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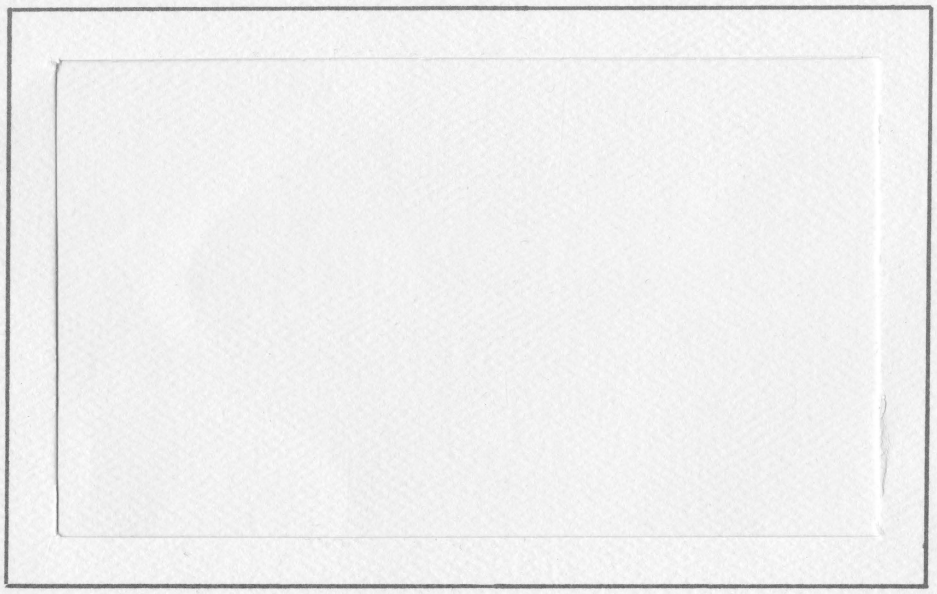

Agricultural Experiment Station
Institute of Agriculture
University of Tennessee
P. O. Box 1071
Knoxville, Tennessee 37901-1071

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WORLD FOOD SUPPLY: PROBLEMS AND PROSPECTS*

William M. Park**

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**Associate Professor, Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville.

The University of Tennessee
Knoxville, Tennessee
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INTRODUCTION

> It is a pervasive article of human faith that God and man will collaboratively replenish the world's food supply annually. The universal assumption is that in each new spring seeds will sprout, sun will shine, and rain will fall. From the harvest that follows, bins and larders will be refilled and food will be made available for another year. The faith is held in disregard or even defiance of repeated experiences in crop failure, many of them tragic.
>
> Statistics confirm the global precariousness. Without food a healthy person can stay alive one month. This is almost exactly the length of time year-end stocks of coarse grains will last without replenishment. Likewise, only a month's supply of rice is usually on hand at year's end. Only for wheat is the picture better: a two-months' supply is usually carried over (Breimyer, 1981).

Unfortunately throughout the world, a significant number of people are not so concerned about next year, but rather this year, this month, this week, today! For some 100 million people, hunger is a chronic problem, not just a once-in-10-years problem associated with severe drought. For another much larger group of people, between half and one billion in number, moderate to severe malnutrition is a chronic problem. These figures come from the Report of the Presidential Commission on World Hunger, made public in March, 1980. Walter Falcon, Director of the Food Research Institute at Stanford University, was a member of the Commission. In reflecting on the Commission's findings, he suggests that the world hunger problem can be described with five key words: Asia, calories, children, chronic and poverty.

Review of figures on per capita food supply by region in 1977 (Table 1) clearly indicates that Asia (the Far East) represents the most critical problem area, with Africa not far behind. Average per capita protein supplies for Asia and Africa are 48.8% and 43.3% lower than the average for

Table 1. Per capita food supply by economic classes and major regions and countries, 1977.

Economic class and region	Per capita calorie supply (cal/day)			Per capita protein supply (g/day)		
	Vegetable products	Animal products	Total	Vegetable products	Animal products	Total
Developed countries	2280	1073	3353	39.3	57.7	97.0
United States	2266	1312	3578	33.1	73.3	106.4
Canada	1938	1429	3368	35.1	66.2	101.3
Western Europe	2267	1109	3376	40.7	54.1	94.8
South Africa	2507	414	2921	49.8	27.3	77.1
Japan	2399	547	2946	45.6	42.4	88.0
Oceania	2034	1364	3398	34.0	73.5	107.5
Developing countries	2016	188	2203	42.9	12.0	54.9
Latin America	2111	446	2557	38.6	26.8	65.5
Far East (excluding Japan and the Peoples Republic of China)	1914	114	2029	41.2	7.4	48.7
Near East	2372	249	2620	57.9	15.5	73.5
Africa (excluding South Africa)	2060	146	2205	44.1	10.9	55.0
Centrally planned	2235	447	2682	50.9	22.7	73.7
Eastern Europe and Soviet Union	2492	989	3481	51.7	51.6	103.3
China	2141	246	2386	51.0	11.4	62.5
World	2136	435	2571	44.8	23.9	68.8

Source: Barr.

developed countries. But look too at per capita calories supply where Asia and Africa are 39.5% and 34.2% below the world average. Contrary to popular belief then, most people in Asia and Africa are not only malnourished, they are undernourished--plain hungry. The information on per capita meat and grain consumption in Tables 2 and 3 further highlights the regional disparities in food consumption. Furthermore, the population figures in Table 4 remind us that these food consumption levels for Asia are averages for almost one-third of the people in the world. Children, especially weanlings to age four, are at highest risk of incurring permanent physical and mental disabilities from malnutrition. Falcon notes that they literally cannot eat enough of their low-density, cereal-based diet to be nourished adequately. Finally, the indices of food production per capita in Table 5 show the chronic nature of the problem. Food production per capita has grown at a rate of only 0.5% annually in South Asia and has actually fallen in Africa over the last 30 years.

POVERTY--THE UNDERLYING PROBLEM

However, there is a growing consensus that hunger and malnutrition must be recognized as only symptoms of a more basic problem--

> The overwhelming reason why people are hungry is...because they are poor...(P)overty and not food production, is the major problem...(Falcon, 1981).

> (T)he crux of the global malnutrition problem is uneven distribution of resources rather than low volume of food production....(and) reflects a broader income problem....(Tweeten, 1978).

> Merely increasing ag. production in the developing countries is not sufficient in itself to bring about widespread improvement in nutrition....The absence of sufficient income to pay for an adequate diet is the major source of hunger (Hanrahan, 1984).

Table 2--Per capita meat and poultry consumption for selected regions

Region	Red meat	Red meat	Poultry meat	Red meat	Poultry meat
	1960	1970		1980	
	Kilograms per person				
United States	79.4	88.0	22.2	82.0	27.8
Other developed countries	32.9	44.9	9.1	51.6	13.5
Eastern Europe & USSR	27.6	38.7	5.2	56.1	10.0
China	--	--	1.9	12.0	2.8
Latin America	25.5	26.4	3.8	27.2	8.0
Subsaharan Africa	--	9.5	1.3	8.9	2.0
North Africa & Middle East	--	6.6	.8	6.0	1.6
Asia	--	3.5	.6	3.8	.8
World	--	--	4.0	22.4	5.6

Sources: FAO Food Balance sheets (1982) and USDA official statistics.

Table 3--Per capita grain consumption for selected regions and world 1/

Region	1960	1970	1980
	Kilograms per person		
United States	769	803	749
Other developed countries	358	418	447
Eastern Europe and USSR	545	698	828
China	159	210	254
Latin America	194	223	263
Subsaharan Africa	136	151	143
North Africa & Middle East	272	293	346
Asia	166	179	181
World	274	311	329

1/ Consumption totals include grain fed to livestock.

Source: Official USDA statistics.

Table 4--Regional and world population

Region	1960	1970	1980	1990
		Million		
United States	181	205	228	250
Other developed countries	451	498	537	569
Eastern Europe & USSR	331	368	400	431
China	647	814	977	1,114
Latin America	216	284	363	450
Subsaharan Africa	204	265	351	476
North Africa & Middle East	134	174	231	301
Asia	853	1,078	1,354	1,680
World	3,017	3,687	4,440	5,271

Source: U.S. Bureau of the Census and USDA unpublished estimates.

Table 5--Indices of food production per capita, 1950-82

Region	1950	1960	1970	1980	1982	Compound rate of growth
	---- 1969-71=100 ----					Percent
Developed countries	79	92	100	110	114	1.1
Developing countries	86	95	101	104	105	.6
Centrally planned countries	77	87	101	106	110	1.1
World	84	93	100	104	105	.7
East Asia	81	90	101	118	122	1.3
Africa	104	107	99	89	88	-.6
South and Central America	88	89	102	113	115	.9
China	86	76	102	120	129	.8
South Asia	83	96	102	97	97	.5
Middle East	84	96	100	108	104	.5

Source: U.S. Department of Agriculture, Economic Research Service, World Indices of Agricultural and Food Production, 1973-82, SB-697 and previous issues.

Poverty is a two-edged sword, cutting sharply on the supply side as well as the demand side of the balance equation. On the demand side, an important distinction must be made between biological need for food and economic demand for food, which requires not only willingness but ability to pay. On the other side, poverty precludes savings and thus investments in yield increasing technology, severely limiting food production. The problem is as much one of too little demand for food as it is too little supply. Rather than a physical/technical problem of production, then, hunger and malnutrition must be viewed as a social/economic problem of distribution, the distribution of population versus the distribution of wealth and food production, both among and within nations.

The increasingly skewed distribution of food production relative to population among nations is fairly well recognized. The quarter of the world's population in the so-called developed countries accounts for over half of the grain produced and consumed in the world. As can be seen from figures on net grain trade in Table 6, the food imbalance among countries has increased drastically since WWII. The U. S. and Canada export almost 10% of all the grain produced in the world. Barr suggests that this imbalance will continue to grow for the foreseeable future, as indicated in Figure 1. Not that this is all bad, of course. The fact that countries in Asia imported 65 million metric tons of grain in 1981 means their people had more to eat. But recognizing that many still went hungry shows the magnitude of the distribution problem. The higher-income, food-deficit nations (e.g., Japan) can bid in world markets for enough grain and other agricultural products to provide for generally adequate diets. The lower-income, food-deficit nations cannot.

Table 6 --Changing pattern of world net grain trade

Region	1934-38	1948-52	1960	1970	1980	1981
			Million metric tons			
North America 1/	5	22	36	54	133	136
Central & South America	9	2	2	4	-15	-4
Western Europe	-24	-22	-25	-22	-11	-4
Eastern Europe	5	0	-7	-6	-14	-12
USSR	1	2	6	4	-29	-41
Africa 2/	1	0	-2	-5	-21	-24
South Africa	0	0	1	1	3	4
Asia	2	-6	-13	-37	-64	-65
Oceania 3/	3	3	4	8	19	13

1/ United States and Canada.
2/ Excludes South Africa.
3/ Australia and New Zealand.

Source: Food and Agriculture Organization of the United Nations, Trade Yearbook, several issues.

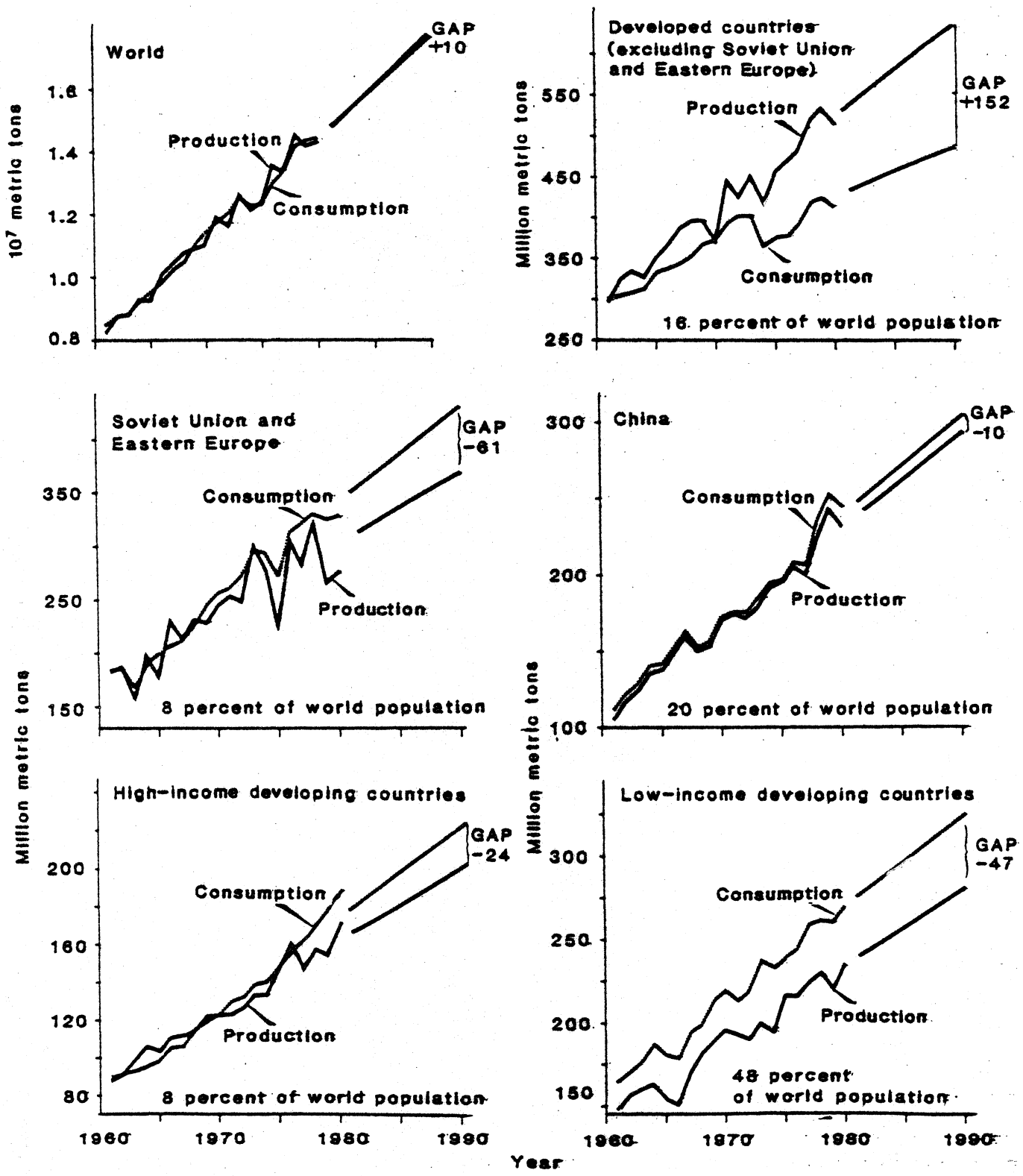

Fig. 1. Total grain production and consumption, and food gaps projected to 1990.

At the same time, Tweeten (and others) conclude that:

> Without question, the U. S. alone could produce enough food to eliminate current and emerging world food deficits....(1978).

Why not do so and give it away? Again, Tweeten:

> If Americans possessed the will to (do so)...it is by no means clear that this would be desirable in view of troublesome issues of (a) food distribution, (b) dependency, and (c) disincentives to producers in developing nations (1978).

This brings us to the issue of food distribution within nations. The skewed distribution of food within low-income, food-deficit nations is perhaps less well recognized. It may well be more severe than in countries like the U. S. Falcon cites research findings that for market economies income inequality in lower-income countries is generally greater than in higher-income countries. Reutlinger and Selowsky have shown that within a country with adequate average food consumption per capita, a small proportion of the population consumes more than it needs while the lowest income groups consume markedly less than they need. Success in targeting substantial food aid to those who really need it is thus highly problematic. Moreover, the dependency that would result from such massive food aid would be self-defeating in the long run. And such a volume of food aid would depress prices, thus having the perverse impact of reducing incentives for production in the country itself.

PRODUCTIVITY--COMPONENTS OF THE SOLUTION

So the burden of increasing per capita food production rests primarily with the developing nations themselves. Experts agree, however, that there is tremendous potential for increased food production at lower cost per unit and its by-product of increased income to buy food in

lower-income, food-deficit nations. But what are the keys to unlocking this potential?

Technology? Well...yes...and no. Yes, in the sense of more widespread adaptation and adoption of appropriate current technologies, e.g., high yielding seeds, fertilizer and irrigation. No, in the sense that we don't have to wait on future technological advances to provide the means for solving much of the problem. But let me take a brief digression to outline some of the expected impacts of new biotechnologies on agricultural production.

Biological technology has been applied in agriculture for decades in the form of plant breeding. The adoption of high yielding wheat and rice varieties, especially in Asia and Latin America, has given a major boost to growth in food production since the mid 1960's. The new genetic engineering research is not expected to result in large crop production gains for some time (Hanrahan). However, impacts on livestock production are expected soon in the form of antibiotics and vaccines, hormone growth stimulants and new high protein feed sources (McElroy and Krause). In terms of possible applications in developing countries, it is noted that expansion of livestock grazing in Africa is limited by diseases which could conceivably be treated effectively by such antibiotics and vaccines (Hanrahan).

Now, back to the main road: The physical/biological potential for increased food production from more widespread adaptation and adoption of current basic technologies is evident from regional comparisons of grain yields (Table 7), irrigation (Table 8) and fertilizer use (Table 9). Though certainly other factors are involved, relatively low grain yields in Asia, Africa and Latin America can be explained to a great extent by

Table 7--World grain yields 1/

Region	1961-65	1969-71	1980
	Kilograms/hectare		
World	1,460	1,806	2,149
United States	2,736	3,458	3,774
Other developed countries	2,017	2,525	3,194
Eastern Europe and USSR	1,173	1,652	1,801
Latin America	1,331	1,481	1,790
North Africa and Middle East	1,075	1,165	1,408
Subsaharan Africa	849	925	969
China	1,538	2,083	2,923
Other Asia	1,130	1,334	1,649

1/ Includes wheat, rice, barley, maize, oats, millet, and sorghum.

Source: Hanrahan.

Table 8 --Total and irrigated cropland

Region	Cropland		Irrigated area		Irrigated area as percentage of cropland	
	1961-65	1980	1961-65	1980	1961-65	1980
	Million hectares				Percent	
World	1,334	1,452	149	212	11	15
United States	180	191	15	21	8	11
Other developed countries 1/	173	173	9	12	5	11
Eastern Europe and USSR	284	286	11	22	4	8
Latin America	116	167	8	14	7	8
North Africa and Middle East	81	87	14	18	17	21
Subsaharan Africa 2/	126	156	3	5	2	3
China	104	99	39	46	37	46
Other Asia 3/	270	293	50	74	19	25

1/ Canada, Western Europe, and Oceania. Excludes Japan and South Africa.
2/ Includes South Africa.
3/ Includes Japan.

Source: Hanrahan.

Table 9--Consumption of fertilizers 1/ per hectare of cropland 2/

Region	1961-65	1969-71	1980
	Kilograms/hectare		
World	27.9	48.5	79.9
United States	45.6	80.0	111.6
Other developed countries	43.8	103.5	132.3
Eastern Europe and USSR	27.7	63.5	105.0
Latin America	11.2	19.6	46.0
North Africa and Middle East	6.2	13.5	32.7
Subsaharan Africa	1.8	4.7	9.7
China	12.2	41.8	154.6
Other Asia	5.7	14.6	37.6

1/ N, P_2O_5, and K_2O.
2/ Arable land and land in permanent crops in FAO land classification.

Source: Hanrahan.

limited use of irrigation and fertilizers. Note the contrast between these regions and China. What then is constraining adaptation and adoption of these basic technologies? Falcon talks in terms of a "productivity triangle": technology, investment and price and trade policies. Let's look in turn at each of these latter two factors which must complement technology in order to stimulate agricultural productivity.

There are at least four types of investments that are important. Natural resource development is needed, in particular water resource development to provide irrigation, as China has demonstrated. Irrigation is needed in many parts of the world to realize the potential of high yielding seed varieties and heavier use of fertilizers.

Investment in physical capital is necessary, e.g., roads, bridges and storage facilities. If an individual farmer is to escape from poverty and malnutrition, he must have markets for any surplus he can produce, which will provide him with purchasing power for a more varied and adequate diet. On a national basis, this physical infrastructure is necessary 1) if domestic distribution is to be improved and 2) if comparative advantage in some crops is to be exploited in order to generate export earnings for financing domestic investments and other food imports.

Investments in institutional infrastructure is critical, e.g., in marketing and in credit institutions and research and extension capabilities. The importance of marketing institutions follows from the arguments for physical infrastructure above. Credit institutions are necessary if farmers are to be able to take advantage of even basic technologies such as high yielding seeds and fertilizers. Added revenues lag added costs by several months at the least. Research capacity is necessary to adapt

technologies to local conditions. Extension capacity to encourage adoption through education and demonstration.

As important as the above types of investment are, perhaps the most important type needed is investment in human capital. Ted Schultz, Emeritus Professor at the University of Chicago and 1979 Nobel Laureate in Economics, has argued long and hard on this point. As the major theme in his Nobel address entitled "The Economics of Being Poor," he argued that land is overrated, while the quality of the human agent is underrated.

> What we have learned in recent decades about the economics of agriculture will appear to most reasonably well-informed people to be paradoxical. We have learned that agriculture in many low-income countries has the potential economic capacity to produce enough food for the still-growing population and in so doing can improve significantly the income and welfare of poor people. The decisive factors of production in improving the welfare of poor people are not space, energy, and cropland; the decisive factor is the improvement in population quality....
>
> A fundamental proposition documented by much recent research is that an integral part of the modernization of the economies of high- and low-income countries is the decline in the economic importance of farmland and a rise in that of human capital--skills and knowledge (Schultz, 1979).

This is in sharp contrast to writers (for example, Brown) who emphasize 1) protection of land (from soil erosion and conversion to other uses) and 2) reducing the quantity of human agents. It should be noted that less than 20% of the growth in total grain production in the world from 1961-80 was accounted for by increased land use (Barr).

What about price and trade policies? Let me defer to Professors Falcon and Schultz on this matter.

> Low-income countries tend to discriminate against the agricultural sector and to provide less than international prices to their farmers. For a long-run production solution, raising prices to farmers in many countries is absolutely essential. However, it is more than sheer neglect or urban bias that keeps governments from making this change. Higher food prices also mean lower real incomes, especially for poorer groups who may spend up to 80

> percent of their incomes on food. This basic pricing dilemma--short-run consumption losses versus long-run production gains--needs to be recognized for the very real problem that it poses, even for the most responsible government (Falcon, 1981).
>
> ....Some governments continue to procure food grains at below market prices so that they can be provided cheaply to fair food shops, mainly for the benefit of urban consumers. The effect of such procurement is to distort the incentives of farmers, and in doing so, reduce their economic opportunities to modernize agriculture....Many low-income countries, despite their urgent requirements for more food, are underpricing their agricultural products. In most of these countries free trade and internal prices at prevailing international levels would be a boon for the modernization of their agriculture....It bears repeating that market prices are an economic necessity (Schultz, 1981).

But are free market prices alone a cure-all? No, they are a necessary (as even China has learned) but not a sufficient condition. The investments outlined above are critical too. And Tweeten offers a further qualification:

> Adam Smith pointed out two centuries ago that pursuit of self-interest by each individual in the market leads to the greatest good for all. That proposition applies only in markets characterized by many buyers and many sellers, where resources are somewhat equally shared. Atomistic markets have been replaced by the agglomeration of power elites in landed aristocracies, trade unions, and unrepresentative governments. Unlike Smith's <u>atomistic</u> greed, which is turned into the good of all by the invisible hand of the market, <u>organized</u> greed leads to exploitation. The source of malnutrition can be traced in part to the collective avarice that is apparent in landownership patterns, trade barriers, exploitative governments, and other institutions (1978).

But how can a low-income, food-deficit nation deal with this pricing dilemma? They could institute something like our commodity price support and food stamp programs, where commodity prices are held even above market clearing levels and low-income food consumption is subsidized. But government costs are high (as we know all too well) and there are competing demands for the limited government resources, e.g., demands for industrial and other "modern" development. Yet, for the long term this type of investment in agriculture may well have a higher payoff.

Finally, what about the issue of population growth rates? Falcon applauded the President's Commission for recognizing that:

> Improvements in nutrition and infant mortality are a prior condition to solving population growth problems and not vice versa (1981).

It is well documented that birth rates decline in a lagged response to increases in income and reduced infant mortality. Birth control is difficult to force before its "time." However, Tweeten suggests there may be a "Catch 22" in that:

> (I)ncomes cannot be adequately raised without lower birth rates, and lower birth rates cannot be achieved without more income (1978).

What to do about population growth rates remains a difficult issue at best, fraught with moral as well as practical concerns.

A ROLE FOR THE U. S.

Given the importance of the above factors, what can countries like the U. S. do? Tweeten argues the most important thing would be to remove trade barriers to imports from developing countries (e.g., food items like sugar and nonfood items like textiles) so they can better finance domestic investment and food imports. Second, maintain a strong basic research thrust in hope of a major breakthrough that might revolutionize food production. Third, increase aid for investments of the four types outlined above. It is of interest to note that the U. S. devotes only 0.2% of GNP to international development aid, significantly less than almost all other so-called developed nations. Fourth, make food aid available for emergency shortages through a commodity reserve.

But one might ask, "Wouldn't such actions be inconsistent with regard to our interest in increasing agricultural exports?" No, they would

be consistent. As incomes increase in these countries, economic demand for our agricultural exports will increase, as history has demonstrated in the case of several nations. They would also be consistent with our national security concerns. Some argue that in the future food issues will be an increasingly important cause of instability in 1) the political and social structure within food-deficit countries and 2) international relations.

CONCLUSIONS

Returning to the opening quote from Breimyer, it must be concluded that in the collaborative effort between God and man to annually replenish (and over time enlarge) the world's food supply, God has kept His part of the bargain, but man has not. Hanrahan notes that even most major famines in recent times were not brought about by sudden decline in the physical availability of food (due to drought or flood, for example), but by sudden increases in food prices or sudden contractions in real incomes--caused by man-induced factors like political and social strife or military conflict. And without question, the chronic hunger and malnutrition millions in the world face is self-inflicted by man upon man. Terry Barr, then chairman of the World Agriculture Outlook Board, clearly recognized the problem when he concluded:

> The basic realities of the distribution of the world's population, wealth, and agricultural production base are not conducive to an automatic stabilizing process for the world's hungry....Any solution under these constraints will require a greater degree of international cooperation and flexibility that has been evident to date (1981).

We may well double food production in the world within the next 30 years as we have in the last 30 years and increase food production per capita by another 20% (Table 10). But whether the poorest quarter of the world's

Table 10--Indices of total food production, 1950-82

Region	1950	1960	1970	1980	1982	Compound rate of growth
	---- 1969-71=100 ----					Percent
Developed countries	63	82	98	119	126	2.1
Developing countries	54	74	101	133	141	3.0
Centrally planned countries	53	72	101	123	130	2.8
World	58	77	100	124	131	2.6

Source: U.S. Department of Agriculture, Economic Research Service, World Indices of Agricultural and Food Production, 1973-82, SB-697 and previous issues.

population will eat a lot better 30 years from now than today remains something of an open question. There is a "way," but is there a "will?" Tweeten sums up the dilemma in this way:

> To recognize that man, not nature, is the chief obstacle to economic progress is to shift the spotlight from the agricultural scientist and technician to the social scientists and moral philosopher for solutions to world food problems. Unfortunately the tools of science are but blunt instruments when confronting attitudes and institutions that block mankind's progress. Moral dilemmas are inescapable (1978).

This brings me to my closing comment. There is at least one biblical principle which is relevant to the world food problem. It is found in the Apostle Paul's second letter to the church of Corinth, where he writes:

> Our desire is not that others might be relieved while you are hard pressed, but that there might be equality. At the present time your plenty will supply what they need, so that in turn their plenty will supply what you need. Then there will be equality, as it is written: "He that gathered much did not have too much, and he that gathered little did not have too little" (2 Corinthians 8:13-15).

There are surely many who would make more effort to apply this principle with regard to world hunger if there was a practical way to do so individually and if they could be assured their effort would make a difference. However, until there is more widespread support for this principle (not only in food-surplus nations but also in food-deficit nations) and more collective wisdom as to practical strategies for applying it, progress in solving the problem of hunger and malnutrition will be slow.

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