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The „green revolution” and the trade prospects in selected cereals for the developing countries

by R. Banerji

- C O N T E N T S :
- The developing countries which had been the net exporters of cereals vis-à-vis the developed countries in the 1930s have gradually turned into net importers over the last few decades.
 - If the „green revolution” is able to persist, the net food importing regions of Asia may become self sufficient in foodgrains in the near future. In fact, available evidence already indicate a certain degree of recovery in food production in many of these countries.
 - The net rice exporting countries in south east Asia will presumably find it increasingly difficult to maintain their market in other developing countries. This is because, with the increase in domestic production, the import demand in the net rice importing regions can be expected to fall proportionately.
 - Self sufficiency in wheat production will mainly affect the net import demand from the developed countries.
 - There appears to be a strong case for product and export diversification in those developing countries which depend heavily on cereals export. The scope for more trade in cereals within the developing countries will depend to a large extent on the willingness of the developed countries to withdraw from competition.

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The "green revolution" and the trade prospects in selected cereals for the developing countries.

1. The purpose of this note is to examine the export possibilities from the developing countries of those agricultural commodities which have benefitted most from the results of organised research in agricultural science. Available evidence indicates that the "green revolution" has so far been confined to only a few crops¹. This observed feature of the green revolution is basic to the arguments that will be developed in the following sections.

Hypotheses:

2. Our main hypotheses can be briefly summarised. Rice and wheat are the two principal crops that have commanded almost the entire attention of the agricultural development strategists during the last few years. This should be largely obvious since the immediate concern of the scientists has been to increase food production in areas where traditionally (and to an important extent dictated by ecological factors), wheat and rice are the staple items in the diet. The simultaneous adoption of new cereal varieties and associated complementary inputs (physical and in some cases institutional) by a number of developing countries has resulted in high agricultural production in different regions (of Asia in particular) at approximately the same time.
3. Two immediate implications of this phenomenon are as follows. First, the traditionally food deficit countries which have depended on food imports as the chief source of supply are becoming increasingly selfdependent. In other words, for these groups of countries, a successful green revolution can be looked upon as a synonym for import substitutions in food grains. This represents, further, a saving of foreign exchange to the extent of at least that part of the food imports which would otherwise have to be financed by hard currency. Secondly, for the traditional exporter of food grains, the success of green revolutions implies a loss of the existing and potential outlets of their products. This poses a serious problem for those countries whose principal means of earning foreign exchange are through the export of cereals. Burma and Thailand are classical examples whose rice exports constitute the major part of their total export.
4. The situation seems to be worse confounded by the fact that some of the traditional food importers pose a potential threat as they are likely to emerge as strong competitors in the world market once they reach self sufficiency in foodgrains. For this to happen, however, at least two conditions need to be fulfilled. First, it should be assumed that the public policy in the developing countries will continue to give increasing attention and active support to the agricultural sector, as they appear to have been giving over the last few years. Second, it would imply that there would

¹The term "green revolution" refers to the phenomenon of an unprecedented growth in agricultural production that have occurred over the last 5 years in the developing countries in Asia and elsewhere, following the genetic breakthrough in certain types of cereals. The miracle seed varieties which have been successful commercially are confined to wheat, rice and maize crops. It is not denied, however, that conceivably the revolution can be spread over other crops and also over live-stock. In fact, serious researches are under way to discover new varieties of non-food crops. However, unlike the food crops, the results so far have been less than "revolutionary".

be very little product diversification in agriculture in the near future. In other words, the present bias towards cereal-based agricultural development should be assumed to be the modus operandi for at least sometime to come. If these suppositions hold true, then the implication is that unless some form of foreconceived and well coordinated division of labour in food production can be achieved among the developing countries, the prospect of trade in cereals among themselves seems to be bleak. The export prospects to the market of the western industrialised countries can be ruled out for the present, at least in the light of their current agricultural and trade policies. The developed countries have, in fact, been the major supplier of cereals to the rest of the world and it is unlikely that there is going to be a reversal of their role from net exporters to that of net importers.

5. In what follows, we shall attempt to provide a quantitative analysis of the arguments developed so far. However, before we go on to the more specific question of the world trade in food and feed grains, it appears reasonable to dwell on some salient features of the "green revolution" itself.

The "green revolution": some features:

6. The technological changes underlying the "green revolution" in South and South East Asian countries are embodied mainly in the increased availability of new high yielding wheat and rice strains and lower cost inorganic fertilisers. This technological change is essentially land-saving in character. In other words, its chief objective is to obtain a higher yield from a given and limited supply of cultivable land. Broadly speaking, the impact of this "green revolution" on a country will depend to a great extent on its rate of adoption of new varieties and thus its output increases and on its demand for cereals, which in turn is a function of the rate of growth of population and income.
7. The rate of adoption of the new technology is however severely limited by a number of factors. Foremost, a shortage of good irrigation system appears to be the most serious input limitation. The proportion of irrigated area to the total cultivated area varies widely in the Asian countries, but in no case can it be said to be significant¹. Also, the new rice varieties (e.g., IR - 8 and IR - 5) which are most extensively used in the South and South East Asian countries are known to be notoriously susceptible to wide varieties of pest and disease². In the absence of adequate pest control measures, this is likely to be an additional set-back toward a further spread of the new technology³. Moreover, the new varieties are also

¹For instance, the proportion of irrigated rice area to the total rice area has been estimated to be 2 per cent in Laos, 3 per cent in Cambodia, 30 per cent in Philippines and Thailand and 40 per cent in W. Malaysia. In India the proportion of irrigated area to total cultivated area is estimated to be 25 per cent. See: Asian Development Bank, Asian Agricultural Survey, University of Tokyo Press, Tokyo, 1968, pp. 519-520.

²See: FALCON, W. P. "The Green Revolution: Generations of Problems", Harvard University, 1970 (mimeo). ASIAN DEVELOPMENT BANK: Asian Agricultural Survey, Manila, March 1968.

³It should be added that vigorous research is underway in many countries to discover new strains which are less prone to disease under local conditions. However, commercial uses of such varieties are, as of yet, relatively few.

known to have sold at prices lower than traditional ones, apparently because of the consumer's taste and preferences for the latter type. Such a factor may discourage further the adoption of new technology at the farm level. One important inhibiting factor in most countries is the lack of adequate supply of complementary fertiliser inputs at a low cost to the farmers¹. All these factors are indicative of the sort of constraints that are likely to slow down and limit the speed of adoption in many countries.

8. The extent of adoption so far of the new varietal technology can be seen from the following figures. In Asia, the area under the new varieties of wheat and rice increased from 200 acres in 1964-65 to over 16 million in 1967-68 and about 30 million in 1969; this accounts for approximately 16 per cent of the wheat acreage and 7 per cent of the rice acreage in non-communist Asia. In India and West Pakistan, where the new varieties are being adopted most extensively, it has been estimated that it accounted for almost 31 per cent and 41 per cent respectively of the wheat acreage in 1968-69. The acreage planted to new rice varieties varied from about 2 per cent in East Pakistan and 7 per cent in India to 27 per cent in West Pakistan².
9. Thus, admittedly, the yield increasing technological change is a relatively new phenomenon in the developing countries. It is even perhaps too early to realise the true potential and significance of this change in all its various aspects. However, since its inception immediately after the food crisis of 1965-66 in South Asia, a certain degree of recovery and acceleration in food production in particular and in agricultural and other spheres of activity in general, can be observed. While the general deceleration during the early sixties which culminated in the "crisis" was largely the product of insufficient emphasis on agricultural development programme and successive bad weathers, the credit for the subsequent recovery should go to a large extent to the yield augmenting technological changes³.
10. The compound annual growth rates of food and agricultural production in the developing countries are shown in Table I. The growth rates are shown for three different periods (the last period presumably reflecting the effect of "green revolution", in Asian countries in particular) and in relation to the rate of growth of population in each period.

It is seen that the rate of growth of population has increased in all developing regions while the rate of growth of food production has barely kept pace with it. One fact, however, emerges clearly. In Asia, there is a distinct improvement in the rate of growth of per capita food production in the years after 1965 compared with the earlier periods. In Africa, the per capita food situation has gradually deteriorated since 1960 because of a rise in the rate of growth of population and a fall in that of the food production. In Latin America, the per capita food production over the last half a decade (1965-70) increased at a rate slower than in the earlier period (1960-65). This was partly because of an accelerated rate of increase in the population. The

¹ F. A. O.: Production Year Book, 1967, 1968, 1969, Rome; the section on prices.

² SCHERTZ, L. P.: The Green Revolution: Production and World Trade: in Columbia Journal of World Business, Vol. V, No. 2, March-April 1970 Columbia University, pp. 54-55; UNITED NATIONS: Economic Survey of Asia and the Far East, 1969, Bangkok 1970. Table I-A-11: pp. 25.

³ For a description of the cyclical behaviour of the agricultural production, see SCHERTZ, L. P.: The Green Revolution; op. cit.

rate of growth of per capita agricultural production in the last phase, in fact, declined compared with two previous periods.

Table I : The Compound Average Annual Rates of Growth of Population, Food and Total Agricultural Production in Developing Zones (selected periods).

Unit: Per cent

Year Region	1948-52 to 1960 (average)			1960 to 1965			1965 to 1970		
	Pop.	Food	Agr.	Pop.	Food	Agr.	Pop.	Food	Agr.
All developing	1.86	2.67	2.75	2.60	2.36	2.48	2.70	3.14	2.84
Latin America	2.26	2.46	2.67	2.86	3.60	3.38	2.90	3.26	2.02
South, East and S.E. Asia ¹	1.79	2.82	2.65	2.62	1.72	1.88	2.60	3.82	3.70
West Asia ²	2.19	3.31	3.27	2.56	2.74	3.16	2.80	2.78	2.60
Africa ³	1.95	2.37	2.67	2.44	1.80	2.06	2.60	1.78	2.00

¹ Excludes Japan. ² Excludes Israel. ³ Excludes South Africa

SOURCE: F.A.O. Monthly Bulletin of Agricultural Economics and Statistics: Table I, pp. 17, Vol. 20, January 1971.

The increases in the grain yields (which is more relevant for evaluating the "green revolution") in selected countries between 1952-56 average and 1968-70 average are also shown in Table II.

11. It is debatable as to how much of the recent increases in output can be attributed to the technological change. However, some crude estimates of the relative contribution of area expansion and the yield increases to the total growth of crop production, make interesting reading. These estimates indicate that the cultivated area in most Asian regions expanded at approximately the same rates in 1950s and 1960s; however in all regions, the growth of output in 1960s exceeded the growth of area by more than in the 1950s. In other words, the growth of area relative to growth of output (the ratio of the annual growth rates of area to that of output) has tended to decrease in 1960-68 compared with 1950-60¹. In Ceylon, for instance, the ratio has declined from 52 per cent to 20 per cent; in West Malaysia, it has decreased from 185 to 36 per cent. These estimates suggest that presumably with the increasing adoption of yield increasing technology in the 1960s, the relative importance of area expansion as a growth factor has declined while that of yield expansion has increased.

¹ UNITED NATIONS: Economic Survey of Asia and the Far East, 1969, Ch. II, Tables, I-A-6 and I-A-), pp. 15-16, Bangkok 1970.

Table II: Changes in the yield per hectare of selected cereals in selected countries
(Unit: 100 kg/ha.)

	Wheat			Rice			Maize		
	(average)			(average)			(average)		
	1952-56	1963-64	1968-70	1952-56	1963-64	1968-70	1952-56	1963-64	1968-70
India	7.4	7.6	11.61	12.8	16.0	16.1+	7.8	10.0	9.8+
Paki- stan	7.5	8.3	11.05	13.7	17.0	18.0+	10.0	10.5	10.1
Ceylon	-	-	-	15.7	20.0	24.2	5.3	8.0	12.6 ⁺⁺
Turkey	10.0	10.6	11.81	35.8	43.5	38.8 ⁺⁺	12.4	14.7	15.2
Tunisia	5.0	5.5	5.0	-	-	-	-	-	-
Thai- land	-	-	-	13.5	16.0	18.1	12.2	19.5	21.7
Philip- pines	-	-	-	12.0	12.5	15.9	5.8	6.8	8.0
Argen- tina	13.3	17.1	11.6 ⁺	31.7	34.5	39.6	16.0	17.0	20.8
Europe	16.2	20.4	25.0	44.4	47.0	44.4 ⁺	15.5	24.5	31.1
U. S. A.	12.5	17.6	20.2	30.0	45.0	49.4	26.5	41.5	49.0

+ Average 1968-69
++ Average 1967

Source: Production Yearbook, 1968, Vol. 22, F.A.O.

Monthly Bulletin of Agricultural Economics and Statistics; F.A.O. No. 12, Vol. 19, Dec. 1970; Nos. 1, 2, Vol. 20, January and February, 1971.

12. The general nature of the relationship between technological change, production and trade in agricultural commodities in a developing country can be formalised in the following manner. *Ceteris paribus*, a net food grains exporting country (or a region) can be said to face an income inelastic domestic demand for its grain products. As a consequence the scope for increasing the grain production is limited primarily by its rate of growth of population. On the other hand, the "revolutionary" rate of growth of supply of the exportable crop may be much higher (following the adoption of new technology) than the rate of growth of world demand. If the world price for the product in question falls as a result, this would not only seriously undermine further innovations, but would also adversely affect the balance of payment position of the country (region). The rice production and trade prospects in the South East Asian countries seem to typify this situation. In a net food grains importing country or a region, the demand for food can be expected to be relatively more price and income elastic. Hence the initial impact of the increase in production (as a consequence of technological change) would be a higher rate of domestic consumption and a lower rate of imports.

If the region continues to remain a net importer, the local producers must compete with imports that may have become cheaper (because of technological changes in the net food exporting countries). If the net importing region expands production sufficiently to become a net exporter, the domestic price of the commodity falls by the difference between the c.i.f. and f.o.b. levels. In both instances, the fall in

prices may be an obstacle to further innovation. If local production is subsidised to countervail this effect, it distorts the relative prices and may only lead to further production under inefficient conditions. The net cereals importing countries of South Asia are likely to face this dilemma. A priori, when the production and trading prospects in the cereals, following the initial success of green revolution, are taken into account, there would thus appear to be a strong case for product diversification in agriculture. However, to examine further the trade prospects in cereals, it is necessary first to understand the actual pattern of international trade flow in these products.

13. It seems most appropriate to start with a look at the relative importance of agricultural exports in less developed countries (Table III). For the developing countries as a whole, the agricultural export accounted for nearly 45 per cent of their total export in 1967-68, on average. The share was as high as 75 per cent for the countries in South East Asia and was as low as 23 per cent for the Middle East Asian countries. Moreover in South East Asia only cereals account for nearly 60 per cent of its total agricultural exports¹. For our purpose, further analyses will be restricted to cereals only for the reason that the "green revolution" has so far been significant on the plane of food and feed grains only.

Table III: Relative importance of agricultural exports in selected developing regions:
(Unit: per cent) 1967-1968 (average)

Exporting Regions	Share of Agriculture in total exports	Share of cereals in total agric. exports
South America and Mexico	43.3	11.0
Central America and Caribbean	42.0	1.0
North Africa	30.0	12.0
East Africa	72.0	3.7
West Africa	66.3	0.2
Middle East Asia	23.6	2.3
South Asia	46.0	3.2
South East Asia	75.0	59.0
Total developing	45.0	

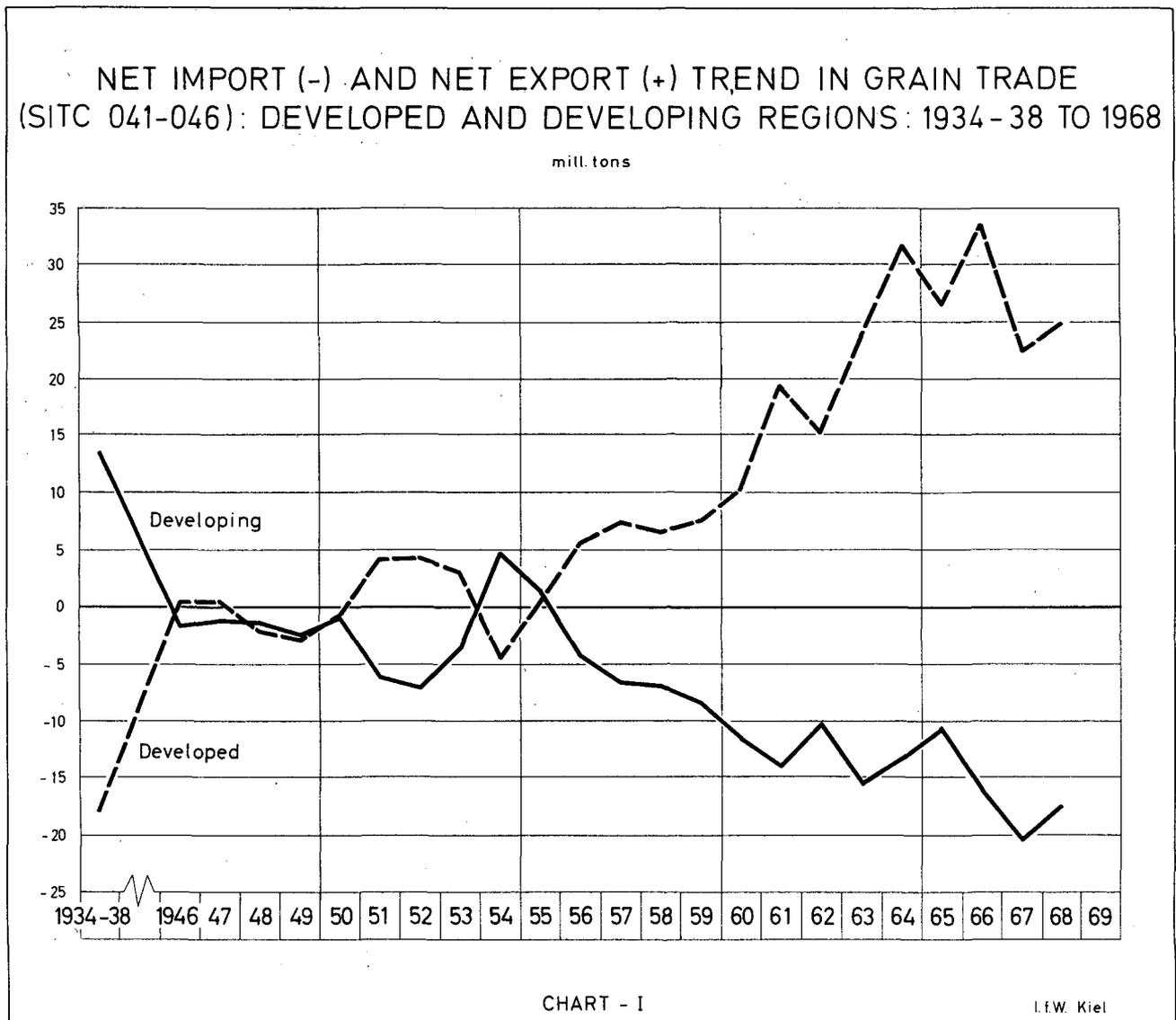
Source: F. A. O. Trade Yearbook, 1969.

14. A historical review

Over the period of last seven decades, there has been a neat reversal in the respective roles of the developed and developing regions in the world market for cereals. The developing countries which had been net exporters of approximately 14 million tons

¹ Generally speaking, there exists a broad pattern of regional importance of certain specific commodities in the world export of agricultural goods. Compared with other developing countries, fibres and fruits together account the largest share in agricultural exports from North Africa and West Asia. East and West Africa specialize in the exports of oilseeds, coffee and cocoa. The export of coffee constitutes the largest proportion of its total agricultural export from Latin America and that of tea in South Asia.

of cereal grains each year in the 1930s, gradually turned into net importers of more than 10 million tons per year in the 1960s. The situation worsened further between 1965 and 1967 apparently because of the widespread drought and since 1967 there has been an upward turn reflecting mainly the effects of "green revolution" and a greater degree of self dependency. As can be seen from Chart I, the trend in the developed zone was just the reverse and it turned into a net exporter of food and feed grains from a net importer in the 1930s¹.



15. Broadly speaking, this phenomenon is a reflection of the differences in the net demand-supply situation in the two zones. It is an observed fact that at a higher level of development, the domestic demand for food tends to shift away from grains

¹ The developed and developing regions referred to in the text include only the non-communist countries.

to livestock¹. In other words, compared with the developing countries, the demand for food in developed countries is concentrated more on meat than grains. At the same time, as a consequence of a high speed of technological innovations in the developed region, the rate of growth of per capita grain supply has been much higher than the rate of growth of demand. Hence, these countries have been accumulating large stocks of food grains over the past years. While the demand for food has gone up in developing world primarily because of a very high rate of population growth, the supply of food grains has lagged behind, among other reasons, because of lack of meaningful technological innovations in agricultural sector, at least until very recently. Under such a constellation of circumstances, it could be expected that the developed countries would become the net exporter of their surplus grains vis a vis the developing countries.

16. Between 1951 and 1968, the volume of world trade in grains increased at a compound average annual rate of 4.5 per cent from 47 million metric tons to 101.2 million metric tons. In this period, the total grain export from the developing countries as a whole, increased by 9.1 million tons or it increased at an average compound rate of 3.8 per cent per annum; on the other hand, the total import of grains into the developing countries increased by 4.2 per cent per annum. In the developed countries, on the whole, the average rate of import increased by 3 per cent annually whereas their exports increased at a rate of 4.6 per cent per year. In brief, for the developing regions, cereals import has tended to increase at a rate faster than export, whereas for the industrialised countries, the rate of growth of export has far exceeded their total import demand.
17. As a corollary of what has just been said, it is equally revealing to have a look at the world trade structure in food and feed grains (SITC: 041-046). The structure of trade refers to the share of different regions in the world trade in a commodity. Some interesting feature of the comparative market share of the developed and developing regions can be summarised. (See Chart II).
 - a) It should be clear that the developing countries have gradually given way to the developed countries in the world market for cereals. The latter's share in the market increased from less than 30 per cent in prewar years to 75 per cent in 1968; the share of the developing countries, on the other hand, has declined steadily from 55 per cent of the total world export in prewar times to barely 15 per cent in 1968².
 - b) The regional trends within the developed and developing zones were as follows. Among the developed countries, the share of U.S. and Canada declined over time, whereas it increased at a very high rate for the rest of the developed countries. In the developing zone, the share of West Asia, South Asia and South East Asia recorded a decline, whereas for the East African regions there was a modest

¹ On the basis of an estimated world demand function, the income elasticity of demand for meat is approximately 0.65.

See: ROJKO, A. S. and MACKIE, A. B. World Demand Prospects for Agricultural Exports of Less Developed Countries in 1980: U.S.D.A., Economic Research Service, Foreign Agricultural Report No. 60. pp. 8.

² Source: U.S.D.A. World Trade in Selected Agricultural Commodities, 1951-65, Foreign Agricultural Report No. 49, Vol. II Washington.

MARKET SHARE OF THE DEVELOPED AND DEVELOPING COUNTRIES IN THE TOTAL WORLD EXPORT OF GRAINS (SITC: 041-046): 1934-38 TO 1968

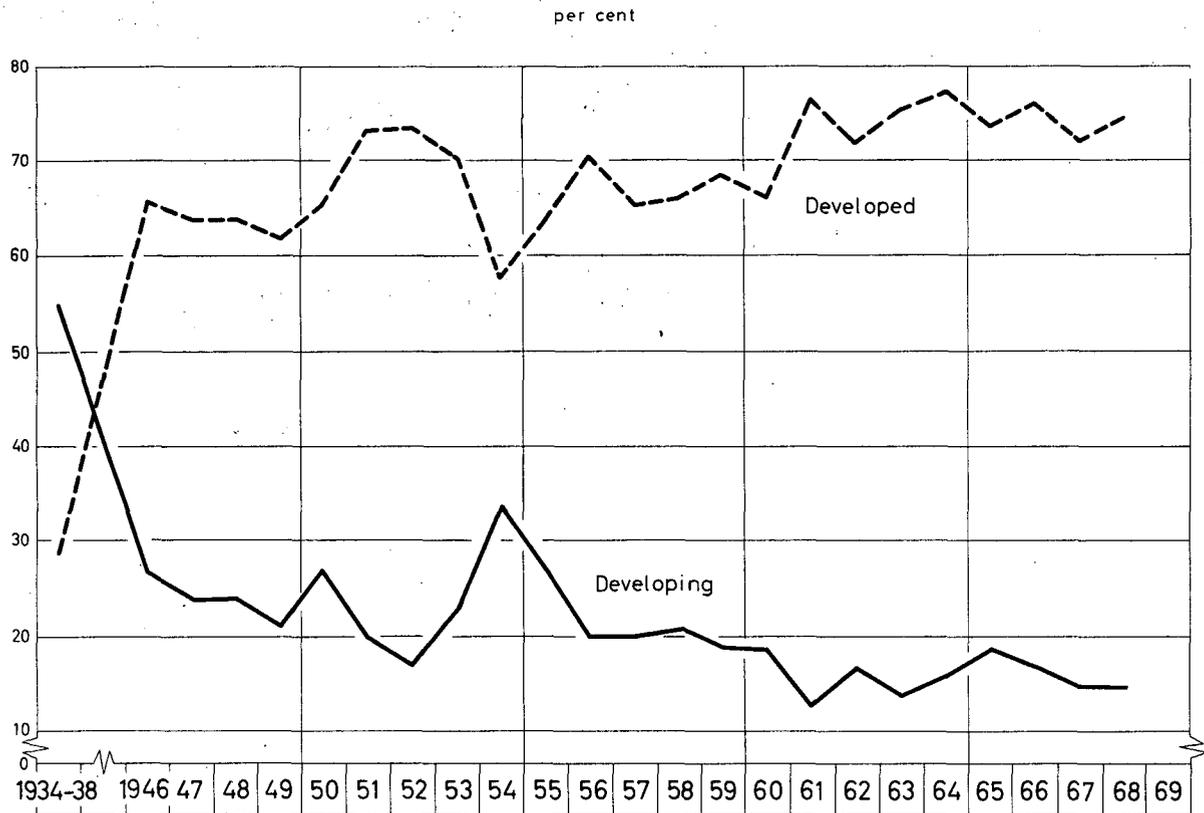


CHART - II

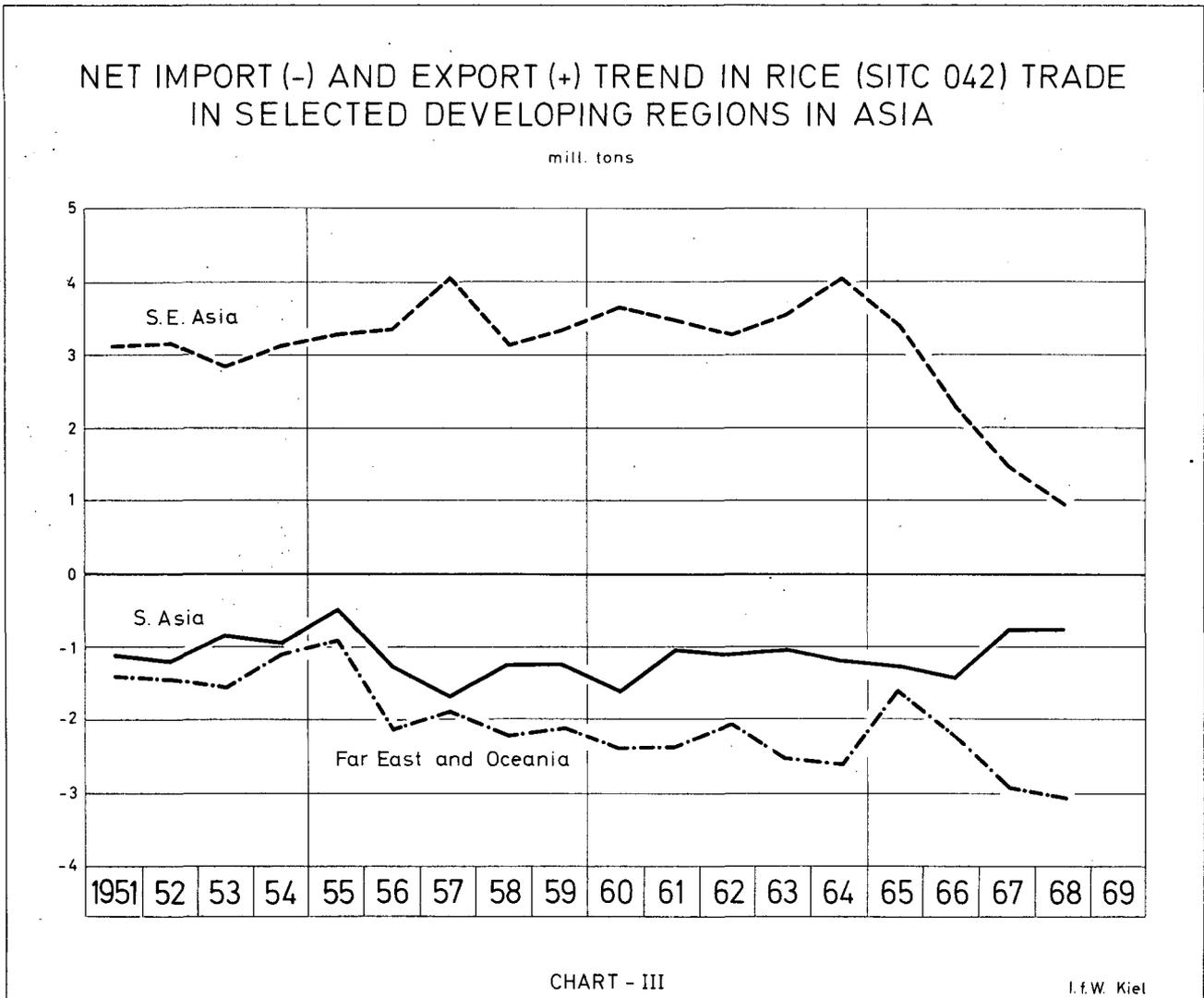
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increase. The share of the Latin American countries improved a little¹. To reiterate, while the total world cereals-trade has increased in volume over time and while the exports from both developed and developing countries have shown an upward trend, the relative share of the developing region in the world export has considerably declined. In the background of this global trade pattern we shall now examine the export prospects of two principal crops, rice and wheat, from the developing countries.

¹ The changes in the relative market shares between 1951 and 1968 were as follows: for U.S., and Canada, it fell from 62 to 49 per cent; it increased from 9 to 26 per cent in the rest of the developed countries (excluding communist countries). East Africa's share increased from 0.18 to 0.65 per cent while that of whole of Asia's decreased from 9 to 4 per cent. Latin America's share increased from 8 to 9 per cent. However in each region the market share fluctuated widely within the stated range over this period. Source: *ibid.*

18. Trade prospects in rice :

The world trade in rice increased at the compound rate of around 3 per cent per annum between 1951 and 1968. The total share of the developed countries in the world export of rice more than doubled in this period (from 15.5 per cent to 36 per cent) while the combined share of the developing countries fell by nearly half (it fell from 81 per cent to 45 per cent)¹. Some highlights in the market share of the different regions can be observed. Among the developed countries, the share of the United States increased by nearly three times from 9.6 per cent (in 1951) to nearly 29 per cent (in 1968) and is now the principal supplier in the world market. Among the developing countries, the South East Asia which had been the major supplier in the world market with more than 60 per cent of the market until 1957 and about 55 per cent of the market until 1964, faced an abrupt drop in its share after this time; in 1968, it had only about 25 per cent of the market. Another interesting feature is the growing importance of communist Asia as major rice exporter; in 1968, it captured about 17 per cent of the market compared with its share of only 3 per cent in 1951.



¹ These figures exclude East European countries, USSR and the communist Asia.

19. The main picture that emerges out of this can be depicted in the following way. The major rice exporter from the developing countries, the South East Asia, has been facing a falling demand in the world market. As can be seen clearly from Chart III, as a net exporting region, the South East Asia, hit a peak point in 1964 and since then its net rice exports have tapered off to a trickle-less than 1 million tons in 1968. On the other hand, in South Asia - one of the major net importing regions - the conditions deteriorated between 1963 and 1966 and since this latter year the trend appears to be in the direction of an equilibrium between export and import of rice. In Far East Asia and Oceania, however, the net import continues to rise and appears to be providing the only outlet of rice from the South East Asia. Before we go on to examine the specific variables that can presumably explain these phenomena, it is useful to analyse the changes that have taken place in the pattern of international rice trade, over time.
20. The relative changes in the importance of rice trade from the developing countries to the developed countries and to themselves are shown for selected years between 1951 and 1965, in Table IV. It should be added that, the developed countries as a whole have been importing less and less of the total export of rice from the developing regions. In 1951 the developed countries bought 25 per cent of the total rice exports from developing zones; in 1968, the proportion stood at only 5.6 per cent¹. Referring to Table IV, it is

Table IV: The percentage distribution of export of rice from selected developing regions to developed and developing zones: 1951, 1955, 1960 and 1965

(Unit: Per Cent)

Destination Exporting region	1951		1955		1960		1965	
	Developing	Developed	Developing	Developed	Developing	Developed	Developing	Developed
Latin America	61.7	38.3	62.6	33.3	70.4	29.6	63.8	22.1
North Africa	18.4	66.3	26.6	58.1	72.3	17.0	1.5	18.8
West Africa	-	100.0	100.0	-	4.0	96.0	-	-
East Africa	83.3	16.7	74.1	25.9	45.2	58.8	50.0	50.0
West Asia	-	100.0	46.2	23.1	-	-	-	-
South Asia	100.0	-	89.4	3.4	100.0	-	86.3	2.8
South East Asia	78.4	20.1	62.7	24.1	87.2	8.5	82.5	9.3
Other East Asia	-	100.0	1.1	98.9	65.0	35.0	1.3	98.7
Far East and Oceania	100.0	-	100.0	-	100.0	-	100.0	-

Source: Calculated from: U. S. D. A. World trade in Selected Agricultural Commodities, 1951-65, Vol. II, Food and Feed Grains, Economic Research Service, USDA, June 1968.

seen that except for some East Asian countries, it appears that the largest proportion of export of rice from the developing countries is confined within the developing countries themselves. One interesting feature is the growing importance of the communist countries as the major market for the North African countries. For example, in 1960, the communist countries accounted for only 10 per cent of North African rice exports; in 1965, the proportion was 80 per cent. For the major exporting region in the world - South East Asia - the Asian countries themselves provide the biggest market for the

¹ See: O. E. C. D., Statistics of Foreign Trade, Series c, Trade by commodities: imports: JAN - JUN 1968.

outlet of their products. Thus for instance, in 1951 about 74 per cent of the rice exports from South East Asia were absorbed within the Asian regions (especially in the South and Far East Asia) and in 1965, the proportion was nearly 72 per cent. Thus it is interesting to note that, among other variables, geographical contiguity is an important factor to reckon with in an analysis of the international trade flows.

21. Because international trade is a function of both exportable supplies and import demand, a continuous increase in production in itself is no guarantee for a continuous increase in trade. In fact, as we have emphasised earlier, if the increase in production occurs in both exporting and importing regions, a fall in import demand may accompany a rise in exportable surpluses; the net trade in the commodity may as a result fall.

Between 1951 and 1969, the world trade in rice has undergone alternate phases of acceleration and deceleration (Table V). The rate of growth of trade was highest - equal to 7 per cent - in the period when the rate of growth of world production in rice in fact declined by 2.2 per cent (1963-65). On the other hand, the rate of decline in the world trade in rice has been fastest in the period when the rate of growth of production has been the highest (1965-69).

Table V: Compound annual rate of growth of world trade and production in rice, selected periods 1951-1969

	(Unit: Per Cent)	(Unit: Per Cent)
	Trade	Production
1951-1960	+ 4.2	+ 4.0
1960-1963	- 3.2	+ 2.7
1963-1965	+ 7.1	- 2.2
1965-1969	- 4.6	+ 5.0

Source: GATT: 1. International Trade Statistics 1969 Geneva, 1970, pp. 28-30
2. F. A. O. The State of Food and Agriculture, 1968, 1969, Annex Tables

Only in the period 1951-1960, that the world production and world trade increased at approximately the same rate. It was the consequence of a "fortunate" coincidence of the major rise in production being concentrated in the net exporting countries, while the import demand continued to rise in net importing countries. In South East Asia - the world's major supplier of rice - the net export increased by 1.6 per cent in this period, whereas the net import increased by 4.5 per cent in South Asia and by about 6 per cent in other East Asian countries (including Far East and Oceania) - the major net rice importing regions.

22. The situation changed radically after 1965. Increase in production is no longer restricted to the major exporting countries. The spread of technological change in agriculture to the hitherto net importing regions as well, has caused reduced import demand and thus large increases in stocks in many exporting regions. This has in

its turn caused a fall in the international price of rice¹. The most striking change in the import side is the position of Japan, which among the developed region, was the largest single importer in 1965 and is now a net exporter of rice. Among the countries of South and East Asia, Ceylon, India, Malaysia and the Philippines have been substantially reducing their import since the mid-1960s. However the import requirements in other East Asian countries like Indonesia, the Republic of Korea and of Vietnam have grown markedly during this period. The overall picture of the net trade in rice in 1965 and 1969, is shown in the table VI.

Table VI: Net trade in Rice, 1965 and 1969 (million tons, net imports -, net exports +)

	1965	1969 ^a
Japan	- 0.94	+ 0.28
South and East Asia	+ 0.46	- 1.57
Of Which: Burma and Thailand	+ 3.20	+ 1.44
Ceylon, India, Malaysia, Philippines	- 2.49	- 0.96
Indonesia, Rep. of Korea and Vietnam	- 0.39	- 1.68
Other developing countries	- 0.85	- 0.31
United States	+ 1.55	+ 1.92
Other developed countries	- 0.45	- 0.40
Eastern Trading Area:	+ 0.16	+ 0.33

a) Preliminary

Source: GATT, International Trade 1969, Geneva, 1970, Table II, pp. 29.

23. The major conclusions from the foregoing can be very briefly summarised. So far as trade and production in rice is concerned, the "green revolution" is likely to result in lower world import demand, a demand centred in the less developed countries. The import demand in the developed areas can be expected to rise only moderately. However, the increase in demand will probably be small relative to potential supplies for exports - from both developed and less developed countries. Consequently continued downward pressures on the world price for rice can be expected. The lower world price in itself may not lead to increased trade in rice mainly because production increases are occurring in major importing regions.

24. These conclusions are tend to be supported by projections on trade situations which have been made by the United States Department of Agriculture and by the Food and Agricultural Organization of the United Nations² (Tables VII a + VII b). According

¹ According to the F. A. O. price Index for all rice, prices fell by 12 per cent between 1968 and 1969. From a peak level of 158 (1957-59 = 100) in March 1968, the index receded to 113 in March 1970.

² a) ROJKO, S. A. & MACKIE A. B., World Demand Prospect for Agricultural Exports of less Developed Countries in 1980, USDA, Agricultural Economic Report 60, Washington 1970.

b) Indicative World Plan, Ch. 14, F. A. O., Rome.

to the first projection, if the green revolution accelerates, the net developing importers will reduce their import demands by 30 per cent in 1980 from their net import of rice of about 4.3 million tons in the base period 1964-66. The net exporters on the other hand are projected to increase their export of rice by only 17 per cent over the base period net export of 3.2 millions.

Table VII (a): Production, Consumption and Trade in Rice, 1964-66 Average and Projection to 1980: U. S. D. A. estimates. (Unit: Million Metric Tons)

Exporting Region	1964-66 (average)			1980-Projection		
	Produc- tion	Consump- tion	Net Trade	Produc- tion	Consump- tion	Net Trade
Less developed: Importers	68.5	72.8	- 4.3	124.9	127.9	- 3.0
Exporters a)	24.5	21.5	3.2	38.4	34.5	3.9
Total less developed	93.0	94.3	- 1.1	163.4	162.4	0.9
Total developed	15.0	14.3	0.4	15.4	14.4	- 0.8
World Total	172.4	172.6		268.7	266.7	

a) East South America, Argentina, North Africa and South East Asia.

Source: ROJKO, S. A. and MACKIE, A. B. World Demand Prospect for Agricultural Export of less developed countries in 1980, United States Department of Agriculture. Economic Research Service, pp. 22, 38 Tables 9, 19.

Table VII (b): Production, Consumption and Trade in Rice: Projections to 1985: The F. A. O. estimates (million tons)

	1962			1985		
	Produc- tion	Consump- tion	Net Trade	Produc- tion	Consump- tion	Net Trade
Less developed Exporters	20.5	18.4	2.8	41.0	33.7	7.3
Importers	80.8	84.2	- 3.1	173.8	168.2	5.6
Total less developed	101.3	102.6	- 0.3	214.8	201.9	12.9

Source: F. A. O. Provisional Indicative World Plan for Agricultural Development. Ch. 14 Commodity Balances and Trade Policy Issues. The estimates are those of "Studied countries" covering about 84 per cent of total population of the less developed countries. The definition of importers and exporters is based on their trade position in 1962 - the base year

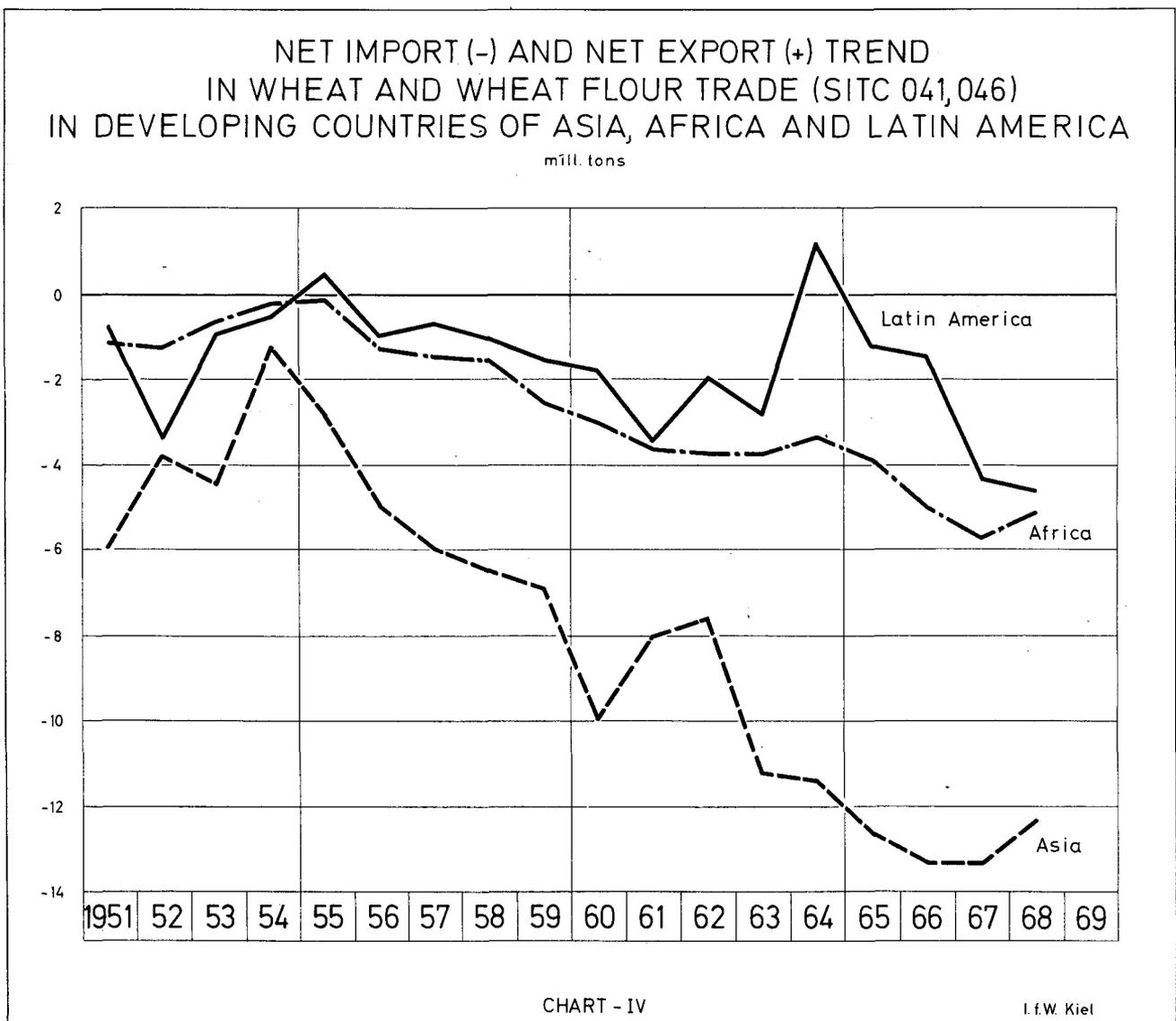
25. The F. A. O. projection (it extends to 1985 and has the reference year, 1962) of the future tradeable surplus of rice is relatively more optimistic. The net exporters of rice from the developing countries are projected to increase their exportable

supplies by more than 150 per cent in 1985 compared with their base year performance. The net importers of 1962 (together they imported about 3.1 m. tons of rice in that year) are projected to produce an exportable surplus of 6 million tons in 1985.

26. According to the F. A. O. estimate, the net exportable supplies of rice from the total developing countries alone will be of the order of 13. m. tons in 1985; according to the USDA projections, it will be around 1 m. tons in 1980. Both projections assume an annual rate of growth of production of approximately 3.5 per cent between their respective base years and the projected year. However the rate of growth of consumption is assumed to be higher in the latter projection (3.43 per cent) than in the former (2.9 per cent). This explains partly the implied differences in the trade surpluses as estimated in these projections. Also, because of a difference in the use of the base period, the estimated magnitudes of production, consumption and net trade in the future differ in these two projections. The choice of the reference period 1964-66 by the USDA appears to be particularly unsatisfactory as these were the years of acute crop failures and consequently both production and consumption of rice were low. Hence projections based on these years are likely to yield underestimates.
27. It should be stressed at once that a projection of the future production and trade possibilities in agricultural goods from the developing countries may not be very practical on number of grounds. In fact both the F. A. O. and the USDA projections appear to suffer from some serious limitations. First, the agricultural production in most developing countries depend largely on the availability of rainfall and this is particularly true of the Asian countries. We have noted earlier that only a minor portion of the total cultivated land in these countries is under irrigation. Since it is almost impossible to predict the amount and distribution of rainfall in any region, it is very likely that the projected output figures are exposed to a high degree of error. Secondly, the relative prices of different agricultural products are an important variable determining the output of a particular product. In projecting future output, it is necessary to make some strong assumptions in respect of future relative prices. Such assumption may not hold true in reality however, as future prices in their turn will depend on future output and on future price policies which are not predictable. Thirdly, in these projections, the level of consumption is made to be a function of level of income, population growth and price. It is implicitly assumed that the prevalent distribution of income within the countries will continue into the future. However, a structural change such land reform in any country may affect both the level and the pattern of consumption through a change in the distribution of income.
28. In view of these limitations, these projections should be treated, at best, as only indicative of feasible future trends in the relevant variables. However, it seems possible to derive at least one policy implication from these projections. The substantial amount of tradeable surplus of rice in 1985 as projected by the F. A. O. Indicative World Plan, will most probably have adverse effect on the future international price of rice. On the basis of this presumption, it can be argued that the countries which are heavily dependent on the export of rice should take appropriate measures towards export diversification, so as to prevent a likely fall in their foreign exchange earnings. This would mean diverting resources away from rice to other products which are likely to face a relatively more favourable market situation in the future.

Trade prospects in wheat:

29. Unlike in rice, the developed countries have had the lion's share in the world export market for wheat and flour (SITC: 041, 046) and the situation had changed very little between 1951 and 1969. While the total market share for this group has declined from 88 per cent in 1951 to 81 per cent in 1968 (manily because of the fall in the share of United States from 49 per cent to 34 per cent and of Canada, from 25 per cent to 19 per cent), that of the European Economic Community has increased from 3 per cent to more than 13 per cent. Latin America (more specifically Argentina and to a lesser extent, Mexico) - the only exporting regions of any significance from the developing group - has faced a declining share of the market, the fall being most abrupt since 1965. The market share rose from 9 per cent in 1951 to a peak point (in the sixties) of 12 per cent in 1965 and in 1968, the proportion was 4.6 per cent¹.



¹ The market shares are calculated from: a) U.S.D.A.; World Trade in Selected Agricultural Commodities: 1951-65, op. cit. pp. 65-79. b) F.A.O.; Trade Yearbook, 1969, Rome 1970, pp. 119-123.

30. With the exception of Argentina, the rest of the developing world (including Latin America) constitute the net importing regions for wheat and wheat flour. (See Chart IV). The implications are thus somewhat different from that of international trade in rice. The impact of accelerated green revolution is most pronounced in major wheat importing regions of South Asia (especially India and Pakistan). The increased production is likely to cause a fall in import demand whose initial impact will be on the United States PL 480 programme (under which, wheats from U. S. are exported under special terms) and eventually on the wheat sale of the exporting countries throughout the temperate regions of the developed world. To the extent that Argentina (the only net wheat exporter from the developing region) is faced with increased domestic production and falling external demand, the situation is similar to that of the net rice exporting regions of South East Asia.
31. Irrespective of the small and declining magnitude of wheat export from the developing countries, its pattern has changed over time in an interesting manner.

First, the proportion of wheat export going to the developed regions increased between 1951 and 1955 from 42 per cent to 54 per cent and since this latter year the ratio has declined at a very fast rate so that in 1968 it was only 12 per cent. In other words, increasingly greater proportion of the total wheat exports from the developing countries has tended to be confined within developing regions themselves. North Africa has been the only exception to this rule, thanks mainly to its privileged position in the EEC as per "associate" status (See Table VIII).

Table VIII: The percentage distribution of export of wheat and wheat flour (SITC 041, 046) from selected developing regions to developed and developing zones

Destination Exporting region	1951		1955		1960		1965	
	Developing	Developed	Developing	Developed	Developing	Developed	Developing	Developed
Latin America	65.33	34.7	46.1	47.2	65.6	34.4	31.3	29.9
North Africa	-	100.0	-	100.0	-	100.0	27.1	72.9
West Africa	-	-	-	-	-	-	-	-
East Africa	-	100.0	-	100.0	-	-	100.0	-
West Asia	64.51	35.5	24.5	70.5	77.3	22.7	66.0	33.3
South Asia	-	100.0	-	100.0	-	-	100.0	-
South East Asia	-	-	-	-	-	-	100.0	-
Other East Asia	-	-	-	-	100.0	-	100.0	-
Far East and Oceania	-	-	-	-	100.0	-	100.0	-

Source: Calculated from: U. S. D. A. World Trade in Selected Agricultural Commodities, 1951-65, Vol. II, Food and Feed Grains, Economic Research Service, U. S. D. A. June 1968.

Note: Wheat and wheat flour are in wheat equivalent.

Secondly, the proportion of total wheat imports into the developing countries from the developed ones has recorded a decline in the recent years. This has not, of course, altered the fact that the latter group still continues to be the largest net supplier to the rest of the world. Thus, for instance, the proportions were 84 per

cent in 1951 (72 per cent from the OECD countries only) and 86 per cent in 1965 (80 per cent from OECD countries). However the decline in the relative importance of the developing countries as the wheat market for the developed countries can be seen from the fact that in 1968, the OECD countries accounted for only 40 per cent of the total wheat imports into developing countries¹. This, in part, is a reflection of the growing degree of self dependence on the part of the developing countries - due mainly to the "green revolution".

32. As in the case of rice, the dynamic relations between world production and world trade in wheat indicate some interesting features. The rate of growth of world wheat production accelerated from 3.3 per cent per year in the "pre-revolutionary" years (1955-1965/66) to 7.5 per cent annually in the years after the beginning of the "green revolution" (1965/66-1968/69). The world trade in wheat, on the other hand, declined in the second period as compared with the earlier one. After a yearly growth rate of 7.5 per cent between 1955 and 1965/66, the world trade has fallen rapidly at the rate of 8.5 per cent per year between 1965/66 and 1968/69².
33. The inverse relationship between the rate of growth of world production and of world trade (in the second period) has to be seen in the light of general increases in wheat production that have occurred in developed (the net exporters) as well as developing (the net importers) countries. The developing countries' share in the total world production of wheat declined at an average annual rate of 1.7 per cent in the period during which both world trade and world production increased (1955-66). On the other hand, in the period when world trade in wheat declined annually by more than 8 per cent, the share of the developing countries in the world wheat production increased at an average rate of 5 per cent per year³.
34. However, a large part of the decline in trade prior to 1968/69 season has been attributed to reduced import requirements in the eastern trading area (due to improved production). In fact, the impact of green revolution (the improved cereal situation in developing countries) on the international wheat trade was really felt during the season 1968/69. It was for the first time since 1950s that the import demand from the developing countries were decreased and this reflected mainly a reduction by about one third in import into South and East Asia. The overall picture in respect of world trade in wheat and flour in these later years are shown in Table IX.

¹ OECD, Statistics of Foreign Trade, Series C, Trade by Commodities, Exports, JAN-JUN 1968, Paris 1969. The proportion was approximately 49 per cent when Australia is included.

It should be added that the communist countries are becoming important source of outlets of wheat from non-communist developed countries.

² Source: Calculated from:

1) F. A. O., The State of Food and Agriculture, 1969, pp. 139

2) U. S. D. A., World Trade in Selected Agr. Commodities, 1951-65 Vol II. pp. 65-79.

3) GATT, International Trade, 1969, Geneva, 1970, pp. 25-28.

³ Source: F. A. O. The State of Food and Agriculture, 1969, Rome 1969; Annex Tables, pp. 138-196.

Table IX: World Trade in Wheat and Flour (Million Tons, July-June Season)

	1965/66	1966/67	1967/68	1968/69
Total imports:	61.4	55.6	51.9	46.5
Developed Countries	17.5	16.4	15.0	17.4
Developing Countries	23.0	25.6	26.9	20.8
Eastern Trading Area	20.9	13.6	10.0	8.3
Total Exports:	62.3	55.9	53.0	47.8
Of which from				
United States	23.4	20.0	20.5	14.5
Canada	14.8	14.8	8.9	8.7
Australia	5.7	7.3	7.0	5.3
Argentina	7.8	3.1	1.4	2.8
EEC	6.3	4.7	6.0	7.9
USSR	2.2	4.1	5.1	5.4

Source: GATT: International Trade, 1969, op. cit: p. 26

35. From the foregoing analysis it would appear that, thanks to the new agricultural technology, the developing countries are at present undergoing a process of import substitution in wheat. However, it seems, even at the present rate of increase it will take some years before the countries of South and East Asia will be self-sufficient in wheat production. Some tentative estimates have put "after 1975" as the first year of sustained surplus in wheat in India and Pakistan - the two countries in South Asia where the rate of adoption of new varieties has been the fastest¹. For the developing countries, the immediate implication of the present downward trend in import requirements is the saving of foreign exchange to the extent of that part of current imports which is now on commercial term.
36. Any overspill of production into export might imply a net gain in foreign exchange². Such a prospect, however, does not appear to be very bright. Unless the domestic productions in developed countries are cut down voluntarily below their level of domestic requirements - a highly unlikely hypothesis - there is unlikely to be any net import demand for wheat in the developed countries. Even at the current rate of production, the trade policies in industrialised countries - outside and inside custom areas - are highly discriminatory vis a vis grain exports from developing

¹ Rice, E. B., Spring Review of the New Cereal Varieties; A perspective, A.I.D., ppc/Evaluation Staff, January 1970, Table 4 pp. 27 A.

² Admittedly, a net gain in foreign exchange will occur only when the additional foreign exchange requirements for importing the essential agricultural inputs like fertilisers (on which the success of the green revolution is largely dependent) do not exceed the additional foreign exchange saved and earned through import substitution and net export.

countries¹. Also, because of the "inferior" quality of the new varietal wheat, it will be difficult to find a market in the western world².

37. One possible alternative would be to increase the scope for intradeveloping countries' trade in wheat and thus replace the developed countries as the traditional source of supply to the developing regions. This amounts to identifying, as a first step, the potential surplus and deficit areas within the developing zones. Some tentative suggestions can be attempted. In Asia, Ceylon and Malaysia for instance appear as net importer of wheat and without any domestic production. Similarly in Ghana, Mauritius, Senegal and Sierra Leone (in Africa), the domestic consumption of wheat is entirely dependent on import, the major part of which comes from the developed countries³. It seems, however, that these African markets should provide the possible outlet for the surplus of Kenyan wheat - a surplus that has been estimated to figure around 105 thousand tons in 1972⁴. Provided that the current tempo of the "green revolution" in Asia can be maintained, India and Pakistan are likely to emerge as net surplus states and then can possibly supply the wheat requirements of the neighbouring Asian countries. These are indicative of the sort of possible future trade patterns that should be explored further and which are likely to be to the advantage of the developing countries.
38. However as we have seen, the developed countries are still the major suppliers of wheat to the net importing developing regions of the world. In order to replace the developed regions and to prevent a possible international price war in wheat⁵, it

¹ For instance, The Common Agricultural Policy (CAP) of the European Community is based on high support prices (for wheat it is approximately 100 per cent of the world prices), system of variable levies (to keep away foreign products which might otherwise be attracted by high prices) and subsidising export to third countries. See: (1) COOPER, R. N. Issues for Trade Policy in the Seventies, Kieler Vorträge, Neue Folge 66, Kiel 1971. pp. 13-14. (2) F. A. O. National Grain Policies, 1967, 1968, Rome.

² For the most part, the tropical regions produce soft wheat of a quality not suited to present baking technology. See: RICE, E. B., Spring Review of the New Cereal Varieties. A perspective: op. cit. pp. 2-3.

³ The recent trend and provisional forecast in net import for some of these countries are as follows:

	1964-66	1968	1972 (forecast)	(Unit: 1 000 tons)
Ceylon:	356	550	600	
Malaysia:	253	245	290	
Ghana:	61	36	45	
Mauritius:	43	47	50	

Source: F. A. O. Committee on Commodity Problems, Document No. CCP 69/24/I 30 July 1969, Review of Medium Term Food Outlook 1969 to 1972 pp. 1 - 57.

See also: World Grain Trade Statistics 1968/69, F. A. O. Rome 1970, Part II, Tables 11, 12, 13, pp. 30 - 35.

⁴ F. A. O. Committee on Commodity Problems, op. cit. p. 15.

⁵ The downward movement in international wheat price has occurred despite the International Grains Arrangement that came into force in mid-1968. In 1968, the export prices were around the agreed minimum price levels, which are based on \$ 1.59 per bushel, or 7 per cent less than in 1968. By October 1969, the price had fallen to \$ 1.42 per bushel and remained at that level during the early month of 1970. See: GATT: International Trade 1969, op. cit. p. 27.

seems that at least one condition needs to be fulfilled. The developed countries should be willing to undergo a voluntary restriction on the production of wheat and also to undertake the cost of such structural adjustment¹. To the extent that such guarantees from the developed countries are not forthcoming, the export prospects in wheat from the the developing countries should be treated as fairly uncertain².

39. As in the case of rice product, the USDA has also attempted to project the future net trade in wheat from the developing countries³. These projections are however subject to the same limitations which we have discussed earlier. According to these estimates, despite an average annual rate of production of 5 per cent, the total developing countries' net import of wheat in 1980 will be around 18 million tons which is about the same as in the base period, 1964-66. In this estimate it is assumed that South Asia will shift its position from being a net importer to that of a net exporter of nearly 7 million tons of rice in 1980 (Table XI).
40. We have argued before that it is almost impossible to predict the future output of agricultural products from these countries because of their vulnerability to such external factors as rainfall. Even if we make the strong assumption that the green revolution will be a success so that South Asia may produce a substantial tradeable surplus in the future, there will remain the problem of marketing this product. In order to trade it in the international market at a profitable price, there will be the need for some degree of cooperation from the existing exporters of wheat. This might take the form of an arbitrary sharing of the international market through agreements requiring the traditional developing exporters to withdraw from competition to agreed extent.

C o n c l u s i o n s

41. The principal conclusions in respect of trade situation and trade prospects in rice and wheat can now be summarised. In general, the world's largest net exporting and importing regions in rice are within the developing zone. The net export outside this zone i. e. to the developed countries is on a decline primarily because of changing pattern of food consumption (away from cereals to livestock) and increased production (e. g. in Japan), in these latter countries. Apparently the trade opportunities within the developing zone are also limited because of a rapid rate of transformation of the less developed net importing regions into potential exporters, thanks largely to the "green revolution". Thus while the presently net importing regions are likely to save foreign exchange, equivalent of the imports foregone, the net exporting countries apparently stand to lose from this. There is an added concern for a potential warfare in the international rice price in the near future unless steps are taken in time (through international agreements) to prevent rice prices from falling. All told, keeping in mind the potentials of the green revolution and the dim trade prospects in rice, there is a strong case for product diversifications in agriculture,

¹ United States is already known to have restricted area under wheat productions in the recent years, as a conscious agricultural policy.

² Moreover, since the producers price of wheat in South Asia are much higher than the international price levels (because of artificial price incentives), substantial export subsidies would be needed to sell wheat in the international market.

³ ROJKO, S. A. and MACKIE, A. B. World Demand Prospects for Agricultural Exports of Less Developed Countries in 1980, USDA, opp. cit. P. 21 - 37.

Table XI: Production, Consumption and Trade in Wheat; 1964-66 Average and projections to 1980

(Unit: Million Metric Tons)

Exporting Region	1964-66 (average)			1980-Projection		
	Production	Consumption	Net Trade	Production	Consumption	Net Trade
Less developed:						
Importers:	39.1	62.4	- 23.3	94.6	119.2	- 24.6
Exporters ^a):	7.9	3.9	5.1	10.6	4.4	6.2
Total less developed:	47.0	66.3	- 18.2	105.2	123.6	- 18.4
Total developed	109.3	78.8	33.0	124.5	94.6	21.8
World Total:	263.1	265.7		380.6	372.6	

a) Argentina.

Source: ROJKO, S.A. and MACKIE, A. B. World Demand Prospects for Agricultural Export of Less Developed Countries in 1980, U.S.D.A. opp. cit. pp. 21, 37.

in particular in the net exporting countries of Asia. This would mean exploring the prospects of shifting on to other commercial crops which are likely to face an elastic demand in the international market.

42. In respect of wheat, the implications are slightly different. As of present, in general, the developing zones together are the major net importers of wheat in relation to the developed zones which are the world's net exporters. The immediate impact of the reduced import requirement (as an offshoot of green revolution) would be a lesser degree of dependence than hitherto on PL 480 and other forms of imports on special terms. However despite the rapid increase in production envisaged under the "green revolution", the net import demands are likely to continue into the future though the intensity will, of course, be far less. To the extent that some net importing regions in South Asia may emerge as potential exporters, their success as such will be dependent on the reaction of the developed countries. For the future growth of world trade in wheat to be healthy and "properly" distributed, two things have to be kept in mind. First, there is the need to obviate a possible international price war in wheat (which will be self defeating in purpose, if trade is motivated, as it should be, by mutual profitability). Secondly there is also the need to encourage more trade among the developing countries themselves. As we have argued, these requirements are dependent to a large extent on some amount of voluntary action on the part of the developed wheat exporters (e.g. a readiness, through an agreement, to restrict the supply in the international market)¹. It should be added immediately though, that these last remarks will be relevant only in the eventuality that the "green revolution" becomes a permanent feature in the developing world.

¹ For some quantitative implications of restricting area under grains on the world cereal trade situation, see F.A.O., Indicative World Plan, Ch. 14, op. cit.