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CHANGES IN SUPPLY AND DEMAND OF FOOD COMMODITIES ON THE WORLD MARKET

by

E.O.HEADY,
Iowa State University

Agriculture has gone through an extremely volatile economic environment over the last few years. World exports and commodity prices leaped to record levels, but have fallen back while remaining higher than previously. Because of these large increases in exports and prices and because of hunger generated by droughts in parts of Africa, India and Bangladesh, many world agricultural leaders predict that a new era is now before the world's agricultural producers. The breadth and strength of this belief was characterized by the holding of, and discussions at the 1974 Rome World Food Conference. In this expressed belief of a new era for agriculture, in the sense that food demand will remain extremely strong against supply because of world political changes, monopoly pricing of petroleum, unrelenting population growth in LDC's and growing demands for such commodities as meat and feed grains, prosperity is forecast for the farms of developed countries with export capacity while further misery is forecast for the consumers of poor countries.

While the economic backgrounds for these forecasts are somewhat different, this is not the first time in recent decades that parallel outlooks for agriculture have been spread widely. In fact, world agriculturists seem to go through cycles of frenzy over the world food outlook. They become intensely excited in terms of crop shortfalls, project greater hunger and proclaim the need for world changes in the production, distribution and programs of food. Then, with more normal times in production, exports and even dampened prices, the frenzy dies away, only to reoccur at a later time. The FAO arose at the peak of one of these frenzy cycles. In the early 1950's we in the US were even concerned with ability to feed our growing population and launched vast studies, research and programs to promote agricultural production. By 1960, we were producing vast surpluses and government held stocks of grains began to approach annual production. With the crop shortfall over Asia in 1966-67, the agriculturists of the world again proclaimed the coming of an enduring world food crisis and tried again to crank up world food programs. By 1970, however, success of the Green Revolution was being proclaimed and most leaders had fallen back from their concerns for world institutions to manage and/or eliminate the world's food crisis. However, by 1973-74 we again were at a new peak in the frenzy cycle with a permanent food crisis and near-unlimited demand for food being proclaimed. Accompanying this peak, also were suppositions of changing diet patterns, almost as if the world's people were just discovering food .. at least meat.

Because we have had these cycles of concern and fade-away interest over food in the past, we need to first settle on the outlook for food supplies and demands at this point in time. Do the events, large exports and extremely high commodity prices, of the recent past actually signify a new and sustained era for food in the future? Or are we only at the peak of the frenzy cycle due to stochastic supply and demand variables related to weather? Are the LDC's incapable of managing both their food and population problems so that only greater prosperity for the food exporting nations and greater misery for the poor countries is in sight? Will the mix of commodities moving in international trade be those oriented to rich exporting nations trading with similarly rich importing nations, or of the former shipping subsistencetype commodities to the poor countries? The answers to these questions, if we had them all today, provide the key to the prosperity of agriculture especially in exporting countries: to the extent that commodity prices are favorable relative to factor prices and thus encourage greater investment and larger units conforming to higher investment returns; to the extent that one set of commodities will be favored relative to another; and, that other major adjustments of the agricultural sector will occur. Hence, it is important that we stop to examine the events of the recent past, to determine which are stochastic and transitory and which are enduring for the future. Undoubtedly, the widely swinging variables of exports, prices, farm income, middleman and processor profits and agricultural resource prices fall some in all three categories. Hence, let us try to identify those of each category. While worldwide inflation has boosted all prices, agricultural commodities such as cereals, coarse grains, sugar and coffee fluctuated the most.

STOCHASTIC AND TRANSITORY VARIABLES

Important stochastic and transitory variables have dominated world markets over the last few years. Some of these, such as large-scale entry of the Soviet Union into world grain markets in 1972 and 1975 could not be predicted. Perhaps this action was transitory, but possibly it may have some permanence ... as we shall comment later. In

any case, it was not itself a discrete increment to world food demand. The demand, reflected in means other than market mechanisms, was already there. It was maintained as Russia suffered a large crop shortfall. This supply shortfall in Russia was then translated into a much larger demand, not for the world including the USSR but for residual grain exporting countries. This "supply shortfall in some countries translated into demand increases for other countries" was, of course, a reflection of stochastic variables related to weather. What could not be anticipated wasn't the variability of weather and yields worldwide, but was the unprecendented action of the Soviets as open market buyers. With a shortfall such as this, in Stalin's time, Russian people simply had to buckle their belts and go hungry as Indians and the like have done in recent times. By Krushev's time, a grain shortfall more nearly meant that livestock herds were decreased and feed crops were diverted to people. However, by 1972 the Russians were trying to maintain and increase livestock production even under poor crop yields. Perhaps there were "sufficient signs that it could happen here" when food shortages and prices in Poland brought down one government and handed it to another, even if still Communist. Smaller food riots in the Ukraine some half dozen years back also may have been a sufficient break-through to show that once a country becomes sufficiently developed, income elasticities of demand for food have power of expression even under dictatorships and nonmarket economies.

However, even under these conditions, the events related to stochastic variables which could be predicted. More research needs to be devoted to statistical prediction, worldwide, of the moments of food supplies in various regions of the world and the size of the stocks and the institutional means needed to carry them in order that market volatility of the last few years is not repeated. This is a needed world exercise, perhaps by and through the FAO but I doubt that it will soon occur.

Other stochastic and/or transitory variables causing food demand to increase for exporting countries included the small anchovy harvest off Peru in 1973, perhaps some short-run advantage through currency devaluation and some speculation causing an increase in market demand but also a decrease in supply (to the extent that purchases were actually held for this purpose). In the short run of the last few years, major vacillations in world exports and prices were due to these stochastic and transitory forces. It is thus doubtful that we should look upon the past three years as the continuous mirror for the future. However, there are many agricultural leaders, including government officials and administrators such as those attending the Rome Conference, who believe that world food demand has taken a quantum leap or stair-step jump from the trend line and will stay so or even repeat the jump.

LONG-RUN TRENDS AND PROSPECTS

Taking a longer run view, it is unlikely that world demand for food and feed grains in aggregate and for livestock in particular suddenly jumped vertically from the time trend in 1973-74. It did for countries such as the US, but only because the supply in the rest of the world and not the demand was perturbed. World food demand most likely will continue a more or less smooth trend upward in correlation mainly with population and per capita income. The extent to which the slope of this "smooth curve" accentuates or dampens will depend, aside from the real price of food, on national policies which affect birth rates, economic growth and income distribution. But it is unlikely to leap suddenly and remain upward, due to these variables, as is now proposed by many persons. Perhaps institutional variables, such as the Russians being willing to stay in the market, and the Chinese following, would add a discrete break in the upward trend. They may, however, put more emphasis on developing their own agricultural production and reserves, rather than becoming dependent upon their political rivals of recent decades. Whether accomplished in this manner or through world markets, it does appear that Russia is committed to upgrading consumer diets, emphasizing especially greater meat production per capita. Also, as per capita incomes rise and consumer preference has some chance of continued breakthrough, import demand will be high for such agriculturally based products as citrus and wines.

If we "back away" from the large disturbance caused by the crop shortfalls in Russia and other world regions, it is apparent that the world food situation is fairly well on its long-run trend. People of rich countries with relatively rich diets are still upgrading them with the thrust of time and greater incomes. People in poor countries, as an average and aside from the extreme drought stricken areas, have made some progress and have prospects for more - although the energy of their diet is much less and the variety is highly restricted as compared to rich countries. So, generally, the consumers of both rich and poor countries are better off - but there are more people in the poor countries to pull the world average down.

Over approximately the last two decades, food production has grown at a rate of 2,7 per cent per annum in the developed countries while population has been increasing at a rate less than 1 per cent per year for the last 10 years. So, the rich countries have more to sell to each other to upgrade an already "high diet" - or to use in a world food program if they so select. Food production per capita has been increasing at 1,5 per cent per year in the developed countries. But the poor or developing countries have also made some progress; even more than the developed countries on the side of production - 3 per cent per annum over approximately the last two decades. But with a population increase of 2,5 per cent per year, increased production per capita has risen by only 0,4 per cent per year. Aside from periodic poor

weather and crop shortfalls, the world is not worse off than a decade or two back. These differences are emphasized in Figure 1 which compares growth in food production and population in developed and developing countries. While some improvement has been made in food per capita in developing countries, these countries with the majority of the world's population still have the masses of people who can use more food, not so much for pleasure but more as an eliminator of misery. As Table 1 illustrates these people prevail widely in Africa and South America but are especially concentrated in Asia and the Far East. It would not be necessary to increase livestock production to eliminate malnutrition, although that is the route many poor people would use if their incomes were high enough. Cereals alone, if supplemented with some soybeans and pulses, could accomplish the task. About 0,15 kg daily of wheat, rice, corn, sorghum or millet provides around 500 calories. If the 462 million malnourished persons indicated in Table 1 had another 500 calories per day, much of the world's "malnutrition gap" would be eliminated. If economic growth were sufficient and per capita incomes of this 462 million people grew enough, they could bid more grain away from consumers in developed countries. A sufficiently higher price for grain would do so by diverting it away from livestock fattening and meat diets in the rich countries. Even with rather modest increases in the per capita incomes in the developing countries, this shift in trade has tended to occur over the last three decades. Prior to World War II, developing countries tended to be net exporters of food to developed countries. In post war years, however, developed countries have been exporters to developing countries. As Table 2 shows, developing and centrally planned countries have increased their imports from the developed countries but have decreased their imports from each other (and from within their own grouping). The increase in demand for food could be vast if per capita incomes in both of the latter groups of countries could double. Even doubled, average incomes would be modest and considered at the poverty level in developed countries.

Of course, the population growth rate in the developing or poor countries is 5 times that of the developed countries. These countries now have 83 per cent of the world's population growth - as against 68 per cent a decade back. Developed countries now have only 38 per cent of the world's population, as compared to 44 per cent 20 years ago. Still, the world food per capita in the poor countries has made some progress. There are just a lot of people at a low level of nutrition now as there was 20 years ago, even with some improvement, because there are so many people in these countries. Unless world institutions are really regeared, the prospects are that these trends and conditions will continue for the next 20 years - some improvement in the poor countries and much more in the rich countries selling the big part of their increment in production to each other - unless the world detours from its "food frenzy cycle" and

TABLE 1 - Estimated number of people with deficient protein-energy supply

Region	Population	Per cent population below lower limit	Number below limits
	(Billion)	(Per cent)	(Million)
Developed regions	1,07	3	28
Developing (excluding Asian planned countries)	1,75	25	434
Latin America	0,28	13	86
Far East	1,02	30	301
Near East	0,17	18	30
Africa	0,28	25	67
World (excluding Asian planned)	2,83	16	462

Source: UN Preliminary Assessment of the World Food Situation, Rome, 1974.

TABLE 2 - Pattern of world grain trade: percentage distribution

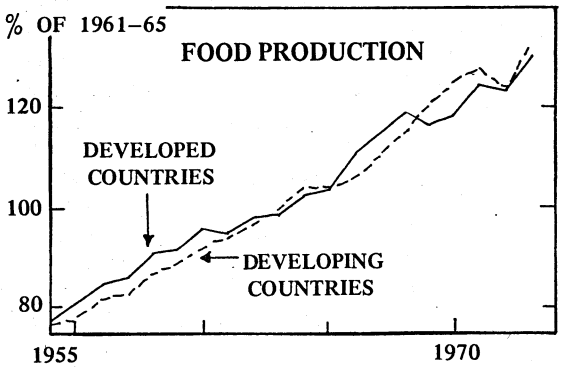
Exporting	Importing regions			
	Developed	Developing	Centrally planned	World
Developed				
1956-60	40,6	18,2	2,3	61,3
1971	42,5	23,6	7,2	73,3
1972	44,9	22,8	15,1	82,8
Developing				
1956-60	10,2	11,9	0,7	22,8
1971	8,5	6,1	1,0	15,6
1972	3,9	6,7	0,6	11,3
Centrally planned				
1956-60	3,3	2,0	10,6	15,9
1971	1,2	2,6	7,3	11,1
1972	0,8	1,3	3,7	5,9
World				
1956-60	54,1	32,1	13,6	100,0
1971	52,2	32,3	15,5	100,0
1972	49,7	30,8	19,4	100,0

Source: The World Food Situation and Prospects to 1985, Economics Research Service Foreign Agriculture Report No. 98, Washington D.C., 1974.

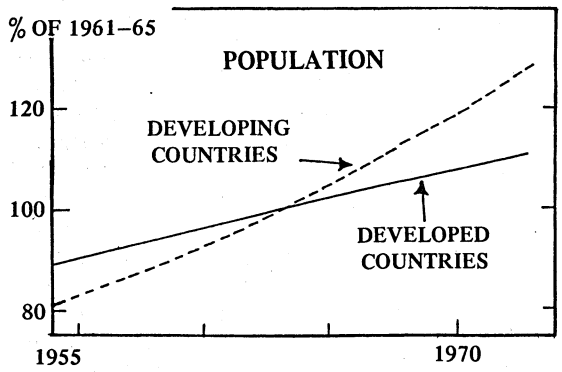
has sustained concern and programming for the entire world's society of consumers. We do have great flexibilities and possibilities in the short run - the next 20-25 years - if the rich and food exporting countries are willing to make adaptations. Over the long run, of course, the solution is entirely in the hands of the developing countries - what they do about birth rates.

The developed countries produce two-thirds of the world's grain supply on one-half of the world's grain area; the less developed countries produce only one-third of the world's grain supply on the other half. The developed countries use

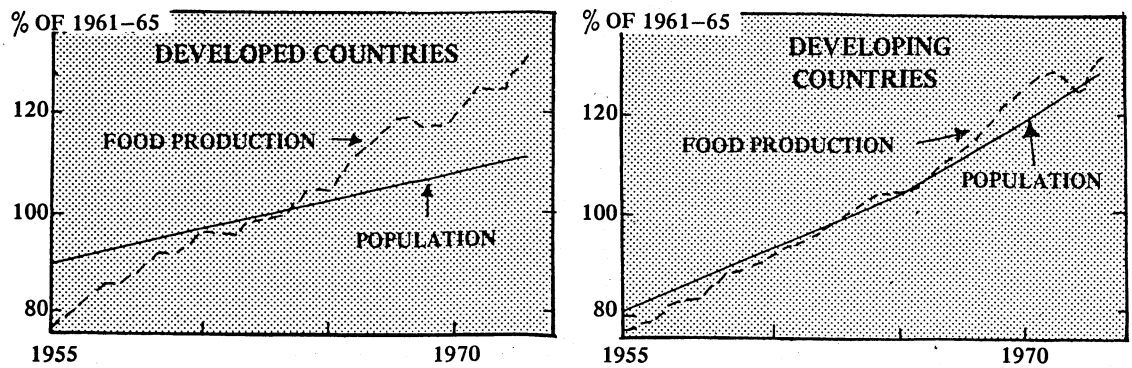
Food production has grown steadily over the past two decades. Growth in the developing countries has roughly paralleled that in the developed countries



Population has grown much faster in the developing countries



Peoples of the developed and developing country groups have not fared equally from the roughly equal growth in food production. In the developed countries production has increased much faster than population, boosting production per capita. In the developing countries, population gains have absorbed nearly all of the production increase; production per capita has improved only slightly



Source: Negative ERS 426–73, USDA

FIGURE 1 – Food production and population, developed and developing countries

about 13 bushels of grain per capita just for livestock products consumed - the United States alone using 25 bushels per capita for livestock products. The LDC's use only a half bushel, with Argentina, at three bushels per capita, using a large share of this. The average calorie intake per day from grain in the US, for example, is only 649 - as compared to 1 250 as an average in the LDC's. As grain production increases in the developed countries, they can mainly ship it to each other to feed to livestock - as they are already doing. Or, they could reorganize markets and institutions and direct it more to the LDC's. A portion of the grain now going to livestock in the developed countries diverted as food to the LDC's would have a sizeable effect in alleviating malnutrition.

The demand mix for foods in the decades ahead will generally follow a pattern conforming to income elasticities of demand in different countries, with the proportion especially weighted by the rate of economic growth and per capita income improvement in specific countries - especially those with large populations and low incomes. As an illustration of this future, I include Table 3 with a grouping of countries by several criteria. Income elasticities for cereals is low in all developed countries, with grain generally serving as an inferior good. Hence, the prospects for grain would not seem bright except that income elasticities (a) are still positive in world regions with large populations, and (b) high generally for meat which uses large amounts of grain because of its low transformation rate into protein and carbohydrates. The difference in grain usage between developed and LDC countries is illustrated in Figure 2. Africa at large, Asia and China are all predicted to have income elasticities of demand for meat considerably above 1,0. Hence, for the two reasons above, expansion of cropping area for particular commodities will be greatly in the direction of all grains relative to other crops in the decades ahead. Income elasticities worldwide are generally high for fruits and vegetables and especially high for sugar in the poorest countries.

SUPPLY-DEMAND INTERACTIONS

While positive and continuous growth in demand for food commodities is certain, due to positive income elasticities and unchecked fertility rates in LDC's, the demands falling on exporting countries will depend importantly on where suppliers are enhanced and the interaction of agricultural development with political events, high energy costs and related variables. Supplies can be increased by three major means:

1. Increasing per unit yields through improved technologies such as high yielding varieties, pest control, improved water management and laws, tenure conditions and capital supplies favoring input use, profitable price ratios, and the availability of capital inputs such as fertilizer, pesticides, vaccines, etc. Opportunities thus for increasing per area yields are generally highest in the developing poor countries.
2. By a more intensive use of currently cultivated land through multiple cropping. There is great opportunity here, especially with the development of water supplies and changes in water management, laws and pricing. The possible gains from this source have been well illustrated in Taiwan, the Indonesia intercropping system and research at the International Rice Research Institute in the Philippines. Roughly, it is the least developed parts of the world which have climates with long or year-around growing seasons conforming with multiple cropping possibilities. The introduction of photoinsensitivity, along with characteristics of new high yielding varieties, permits greater flexibility in cropping seasons.
3. By bringing uncultivated land into production. There still are large areas which are not under cultivation and a considerable area devoted to shifting cultivation. Land not yet cultivated prevails in considerable quantities in the savanahs of South America, the Amazon Basin, large parts of the bush in Africa, outer islands of Indonesia and the Philippines and forested areas of Thailand and Malaysia. It has been estimated that of potentially arable land, only 22 per cent of that in Africa, 11 per cent of that in South America and 44 per cent worldwide is now under cultivation[1]. These figures are somewhat conservative relative to our own calculations. Even the US has a vast expanse of land, 80 per cent as much as now is being cropped, which could be brought into cropping under sufficient capital investment. Capital requirements are even heavier for leveling tropical jungle, controlling second growth and keeping the land productive. Other problems of forest soils, woods, processing facilities and markets also prevail in some of these locations.

The three above possibilities for increasing food supplies are greatest in those poor countries where future food demand growth also appears to be greatest. It is, however, the same set of countries which has greatest capital restraints and low funds for bull-dozing jungles. It is the same countries whose farmers are hardest hit by the high energy costs which have greatly increased prices of fertilizer and pesticides. Without resolution of these difficulties, more rapid rates of food supply enhancement may come in the countries of developed agriculture where farmers are not so intensely restrained by capital and thus are less affected by high energy and input prices. Of course, if the surplus periods of the past returned for the developed exporting countries with large food producing capacity (a not entirely unlikely event), the OPEC monopoly pricing of petroleum could turn out to be a blessing in disguise. The reason is: higher input prices should choke back on supply. Since price elasticities of demand for food are

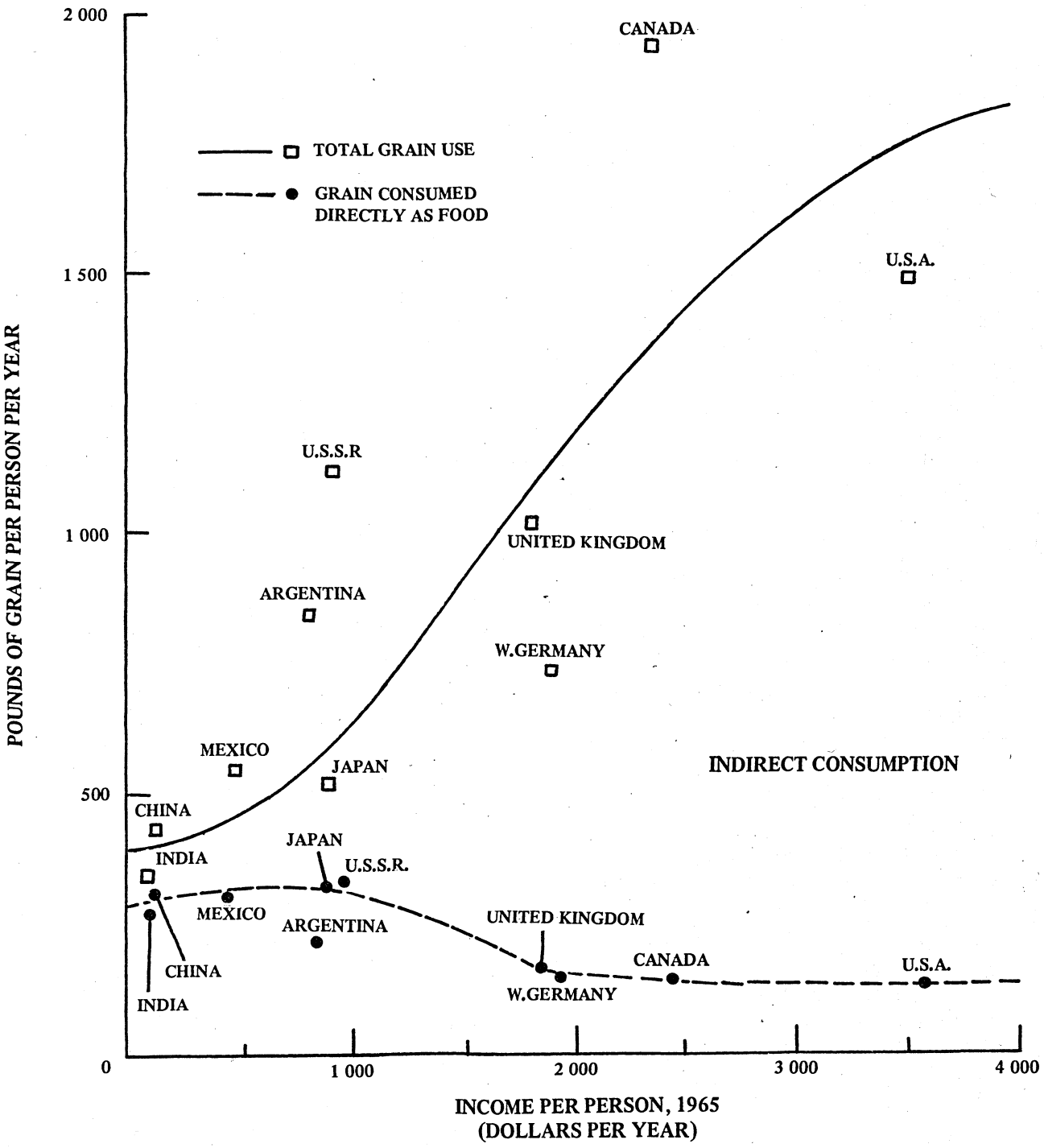


FIGURE 2 – Difference in grain usage between developed and LDC countries

TABLE 3 - Income elasticities of demand for selected commodities, regions and countries

Region or country	Cereals	Pulses	Sugar	Vegetables	Fruit	Meat	Oils
North America	-0,25	0,01	0,10	0,11	0,25	0,26	-0,01
Western Europe	-0,29	0,09	0,25	0,36	0,61	0,44	0,14
Eastern Europe	-0,24	0,22	0,23	0,40	0,76	0,48	0,11
Central America	-0,13	-0,12	0,32	0,44	0,53	0,61	0,62
South America	0,12	0,35	0,40	0,36	0,59	0,31	0,46
Asia & Far East	0,25	0,28	0,81	0,63	0,65	1,06	0,70
South Asia	0,25	0,32	0,91	0,61	0,74	1,20	0,83
Developed	-0,24	0,05	0,25	0,46	0,54	0,35	0,14
LDC's	0,13	0,21	0,57	0,45	0,62	0,56	0,53
Centrally planned	-0,10	0,13	0,13	0,25	0,56	0,39	0,38
Africa	-0,25	-0,03	2,52	0,57	0,93	1,44	0,23
West Africa	0,46	0,49	1,04	0,66	0,56	0,87	0,64
Eastern Africa	0,29	0,39	1,06	0,49	0,54	0,74	0,65
US	-0,24	0,11	0,05	0,10	0,25	0,24	0,01
France	-0,38	-0,10	0,30	0,30	0,56	0,41	0,19
West Germany	-0,28	-0,08	0,28	0,20	0,54	0,43	0,06
Japan	-0,07	0,00	0,40	0,60	0,57	0,79	0,53
USSR	-0,30	0,13	0,20	0,40	0,72	0,50	0,64
China	0,26	0,30	1,18	0,50	0,88	1,22	1,36

Source: Agricultural commodity projections, 1970-1980, FAO, 1971; Income elasticities of demand for agricultural products, FAO, 1972.

generally less than 1,0, reduced supplies lead directly to greater market revenue for farmers.

Land supplies are not the most restraining resource in increasing food production. While in some countries, such as India, Bangladesh and Egypt, dense populations do crowd against the stock of cultivable land, the US is estimated to have 264 million acres of class I and II land not under crops. Estimates also indicate that Africa south of the Sahara has only about 50 per cent of its tillable land under crops while Latin America has only 23 per cent. More important than land in the latter countries is capital, technological packages and knowhow adapted to the location, stable tenure conditions and related input, financial or market conditions. Increasingly, food production has come to depend much more on capital inputs than on land. For most of the world, the impact of extremely high petroleum prices may be a more important restraint on agricultural production than land supplies. However, high fertilizer prices of recent times have not been due alone to high costs of oil but perhaps more to limited fertilizer producing capacity. The surplus capacity during the 1960's caused a halt in plant construction. Hence, with food demand growth generally and very high food prices recently, the demand for fertilizer has been high relative to supply. In the long run, producing capacity can be increased and the real price of fertilizer should decrease rather sharply, even if petroleum prices remain high or go higher. If food production is to increase in most food-deficit developing countries, they will need to use more fertilizer than indicated by present trends. Estimates suggest that if by 1985 they used 15 million more tons of fertilizer than inherent in ongoing trends, their food deficits could be reduced greatly[2]. Capital for plant construction or foreign exchange for imports are likely to be more important obstacles than fertilizer prices in attaining this greater fertilizer use. In general, however, the capital technology needed is a bundle including fertilizer, high yielding varieties, pesticides and facilities for water management. These bundles may be hurried through the world regional research center being established over the world by donar agencies of the developed countries.

SUPPLY-DEMAND BALANCE POTENTIALS

As one summary of the world potentials in supply and demand for the next few decades, we summarize one of our own studies dealing with future alternatives in land use, population growth and per capita income. We measured land not now in cultivation which might feasibly be brought under crops on terms of climate, slope, location, transportation and markets. We then estimated potential production in the year 2000 under three assumed rates of population growth and two assumed rates of per capita income growth. The results are summarized on a worldwide basis in Table 4 under two cases where, (a) cultivated land remains at about 1970 levels, and (b) it is increased per the characteristics above for presently uncultivated land. Additional land has physical and climatic characteristics favorable to cropping but currently lacks transportation and market facilities. Productivity trends are the same for all sets of demand and land availability alternatives - namely, at postwar trend rates during the 1960's. These data, estimated separately on a country-by-country basis then aggregated, cover the world except for China, North Vietnam and minor areas. In a set of estimates including China and both its supply and demand potentials, the possibilities under the several combinations of alternatives are qualitatively the same - deficits being accentuated

under high demand variants and remaining relatively favorable under high land bounds and restrained population growth. We present data here for cereals only (but have estimates also for other major food categories) since the outcomes for other products are similar under each set of the alternative futures. Estimates allow food consumption for cereals to grow with income and population either directly through human consumption or indirectly through livestock consumption.

TABLE 4 - Estimated world food deficit (-) or surplus of production (+) over demand or requirements, under alternatives in food demand and supply variables for the year 2000 (1 000 tons)

Population level	Constant per capita incomes	Historical rate of growth in per capita incomes
	1 000 tons	
	Low land bounds	
Low	302 191	177 069
Medium	158 248	-22 989
High	43 193	-132 801
	High land bounds	
Low	322 988	137 876
Medium	179 055	-2 182
High	64 000	-11 914

Source: Blakeslee, Leroy L., Earl O. Heady and Charles F. Framingham. *World food production, demand and trade.* Iowa State University Press, Ames, Iowa, 1973.

Under the most unfavorable circumstances of high population and income growth and low land bounds, world cereal production would fall short of consumption requirements or demand possibilities by 132,8 million tons in the year 2000. With low population and income growth and high land bounds, our projections even suggest that a world surplus of food commodities could prevail. With only medium population growth, a continued upward trend in per capita food consumption and agricultural productivity and cropping of favorably available land, projected world food requirements could approximate (only slightly exceed) world production possibilities.

Currently, it is difficult to evaluate what population growth rates will be in the future. While natural programs of fertility control have been successful in a few developing countries, other show little or no succes in limiting population growth. On the other hand, birth rates have began to slacken remarkably in some developed countries. Under these uncertainties in the number of future consumers, we present the estimates of Table 5 showing, by world regions, predicted excess demand or exportable surpluses for the year 2000 generally under medium growth rates in population and per capita incomes. For low income countries as an aggregate, we also show outcomes when uncultivated land which is feasible for cropping is or is not employed and when population growth rates are both at medium and continued high levels. (For developed countries, current land use quantities are used.) Again, the outcome, world food deficit or potential adequacy, depends on developments in population control and land development. Large opportunities in trade exist in any case, the biggest volume being in grain but opportunities also existing for other commodities. (Potential imports of cereals may be underestimated in terms of income increments and recent trade developments for the USSR, and Japan and in both cereals and other commodities for North Africa and West Asia.)

Other adjustments in world food production and distribution also could be made. For example we have just completed a study which projects 1985 US grain export possibilities under the conditions of (a) a 25 per cent reduction in meat consumption by US consumers, (b) substitution of 25 per cent soy protein for meat, in total meat consumption and substitution of silage for 25 per cent of the maize used in feeding beef. The 1985 exports could be 2,5 times those in 1971-73 under these shifts, as compared to current human consumption and livestock nutrition. They could be 35 per cent greater than if ongoing meat consumption projections were continued to 1985 and livestock rations went unchanged. Hence, there are many world possibilities in changing production, consumption and trade in agricultural commodities and food. Food adequacy is not at all impossible - depending on which and how many countries are willing to make changes in production and consumption trends.

Which world possibility will prevail in the future depends on the wisdom and abilities of countries and their policy-makers. These projections of production potential and demand in 2000 suggest minimally that with modest momentum in agricultural improvement and restrained population growth, the world food situation need not deteriorate over the next 25 years. Of course, the pressure of demand on food supplies will depend importantly on the rate at which per capita incomes increase over this period. If they increase at trend or higher rates, food will have a higher real price than otherwise. But the cause and consequence will rest with the improved welfare of mankind, in comparison with demand growth reflected mainly through population increases. In the one case, food takes on a relatively scarcity because man has enough income to buy more of it and drive its real price up; in the other case, relative scarcity grows out of restrained supplies holding populations in misery near subsistence levels. These data indicate that potentials in supply expansion and demand constraints are such that the world has sufficient land and could attain a favorable balance in the next three decades. It could do so to the extent that broad problems of hunger might be erased in simultaneous war on equity problems in economic development. Those who will guarantee that these

TABLE 5 - Excess demand (+) for countries and regions of the world in 2000 under medium population; growth rates and historical income growth rates for specified crops (- signifies exportable quantities)

Country	Cereals	Sugar	Pulses	Fruit, Veg.	Oil
			1 000 tons		
US	-232 497	6 184	189	32 231	57 051
Canada	-9 630	1 726	126	6 179	356
Mexico	5 194	919	-697	13 178	571
Central America[1]	8 396	-6 780	560	7 636	541
Brazil	19 713	-1 880	2 249	8 494	-1 416
Agrentina & Uruguay	-3 232	97	34	3 123	-443
Other SA	15 761	1 686	1 233	23 962	1 002
N. Europe	-28 150	2 209	1 869	20 136	12 631
S. Europe	12 526	690	1 548	-44 385	2 837
E. Europe	4 343	-6 802	-381	-1 835	-82
USSR	13 476	-30	-31 232	-28 590	-2 457
Oceania	-14 842	-932	29	467	49
N. Africa	33 271	4 225	2 905	9 299	4 061
W. Central Africa	15 640	1 719	-913	20 963	-1 158
E. Africa	10 794	780	1 392	11 751	694
S. Africa	5 571	-895	160	-1 178	-246
W. Asia	42 996	3 751	1 542	14 266	2 080
India	28 015	1 655	17 562	43 678	4 540
S. Asia	32 006	3 596	2 193	-2 359	2 116
Japan	4 021	3 507	268	-24 294	6 586
E. Asia	49 199	6 294	1 503	34 063	11 776
1. Low income countries[2]	235 092	20 092	29 369	161 858	23 119
2. Low income countries[3]	255 761	22 343	30 222	165 771	23 573
3. Low income countries[4]	300 621	24 600	33 490	186 806	23 826
Medium income countries[5]	36 976	-8 070	1 516	-50 335	10 712
High income countries[5]	269 892	8 835	-28 922	36 199	45 996

Source: Blakeslee, Heady and Framingham, op. cit.
(1) Includes Caribbean
(2) Low income countries with feasible land as (explained in text) developed and medium population growth rate.
(3) Low income countries without feasible land developed and medium population growth rate.
(4) Low income countries without feasible land developed and high population growth rate.
(5) At medium population growth rates.

ends can be attained, or that they will be forfeited with subsequent decades of misery for people, are government leaders in countries of large populations with high birth rates or in countries of large unexploited agricultural resources. Leaders in the former countries have the long-run solution of population in their hands, and will either deliver it or let it slip away from humanity; leaders in the latter countries can provide short-run solutions but, try as hard as they may, cannot extend food supplies to match population growth that other countries do not control.

Hence, our results suggest that the world is not necessarily faced with calamity in the next 30 years but only if the politicians and administrators of selected developing countries do enact agricultural, development and trade policies which hurry and guarantee adequate food supplies. Over the longer run, however, praise or blame for these same politicians and administrators will rest on their actions in initiating and implementing appropriate population policies. In the "pain and joy" of humans, I doubt that a dictator who lines healthy, well fed middle-aged people against a wall and shoots them is less kind and humanitarian than country politicians and administrators who let high birth rates prevail so that millions upon millions are born into poverty and malnutrition and a life of suffering, tension and frustration more cruel and miserable than death outright. If one is decried and dethroned, then so should be the other. The lack of adequate birth control technologies is not a sufficient excuse for nonattainment. Hungary and other countries are near zero population growth with present techniques. Needed immediately and on a much more intensive basis are much larger and more effective communication programs to bring sufficient awareness to all of the population; larger public investments to provide the staffs, personnel and administrative facilities to accomplish the task; effective economic incentives either in the cost of the techniques or in the return for their application; and actual sincerity and concern for future generations to stir the present generation of public officials into action. Of course, the ultimate goal is economic growth and per capita incomes at levels which cause families to exert their own initiative. One threshold level is

attained when the level of affluence of children causes them to draw on family income more heavily as consumers than they contribute as resources. But the world can hardly wait for this threshold level to be attained in all countries. The politicians and officials of these countries must speed effective public population policies. Whether the citizens of their countries live in misery at food subsistence levels in a half century will depend on the actions they take in the next two or three decades. Leaders of developed countries can provide encouragement through technical financial assistances, but success or failure depends mainly on the leaders and citizenry of developing countries during future decades beginning now.

The ultimate answer, of course, in both diverting some grain away from the rich countries and their rich diets to the poorer countries and in causing remarkable "slow down" in population growth in the latter, is in growth in per capita incomes and worth of women's time in developing countries. If per capita incomes rose enough in India and similar countries, these billions of people would keep grain so high priced that much less of it would be fed to livestock in the rich countries - at a low transformation rate into human energy - and would cause it to be spread more evenly among the world's consumers. Evidence world-over clearly indicates that when per capita income education, employment, economic opportunity and possibilities of social participation and expression become high enough and are sufficiently and widely distributed to woman, family size takes a drastic decline. The elasticity of births with respect to females education is about 0,25 and with respect to income about 0,3 in developing countries. Larger families are simply too costly in what must otherwise be given up by women as full social and economic participants under these conditions. Evidence in every part of the developed world indicates that the final determinants of fertility rates and family size are these of social and economic variables - and not biological and physical variables relating to birth control as our (and that of world organizations) foreign aid programs propose. But the task is complex because it also involves social security and pension or retirement schemes so that families do not follow cultural customs such as producing a family of eight to be sure of a few sons to support them in old age.

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