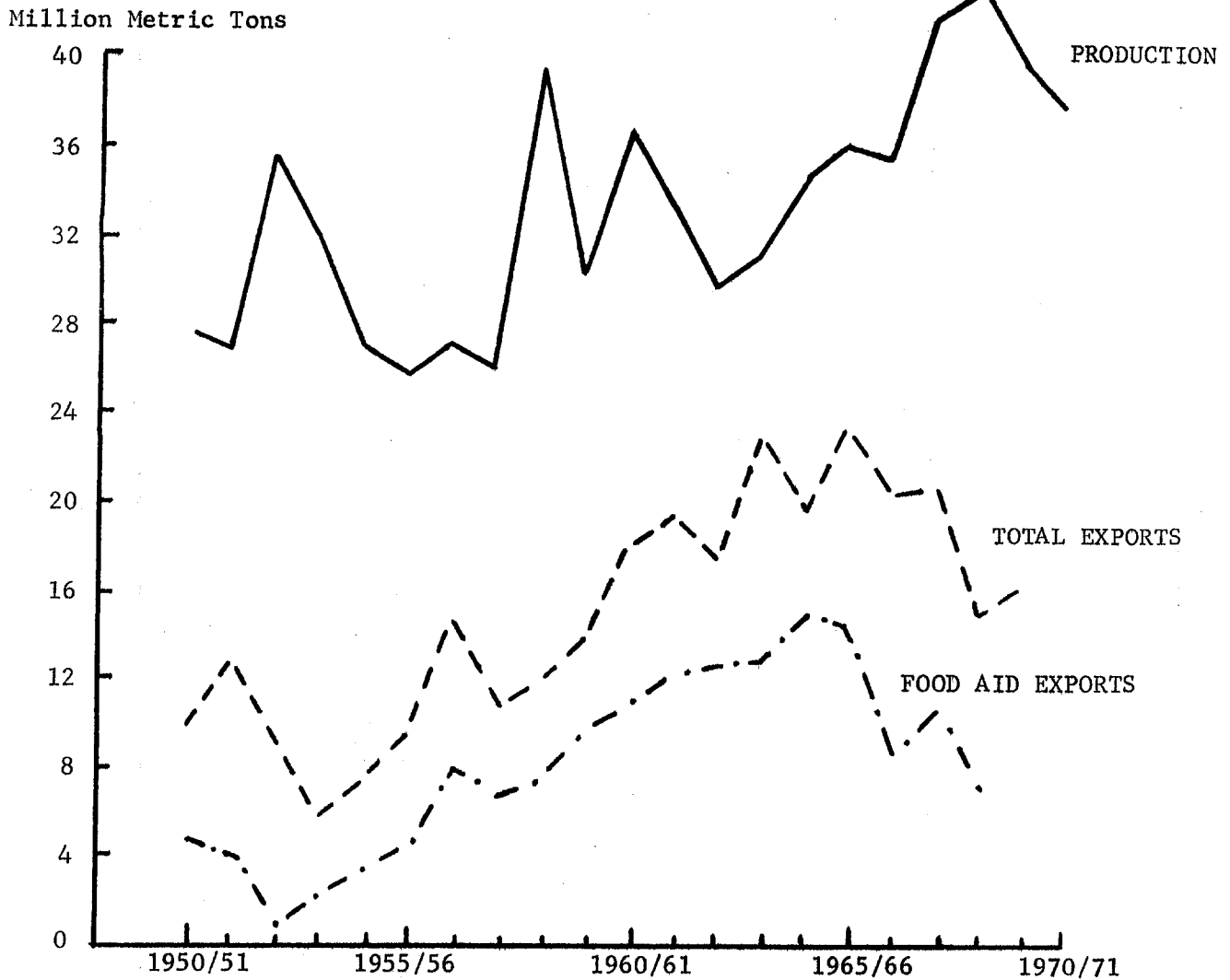
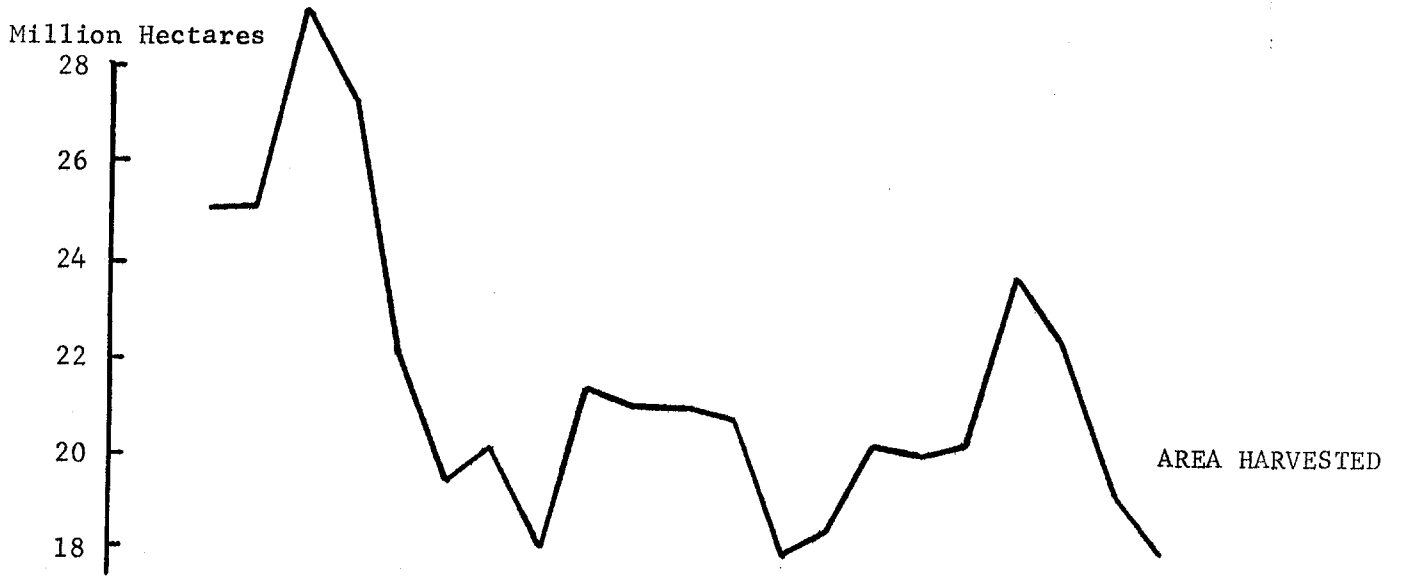
Million Hectares



Million Metric Tons



FIGURE 4. WHEAT - UNITED STATES AREA HARVESTED, PRODUCTION, AND GROSS EXPORTS



controls and lower market prices. Observe the overall importance and recent shrinkage in food aid shipments under U.S. government programs, mainly P.L. 480.

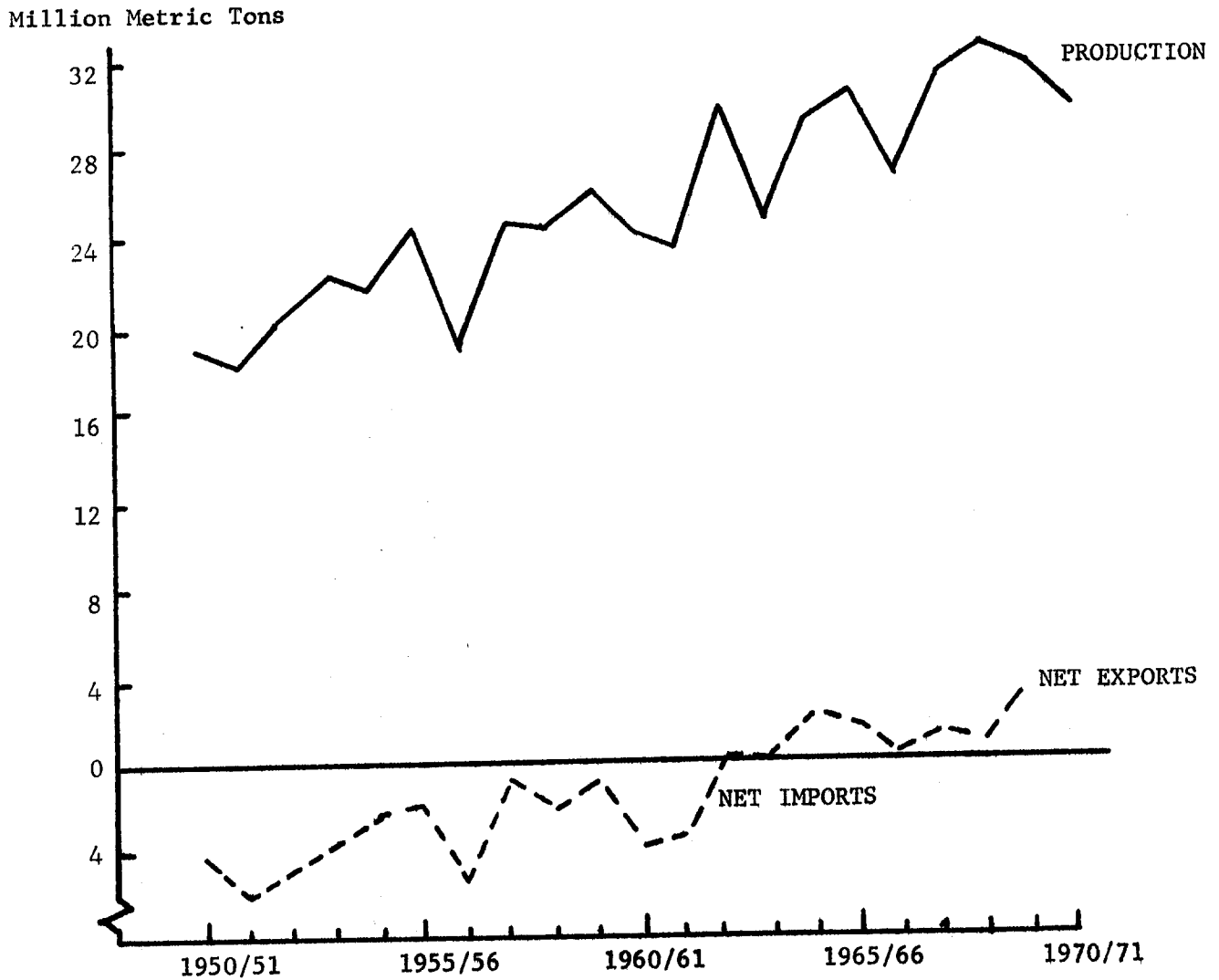
Isolated from world prices, EEC grain farmers respond to circumstances inside the community. The fall in acreage and production in the 1969-71 period, figure 5, reflects internal policy changes. Policy makers in the European Community are aware (1) that the EEC achieved and then surpassed overall self-sufficiency in wheat just prior to a period of world surpluses and weak prices, and (2) that exporting wheat via export subsidies between high internal prices and low world prices is expensive business. Consequently, internal prices and price differentials on various food and feed grains have been adjusted to favor the production of feed grains and internal feeding of wheat to livestock. (2, 19, 31)

#### Concessional Exports

Several developed countries provide non-commercial exports to less-developed nations in order to advance their humanitarian and foreign policy goals as well as to provide them with access to special markets. These exports involve sales for non-convertible currencies, long term credit sales, gifts and donations, barter exchanges, bilateral arrangements, and government-to-government agreements. Since the mid 1950's, special transactions of this variety account for roughly one-fourth to one-third of total wheat exports annually.

Among wheat exporters, the United States has engaged most heavily in food aid sales and donations. Since 1954, when Public Law 480 was

FIGURE 5. WHEAT: EEC, AREA HARVESTED, PRODUCTION, NET IMPORTS, AND NET EXPORTS





first passed, one-half to three-fourths of U.S. wheat exports have been special transactions, mostly sales for foreign non-convertible currency, long term credit sales, and gifts. Canada began food aid exports in the early 1960's, the annual amount reaching 10 percent of total Canadian shipments in 1966/67.

Food aid commitments were made in 1968 by several other nations under the Food Aid Convention of the International Grains Agreement. (10 April 1971) The initial goal was 4.5 million metric tons annually. The goal was reduced to 4.0 million tons when the new International Wheat Agreement was negotiated in 1971. This goal is about 15-20 percent of actual annual imports by the less-developed nations during the 1960's. Commitments may be met with wheat, rice, other acceptable grains, or cash. The negotiated shares are: United States, 48 percent; the European Community, 26 percent; Canada, 12 percent; Japan and Australia, 6 percent each. The remaining 2 percent is divided among several other nations. Actual food aid shipments in 1968-69 were approximately 12 million metric tons, substantially exceeding the goal.

Large consistent food aid shipments, especially foreign currency sales, to nations like India, Pakistan, and Turkey will be among the first casualties of the Green Revolution and food grain self-sufficiency made possible by the Green Revolution.

### Prices

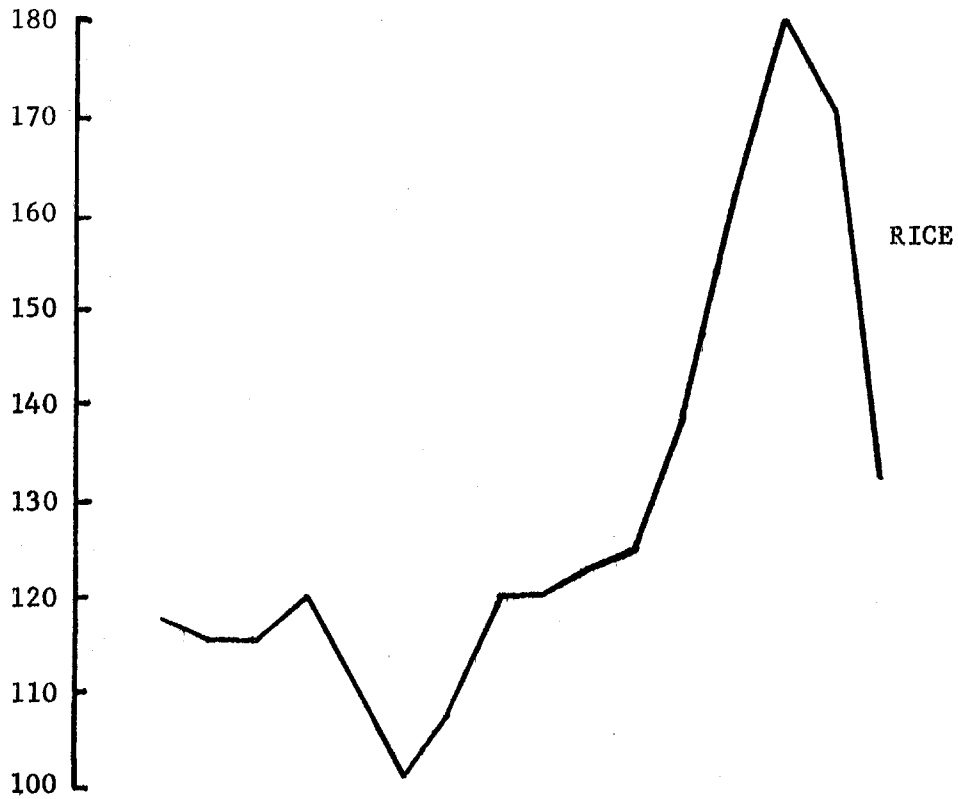
It can be argued with substantial logic that the level of wheat and some other commodity prices on world markets reflects, to a large degree,

the net impact of the protectionist trade policies of importers and exporters played off against each other. However, period-to-period variation in world market prices does reflect shifts in the excess demand and supply functions of individual nations. These shifts are caused by changes in underlying economic relationships and/or agricultural and trade policies. Annual time series of world export unit values for wheat, corn, and rice, figure 6, illustrate shifting relationships among these grains. Notice that the drop in wheat unit values in recent years has occurred in the presence of (1) falling export volumes, and (2) fairly strong world prices for feed grains and, in the 1967-69 period, rice.<sup>9/</sup> Since price is a major connecting link between various food grain markets and between food grains and feed grains, this weakness in international wheat prices is clearly a symptom of narrowing markets and growing supplies.

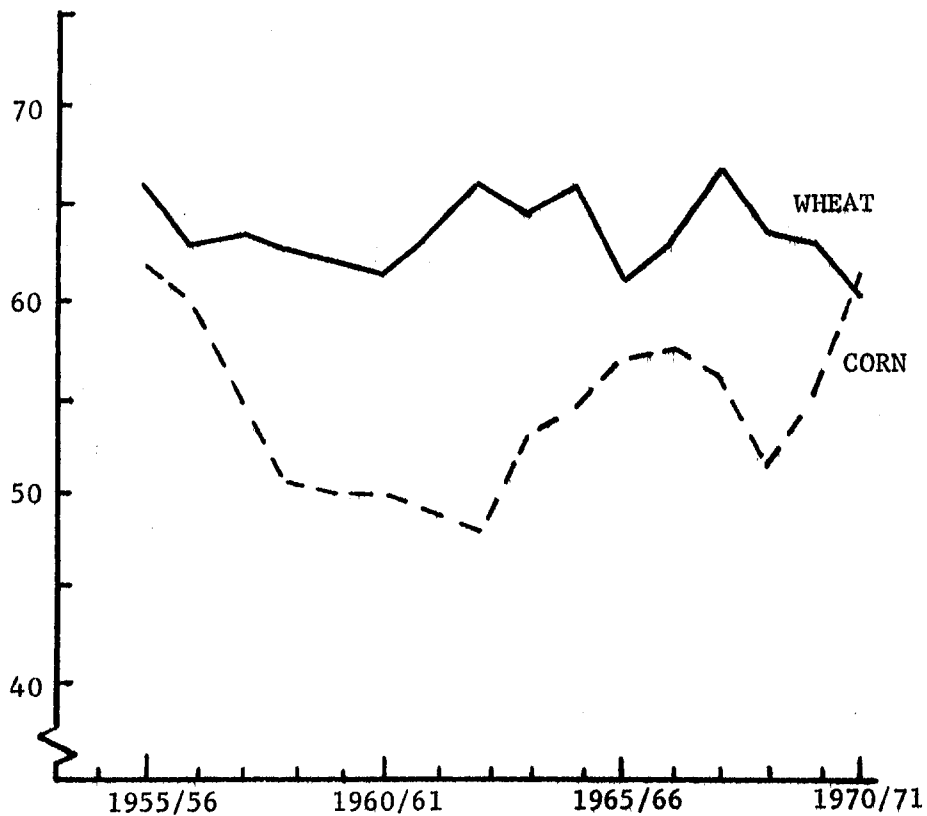
Although international price comparisons are always risky, the following tabulation suggests the extent of protection for several food grain producers in a recent year. The Canadian price can be viewed as an approximation to the world price. The average world export unit value was approximately \$65 per metric ton. Compare this with the wheat prices offered to EEC and Japanese farmers (farm prices for rice in Japan are similarly high). Also notice the middle range of protection offered U.S. wheat farmers via price support loans and the domestic marketing certificate payments mentioned earlier. In this particular year, 1967/68, the United States was the only nation controlling production by direct policy.

FIGURE 6. WORLD AVERAGE EXPORT UNIT VALUES FOR RICE, WHEAT, AND CORN

Dollars per Metric Ton



Dollars per Metric Ton



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Country	Producer prices for wheat, 1967/68. (U.S. \$ per metric ton)
Canada (final realized farm price, No. 1 Northern)	61.60
Australia (average return to grower, f.a.q.)	61.90
United States (average farm price rec'd, includes direct payments)	68.70
EEC (weighted average producer price)	93.70
Japan (producer price, fixed by gov't including bags)	145.50

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#### Summary

This review of wheat production, trade, and policy situation has emphasized the following major points:

- (1) Canada, Australia, and the United States, the main wheat exporters, depend upon foreign markets for one-half to three-fourths of their annual wheat production.
- (2) The European Community, considered as a single entity, shifted from a net import to a growing net export position in the 1960's.
- (3) None of the major exporters can rely on major expansion in domestic food markets for wheat.
- (4) Each of the major exporters has excess capacity locked into its food grain sector.

- (5) This excess capacity is held as stocks or idled land or appears in world markets as subsidized commercial and concessional exports.
- (6) Large world supplies relative to demand have resulted in weak prices on open international markets. Much of the recent increase in world production has come from less-developed nations.
- (7) The developed producers of food grains, for the near future at least, are committed to farm price and income guarantees based on multiple price mechanisms and/or direct payments to growers for land diversion away from food grains.
- (8) Costs of sustaining these price and farm income support programs will grow for both developed and less-developed producing nations as total grain output grows.

#### The Green Revolution and Internal Markets

Grain markets within nations experiencing the Green Revolution are dramatically affected by increasing volumes of domestically produced wheat and rice.

Policy goals adopted by less-developed nations with access to the technologies of the Green Revolution emphasize self-sufficiency in food grains and market stability. For example, India's Fourth Five-Year Plan (1969-74) sets out three main agricultural policy goals: (11)

1. To achieve production growth.
2. To safeguard against fluctuations in agricultural production.
3. To reduce dependency on foreign aid.

Similar agricultural policy objectives are reflected explicitly or implicitly by governments all across Asia. To the extent that these goals are achieved or approached, grain markets within less-developed nations will be subjected to unprecedented stress.<sup>10/</sup> One could argue that, over many years, complex and often sophisticated marketing systems have evolved to facilitate (1) the handling and distribution of grain in relatively small lots, and (2) the movement of grain imports into consumption. The Green Revolution poses an opposite set of problems: namely the handling and distribution of larger and increasing volumes as well as the potential movement of domestic grain into export as well as into channels normally served by imports.

A rough analogy might be drawn between traditional grain markets and traditional irrigation installations in many parts of Asia. The major objective of traditional irrigation works seems to be to spread scarce water thinly and evenly among the maximum number of users so as to avoid a widespread crop failure. When large volumes of well-controlled irrigation water are needed at critical points in the growing season, the traditional works are found to be highly unsatisfactory. Similarly, traditional grain markets operate to spread the limited market surplus into consumption in small lots over a broad market area so as to avoid widespread famine in poor crop years. Consequently, one can expect traditional grain markets to face difficulty when called upon to handle, finance, store, and process large and increasing volumes of grain on a regular basis.<sup>11/</sup>

Less-developed nations, as they struggle to sustain and accelerate economic growth, have adopted a variety of price support and incentive programs to encourage farmers to produce and market increased quantities

of food grains. As long as an individual nation displays a net deficit in grains, such a policy can be pursued rather easily. The costs, measured perhaps as the difference between internal and world prices, can be passed on to consumers. Concessional imports may be negotiated to cover the deficit. Then scarce foreign exchange can be reserved for other uses. Quotas, tariffs, or other barriers can control the import of lower price commercial supplies. Direct government costs are, therefore, minimal.

When, however, the net deficit is erased through output expansion at supported prices, the incidence of program costs begins to shift. To protect its own program the government must meet direct costs of storage or must operate consumer subsidies to handle the excess supplies internally. Or it must provide export subsidies in some form to handle all or part of the surplus externally. Concessional imports become redundant. This shifting of costs occurs even when self-sufficiency is surpassed erratically. Governments which are not financially or administratively strong may find it very difficult to cope with self-sufficiency and price support commitments simultaneously. These nations face a cruel dilemma: they are torn between the realities of small treasuries and already over-burdened administrative machinery, on one hand, and the promise of agricultural prosperity and development on the other.

It is not the purpose of this paper to provide a thorough analysis of the impact of the high yielding grains upon markets within less-developed nations. However, a series of highly stylized observations will serve to illustrate the sequence of events which, to a greater or less extent, has and will characterize traditional grain markets as they cope with the Green Revolution.

1. Rising food grain production trends will create demand for more and better marketing facilities, institutions, and infrastructure.
2. These facilities will expand and improve but probably not as fast as needed.
3. The relatively slow growth of market capacity relative to production will be further aggravated by periodic bumper crops which will occur around a rising production trend.
4. The result will be periodic severe market gluts locally, regionally, and nationally. They will be rendered more acute because market facilities already will be over taxed.
5. Consumption, even with rapidly rising incomes and population, can be expected to fluctuate less rapidly than output--especially if internal price changes are controlled or modified.
6. To the extent that the previous observations hold true, pressures will mount to move excess supplies into export channels. The lack of adequate local storage and other market facilities can cause this tendency to develop even when critical shortages are occurring elsewhere in the country--this is clearly possible in a large nation like India. (6) This tendency to export also may be enhanced because (a) foreign exchange is required for development, and (b) the existing transportation infrastructure may be geared for primary product exports as a residue of an earlier colonial era.



7. These periodic exports, at least in the short run, will probably bring lower than average prices on world markets because of inherent uncertainties in location, volume, and quality.

As a result of these developments, both commercial and concessional imports from the developed world will dwindle. As previously mentioned, these displaced shipments will tend to seek other destinations in a shrinking or rather stagnant international market.

The great promise of the Green Revolution to help lift nations out of poverty depends heavily upon the ability of internal markets, or other allocation systems, to handle and distribute under great stress both outputs and inputs. This paper emphasizes product markets, but equally crucial are markets for skilled and unskilled labor, all kinds of purchased inputs, land, credit, and management skills. The role of these latter markets is being documented elsewhere. (1, 4, 14, 23, 25)

#### The Prospects

By combining the arguments made in the two previous sections, a picture of the impact of the Green Revolution in the international market place begins to emerge. The exact details of this picture are obviously not clear, especially the further we look into the future. In the boiling economic and political reality of today's world, great change occurs rapidly. However, the forces and trends that underpin these changes move more slowly and regularly. Let us turn first to the short term prospects, say between now and the middle or late 1970's.

Short Term

We have already asserted that barring a major natural or military catastrophe, a lower or only slowly-growing volume of food grains, particularly wheat, will move internationally.<sup>12/</sup> This tendency will be a general one but will center on the trade between developed exporters and less-developed importers. This lower volume probably will be most pronounced in non-commercial markets, but will also extend to commercial trade. Generally lower world prices will prevail, forced down by narrower markets on the import side and supply pressure and export subsidies on the export side. Short term economic and political forces may cause prices to bounce up and down around this trend. In fact, a thinner world market might easily display more price fluctuation than previously.

Self-sufficiency among less-developed nations will result in more intense competition for existing commercial markets. The possible intermittent exports from less-developed nations will be added to displaced commercial and concessional grain looking for markets. For a variety of reasons, including lower quality requirements, shorter shipping distances, and bilateral barter deals, regional trade in food grains among less-developed nations can be expected to increase.

It may be that, because of less than perfect substitution among food grains, self-sufficiency in wheat will not also wipe out rice imports or vice versa. But it is difficult to imagine that, in the short run, some downward pressure on internal prices and imports of substitute grains would not occur, unless offset by deliberate policy.

Look again at the world price (unit value) series for wheat and rice, the premier food grains, figure 6. Notice that the wheat/rice price ratio has increased recently even though both prices have fallen. It is possible that some less-developed wheat producers will undertake a deliberate policy of exporting relatively higher priced wheat and importing relatively cheaper rice. This would lessen the downward price pressure on rice but enhance it for wheat. This kind of food grain arbitrage illustrates that the Green Revolution has given nations access to and options within food grain markets not possible just a few years ago. The extent that operations like this are feasible to individual nations also depends upon the range of substitution that exists among food grains in consumption. Much more should be known about this topic.

(9, 24)

It is clearly possible that domestic and international feed grain markets will become an important release valve for low priced, excess food grains. This can be expected to exert downward pressure on the generally buoyant demand for corn, sorghum, and other coarse grains during some years. Whether the short run impact of the Green Revolution can be traced through to lower livestock and meat prices on world markets is difficult to say. The economic logic of the argument suggests it, but it surely will not be easy to establish such a relationship empirically.

Taken together, these projected developments suggest that policy makers in the developed grain exporting nations will be driven to continued and possibly increased levels of protection. Their objectives will be to insulate domestic markets from imports and to meet increased competition

for international sales. They will continue to use import quotas, minimum import prices and variable levies, tariffs, and other mechanisms to control incoming supplies. Continued and possibly expanded reliance on export subsidies, multiple pricing schemes, and special credit arrangements, will occur as exporters attempt to maintain and promote trade. Thus, the links between world prices, domestic market prices, and farm prices in the wealthier exporting nations could become weaker than ever. Even if farm support prices are simply maintained or even lowered slightly, larger decreases in international price levels will mean that relative levels of protection will have increased.

As less-developed nations eliminate regular reliance on food aid imports, this component of the international grain trade will tend to shrink. As it shrinks, it may also become highly volatile and follow the unpredictable fluctuations in weather and natural calamities. One year food aid needs may be negligible. The next year, drought, floods, or earthquakes could combine to send food aid needs soaring to unprecedented levels. Multinational programs going beyond current agreements will be needed to spread the costs of erratic food aid requirements.

It seems likely that production controls will be continued in some form or another in the United States, Canada, and Australia. If the U.S. experience is a guide, more expensive programs to hold acreage out of food grains or divert it to other uses will meet strong resistance from consumers, tax-payers, and fiscal agencies within governments. The potential entry of the United Kingdom into the EEC may take some pressure off of the food grain surplus problem inside the expanded community, but it will add to the problem of narrowing markets faced by outsiders.

That these pressures for heightened protection should be developing at the same time that significant movements toward preferential agreements favoring less-developed nations are occurring is indeed ironic. Despite political rhetoric and speeches by government officials idealizing trade liberalization, potential preferential agreements involving members of UNCTAD, GATT, OECD, EEC, and EFTA probably will involve exclusions on many agricultural products, particularly food grains.

#### Longer-Term

Speculation on longer-term prospects can be wide-ranging and, depending upon the assumptions, gloomy or optimistic. Let us assume that in the less-developed nations of Asia (1) the fruits of the Green Revolution, one way or another, are distributed fairly widely among people in 1980 and beyond, (2) population growth is not stimulated, and (3) per capita incomes continue to grow.

In this setting, the rather pessimistic outlook for the 1970's gives way to some optimism. All this, of course, hinges upon widely distributed growth in per capita incomes. Without it, the long term outlook remains rather bleak for food grain markets and less optimistic than now for feed grains. As per capita incomes grow, the demand for food grains and feed grains will grow.<sup>13/</sup> Since the demand for livestock products, hence feed grains, probably will respond more strongly to income growth, productive resources in the less-developed nations can be diverted into feed production, livestock production, and other activities. With growing incomes and more opportunities for agricultural diversification, the self-sufficiency objectives with respect to food grain probably will weaken.

The developed nations still will have nagging excess capacity problems in food grains, especially those with strong protective policies in place. The longer term developments suggested in the previous paragraph for less-developed nations also will assist and stimulate the movement of resources into feed grains, high protein feeds, and livestock production in the developed nations. Export opportunities will remain and grow, slowly perhaps, for high protein hard bread wheats. Much of the adjustment burden will fall upon the producers of soft wheats and other lower quality food grains all over the world.

#### Policy Implications

Given political realities, is difficult to suggest specific policies that the developed nations reasonably might be expected to adopt in dealing with the issues raised in this paper. The governments of wealthier nations will be torn between policies to foster and promote the promise of the Green Revolution on one hand and the claims of their own farmers and grain dealers for price and income protection on the other. Limited funds available for foreign aid and agricultural support will preclude massive programs in either direction.

Perhaps the major policy suggestion that emerges is for the developed nations to devote more and more of their limited foreign aid and technical assistance to the establishment of stronger more flexible markets and market institutions in nations experiencing major grain production advances. This applies to markets for products and for the critical new inputs. Smoothly operating markets and allocative institutions will be able to

distribute increased volumes more efficiently over time, over space, and among alternative outlets. Success in this policy direction will have the dual advantage of (1) helping to secure the benefits of the Green Revolution for both farm and non-farm people in the less-developed nations, and (2) helping to avoid intermittent disturbances in international markets caused by excess supplies surging out of less-developed nations because local markets cannot handle them.

At home, the most feasible short run policy of the developed nations is probably to continue to restrain production of food grains, especially low quality wheats, within the limits of politically acceptable budget expenditures. Equity and fairness suggest that production restraint is an obligation of any developed nation which chooses to operate a comprehensive price or income support scheme for its domestic wheat farmers. In the longer run, additional movement of resources out of food grains and into other activities, both agricultural and non-agricultural, should be a prime policy objective of the developed nations, difficult as this may be.

Consider one final suggestion on the food grain policy of developed nations. As less-developed nations approach self-sufficiency, their non-commercial or food aid requirements will dwindle. Facing shrinking commercial markets, the temptation will be strong for nations like the United States, Canada, and the EEC to press these non-commercial supplies onto other poor nations where the Green Revolution has yet to begin. These other nations are concentrated in Africa and Latin America. Where food deficits and foreign exchange shortages are critical, there are surely legitimate

opportunities for food aid preferably on a multilateral basis. But if the objective of surplus disposal dominates and highly attractive terms of exchange are offered, then the progress of agricultural development may be further impeded in those nations where it will be most critical in the coming years. This can occur if prices of food grains are held at very low levels with concessional imports and if the easy availability of these imports divert the attention of development officials away from the difficult questions of agricultural progress.

Some might argue that the international costs and consequences of the Green Revolution are falling largely and inequitably upon the world's major grain producing and trading nations. Generally speaking, they are correct. But these are costs which the developed nations are well advised to pay in order to foster agricultural and human development among the less fortunate occupants of this globe.



## FOOTNOTES

- 1/ It is, of course, difficult to be precise about the distinction between developed and less-developed nations. For this paper, the developed nations will be to the wealthy countries of Western Europe, Canada, Japan, Australia, and the United States. The less-developed nations will be non-communist countries in Asia, Latin America, and Africa. When referred to, communist countries will include the USSR, its associated nations in Eastern Europe, Cuba, People's Republic of China (Mainland China), Mongolia and the communist portions of Korea and Vietnam.
- 2/ The terms European Economic Community (EEC) and European Community are used interchangeably in this paper to designate the six-nation common market formed by Belgium, France, the Federal Republic of Germany, Italy, Luxembourg, and the Netherlands. Since the member nations now follow a common agricultural policy, we can view the community as a single "nation" for most purposes. The impending accession of the United Kingdom to membership in the community does not appreciably alter the thrust of the arguments made in this paper.
- 3/ Argentina, the other major traditional wheat exporter, is not considered explicitly in this discussion. Her stage of economic development and policy problems are distinctly different than most other temperate zone grain exporters.

- 4/ Descriptions of these policies and programs are given in (2, 5, 11, 15, 19, 21, 26, 29, 31).
- 5/ The entry of the United Kingdom into the European Community will probably involve, at least at the beginning, the extension of the EEC Common Agricultural Policy to British Agriculture. Consequently, overall self-sufficiency within the enlarged community probably will remain high at the expense of previous exporters to the United Kingdom.
- 6/ The data used in this section were drawn from official tabulations by the Food and Agriculture Organization of the United Nations, the U.S. Department of Agriculture, and other agencies. (10, 13, 30, 32, 33, 34) A good recent country-by-country summary of the relevant data is a paper by Haseyama in (1). See also (12, 16, 18, 35).
- 7/ No specific discussion is included here on the International Wheat Agreements which existed until 1967, the International Grains Arrangement of 1967-70, or the recently-negotiated International Wheat Agreement of 1971-73. It is assumed here that these agreements, especially the 1967-70 version, had rather little impact on the conduct and patterns of world trade.
- 8/ The term LIFT is a wry acronym indicating "Lower Inventory for Tomorrow".
- 9/ The recent data on rice prices in international markets reflect substantial weakness and excess supplies. This tends to amplify the downward price pressure in world wheat markets, and vice versa.

- 10/ Economists and others have identified numerous other critical sources of stress linked to the progress of the Green Revolution. These include differential impacts on employment, income distribution, land ownership and control, and political stability.
- 11/ A related argument along these lines could be developed focusing on markets for purchased inputs like fertilizer, disease and pest control products and services, machinery, tools, and production credit.
- 12/ Someplace in a paper like this, attention should be drawn to the argument that, like many other agricultural products, wheat is not homogeneous. Many distinct qualities exist. Demand for high protein hard wheats is fairly strong and has rather favorable prospects. Demand for lower protein soft wheats is weaker and has poorer prospects. Unfortunately, government price policy in some nations, particularly the United States, has not distinguished sufficiently among qualities. Consequently, excessive production of the soft wheats has occurred and comprises much of the surplus problem.
- 13/ Most empirical estimates suggest that income elasticities for grains, including food grains, are still quite high in the less-developed world, even when numerous problems of measurement are considered. For example, see (22).

## REFERENCES

1. Asian Productivity Organization, Symposium on Food Grain Marketing in Asia, APO Project SYP/VI/70, 1970.
2. B. L. Berntson, O. H. Goolsby, and C. O. Nohre, The Europeans Community's Common Agricultural Policy: Implications for U.S. Trade, Foreign Agr. Econ. Report No. 55, ERS, USDA, October 1969.
3. Lester R. Brown, "Impact of New Cereal Varieties on Southeast Asia's Pattern of International Relations", Agricultural Revolution in Southeast Asia, Vol. II, Consequences for Development, Report of the Second SEADAG International Conference on Development in Southeast Asia, New York, June 24-26, 1969, pp. 72-81.
4. Lester R. Brown, Seeds of Change, Praeger Publishers, New York, 1970.
5. K. O. Campbell, "A Wheat Policy for the Seventies", Australian Journal of Agricultural Economics, Volume 15, No. 1, April 1971.
6. W. W. Cochrane, "American Farm Policy in a Tumultuous World," American Journal of Agricultural Economics, Vol. 52, No. 5, December 1970.
7. Ralph W. Cummings, Jr., "U.S. Export Potentials and the Green Revolution", Farm Program Choices, CAED Report, No. 35, Iowa State University, Ames, 1970.
8. Brian Fernon, Issues in World Farm Trade: Chaos or Cooperation, Trade Policy Research Centre, London, 1970.
9. The Food and Agriculture Organization of the United Nations, The Economic Relationships Between Grains and Rice, Commodity Bulletins Series, No. 39, Rome, 1965.

10. Food and Agriculture Organization of the United Nations, Monthly Bulletin of Agricultural Economics and Statistics, Rome (various issues).
11. Food and Agriculture Organization of the United Nations, National Grain Policies 1969, Rome, 1969, and National Grain Policies - 1970 Supplement, Rome, 1970.
12. Food and Agriculture Organization of the United Nations, The Stabilization of International Trade in Grains -- An Assessment of Problems and Possible Solutions, No. 20, FAO Policy Studies, Rome, 1970.
13. Food and Agriculture Organization of the United Nations, The State of Food and Agriculture 1970, Rome, 1970.
14. J. George Harrar, The President's Review and Annual Report, 1970, Rockefeller Foundation, New York, 1971.
15. Yujiro Hayami, "Rice and Economic Growth: Japan's Rice Policy in Historical Perspective", (recent unpublished mimeographed paper), undated.
16. John E. Hutchinson, James J. Naive, and Sheldon K. Tsu, World Demand Prospects for Wheat in 1980 with Emphasis on Trade by Less Developed Countries, Foreign Agr. Econ. Report No. 62, ERS, USDA, July 1970.
17. International Federation of Agricultural Producers, World Agriculture, Washington D. C., published monthly. (various issues)
18. Arthur B. Mackie, et. al, World Trade in Selected Agricultural Commodities, 1951-65, Volume II -- Food and Feed Grains: Wheat, Rice, Maize, Barley and Other Cereals, Foreign Agr. Econ. Report No. 45, ERS, USDA,

19. H. B. Malmgren and D. L. Schlechty, "Technology and Neo-Merchantilism in International Agricultural Trade", American Journal of Agricultural Economics, Volume 51, No. 5, December 1969.
20. Donald J. Novotny and James P. Rudbeck, Competition for World Wheat Markets and U.S. Exports, FAS M-214, USDA, February 1970.
21. Organization for Economic Cooperation and Development (OECD), Agricultural Policies in 1966, Paris, 1967.
22. Quirino Paris, An Appraisal of "Income" Elasticities for Total Food Consumption in Developing Countries, Development Centre, OECD, Paris, 1970.
23. Lyle P. Schertz, "Food Supplies and Economic Growth in Developing Countries -- The 1970's", (paper presented at Annual Meeting of Western Agricultural Economics Association), Corvallis, Oregon, 1969.
24. T. W. Schultz, "Agricultural Modernization Altering World Food and Feed Grain Competition", Ag. Econ. Paper No. 69:5, University of Chicago, 1969.
25. Robert D'A Shaw, Jobs and Agricultural Development, Overseas Development Council Monograph Series, No. 3, 1970.
26. Hughes H. Spurlock, The Competitive Position of U.S. Farm Products in the Japanese Market, Foreign Agr. Econ. Report No. 32, ERS, USDA, November 1966.
27. Gerald I. Trant, David L. MacFarlane and Lewis A. Fischer, Trade Liberalization and Canadian Agriculture, University of Toronto Press, 1968.

28. U.S. Department of Agriculture, The 1970 Agricultural Data Book for the Far East and Oceania, ERS-Foreign 267, 1970.
29. U.S. Department of Agriculture, Agricultural Policies in the Far East and Oceania, Foreign Agr. Econ. Report No. 37, 1969.
30. U.S. Department of Agriculture, Food Grain Statistics Through 1967; Wheat, Rye, Rice, Flour, and By-Products, Statistical Bull. No. 423, ERS, April 1968.
31. U.S. Department of Agriculture, Foreign Agriculture, FAS, published weekly. (various issues)
32. U.S. Department of Agriculture, Foreign Agricultural Circular, Grain Series (FG), FAS, published several times a year. (various issues.)
33. U.S. Department of Agriculture, Wheat Situation, ERS, published four times a year. (various issues)
34. U.S. Department of Agriculture, World Agricultural Production and Trade, FAS, published monthly. (various issues)
35. Quentin W. West, "World Grain Production Prospects and Trade Stabilization Measures in Southeast Asia," Agricultural Revolution in Southeast Asia, Vol. I; Impact on Grain Production and Trade, Report of a SEADAG Rural Development Seminar Meeting, Honolulu, June 19-21, 1969, pp. 148-165.
36. "Wheat", Current Affairs Bulletin, University of Sydney, December 1, 1968.
37. U.S. Department of Agriculture, Rice Report, unpublished USDA staff report, June 1971.