AFTER THE GREEN REVOLUTION

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The Cincinnati Bengals football team also suffered during the mid-summer meat shortage. They had to cut their weekly training camp grocery list down to 180 pounds of prime rib, 120 pounds of New York cut steaks, 145 T-bone steaks, 137 sirloin steaks, 75 chickens, and about 60 pounds of cold cuts. The Bengals' chef could get only half of the customary 1,000 pounds of meat a week for the 75 team members.

The meat shortage had to be seen as a relative matter, however. At the same time that the Cincinnati Bengals were doing without, other Bengals--natives of Bangladesh--were living in famine conditions. They were not alone. Food shortages or actual famine prevail in many of the world's nations, caused in part by last year's drought; these situations include the sub-Sahara famine in Africa and shortages in Afghanistan, Pakistan, India, Indonesia and Central America. The drought belt also reached into Russia, where crop shortages were worsened by late flooding; floods also caused serious food problems in the Philippines.

The drought decreased world grain production about four per cent. "This small change was enough to cause violent responses in prices and shifting of foreign-exchange expenditure, and human suffering," says Dr. Lowell Hardin, Agricultural Program Officer of the Ford Foundation. In the mid-1960s, the Ford Foundation joined with the Rockefeller Foundation to sponsor development of special crops that, according to their advocates, would produce a "Green Revolution" and end hunger in the poor nations of the world. These crops included "miracle rice," "wonder wheat" and special varieties of corn--all developed to produce high yields under tropical growing conditions with the help of modern technology.

For a few years after introduction of the new crops, there were glowing reports of success. In early 1972, India announced that some food grain reserves had been accumulated, and that it planned to become independent of

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U. S. grain imports by 1973; the Philippines planned to become a major exporter of rice. More recently, however, the Green Revolution has come under attack. Its critics say that the successes are mythical and that application of the new agricultural technology has contributed to social unrest in Third World nations.

An Agricultural Miracle?

The Green Revolution got under way when new varieties of wheat were developed in Mexico under Rockefeller Foundation sponsorship, and "miracle rice" was developed at the International Rice Research Institute in the Philippines, a joint project of the Rockefeller and Ford Foundations. More recently, the foundations and the U. N. have sponsored work on new strains of corn suitable for tropical conditions. These "supercrops" are dependent on large quantities of fertilizers, pesticides and other chemicals and, in the case of rice and some wheat varieties, on irrigation.

Crop yields are considerably higher than those of older local varieties, but at the expense of some reduction in individual plants' protein content. That's because of the "inverse nitrogen law." Protein is based on nitrogen compounds; the effect of nitrogen fertilizer is to increase the protein per acre--in terms of number of plants--but to decrease the ratio of starch-to-protein in the individual plant. Thus, the new crops tend to have more calories in carbohydrates and fats but not in proteins, which remain at about the pre-Green Revolution level.

Campaigns to encourage use of the new seeds were conducted by the local governments with the help of U.N. agencies and the U. S. Agency for International Development, and crop-subsidy and farm-credit programs were set up. The results were widely hailed in the late sixties, but then problems began to develop. These include consumer resistance to some "tasteless" rice strains; a shortage of irrigated land and difficulty in providing irrigation when rainfall is absent; increased costs in terms of fertilizers, pesticides and drying machinery to prevent mildew and sprouting (some new rice varieties grow quickly, which means they have to be harvested during the rainy season).

The reports of success have been called deceptive by some critics. William C. Paddock, an agricultural consultant and author, for one, says, "The revolution is green only because it is being viewed through green-colored glasses like the Emerald City in *The Wizard of Oz*"--otherwise invisible. He ridiculed AID claims of 27 per cent increases in the output of rice and

wheat in India in the 1967-69 period. "1965 and 1966 were poor weather years for the farmer of South Asia," he says, but then the weather improved. "A drought followed by rain will cause a spurt in production with or without new technology." In those same years, Paddock maintains, India had 20 to 30 per cent increases in barley, chickpeas, tea, jute, cotton and tobacco without miracle varieties. "When crops are poor, governments blame it on the weather. When crops are good, governments take credit," he says.

Paddock also claims that the Philippine government's reports of self-sufficiency in rice were based on high subsidies. The government "increased the price support paid for rice by 50 per cent. The support price of corn was also raised but to a lesser degree than rice. Rice production went up. Corn became cheaper to eat than rice, thus more people ate corn. Result: a 'surplus' of rice in the Philippines."

Social Consequences

Other observers have said that the Green Revolution defeated agrarian reform measures in the Philippines. Large landholdings were being broken up, but farming became more profitable as a result of the new methods, and the big landowners were able to retrieve their holdings. Dr. Marvin Harris of Columbia University, an anthropologist who worked in the Philippines, goes even farther. "The precise objective of the managers of the Green Revolution," he says, "is to wipe out the class of small farmers and to replace them with efficient agribusinessmen who will be heavily dependent upon industrial products and world markets."

American corporations are heavily involved in credit and supply arrangements, Dr. Harris says. "In the Philippines, for example, Esso Standard Fertilizer and Agricultural Company has played a critical role in all phases of the introduction and marketing of the high-yield varieties." Esso set up a network of 400 supply stores, and the Philippine government made credit available for purchase of the chemicals, but on terms unfavorable to the small farmer. "The inexorable, planned effect of the Green Revolution is for the millions of 'inefficient' farmers with small landholdings to sell out."

A somewhat more cautious statement of the same problem has been made by Lester Brown, senior fellow of the Overseas Development Council: "Another question persistently raised concerning the Green Revolution is, who benefits from the adoption of these new technologies? The new seeds can be used with equal success by both large and small farm owners if the farmers have equal

access to the requisite inputs and supporting services. In many countries and locales, however, the owners of large farms have easier access to credit and to technical advisory services than the owners of small ones. Where these circumstances prevail, there is a disturbing tendency for the rich farmers to get richer and the poor ones poorer."

Summing up the situation, a recent World Bank working paper said, "Far from reducing social tensions in rural areas, the spread of the new technology is likely to sharpen them, and lead to great demand for the implementation of measures, such as land reform, for the redistribution of wealth and incomes."

Breeding Out Resistance

The Green Revolution also raises ecological questions in the form of threatening plant disease epidemics. As Dr. H. Garrison Wilkes, a University of Massachusetts plant geneticist, says: "Never before in human history have there been comparable monocultures--dense, uniform stands--of billions of plants covering thousands of acres, all genetically similar."

The problem is created by two aspects of the Green Revolution: genetic uniformity of the crop as a result of the breeding process, and world-wide planting of these miracle grains. The Green Revolution is ideal for the domino effect because there always exists the constant threat of mutations for pathogenicity in disease agents, making entire crops vulnerable.

That is what happened in the U. S. corn blight epidemic of 1970, in which one fifth of our hybrid corn crop was lost because of favorable growth conditions for the pathogen (a fungus), and widespread genetic uniformity in the American corn crop. Similarly, wheat stem rust wiped out 65 per cent of our Durum wheat crop in 1953, and 75 per cent of Durum wheat and 25 per cent of bread wheat in 1954. The 1970 corn blight is considered a factor in our present high meat prices. If a similar event took place in one of the tropical areas where large populations have become dependent on new crops, the result could be as catastrophic as the Irish potato famine of the 1830s.

As Dr. Wilkes indicates, we have been going through a Green Revolution of our own in the U. S.--a drastic change in farming methods since World War II. In fact, the Green Revolution abroad has been based on technology pioneered largely in this country, although certain innovations are traceable to Japan. Historically, the starting point of the process was the "yield takeoff"--a dramatic increase in the yield of crops per acre--initiated in the rice fields of Japan shortly after the turn of the century.

Intensive Cultivation

Japan, short of farmland and under population pressure, was the first country to practice "intensive cultivation," using large quantities of chemical fertilizer and many farm workers. Over a period of about 70 years, this has resulted in a jump in rice production from a little more than 2,000 pounds per acre to about 4,500 pounds per acre; an earlier doubling of the yield, from about 1,000 pounds per acre, had taken more than 1,000 years. A few small countries in northern Europe also achieved yield takeoffs in the early years of the 20th century through intensive cultivation, but the next important takeoff took place in the United States. Corn yields have more than doubled since the late 1930's, and the U. S. farmer now produces three tons per acre.

This increase was caused mainly by the introduction of hybrid corn, another crop capable of increasing output when large amounts of fertilizer are applied to the land. More than 95 per cent of the corn acreage in the U. S. is now planted with hybrid corn, cultivated almost entirely for animal feed and industrially prepared foods. Like the "miracle rice," hybrid corn is somewhat lower in protein than the old feed corn, so protein supplements have been added. Fish meal was used until the recent depletion of Peruvian anchovies--caused either by overfishing or by temporary changes in ocean currents; soybean meal and milk products have since been substituted.

A whole cattle-feeding industry has grown up around hybrid corn. Calves, raised by "cow-calf" ranchers to a weight of 400 pounds, are sold to feed-lot operators. In the feed-lot pens, they do nothing but eat, and are shipped to the slaughterhouse when they weigh about 1,000 pounds. Similar feeding methods are now used in raising hogs and chickens. To meet the various nutritive requirements of different animals, hybrid corn feeds have become quite complex--they contain vitamins, antibiotics, tranquilizers, hormones and growth agents.

The Mechanized Meadows

Another reason for vastly increased crop production is the growing use of farm machinery. The number of tractor horsepower on American farms, for example, increased from five million in 1920 to 93 million by 1950, and is well over 200 million today, according to the Department of Agriculture.

Most basic farm machinery was developed during the 19th century, when horsepower still meant horses. Much of the increase in food production then resulted from bringing more land under cultivation; the new machinery was

partly a response to labor shortages on the frontier. The development of animal-powered machinery continued until about 1930, when "big-team hitches" were still used to pull plows and combines on the prairies. Horse-drawn machinery reduced the manpower required to produce a given quantity of crops twelve times; since then, tractor power has reduced labor requirements only an additional 50 per cent.

Replaced by high-horsepower tractors with stereo-equipped air-conditioned cabs, draft horses and oxen disappeared from American farms after World War II, releasing many acres of land on which their feed had been grown. However, tractors on U. S. farms consume about eight billion gallons of gasoline a year, according to Dr. Michael J. Perelman, an agricultural economist at California State University, who calls modern agriculture "farming with petroleum."

Calculating the total energy consumption of farming in this country, including that used to manufacture fertilizer, Dr. Perelman arrives at a figure equal to more than 30 billion gallons of gasoline per year. In caloric value, he says, that's more than five times as much energy as Americans get from the food they eat.

Big Business

The great demands of modern farming has turned it into "agribusiness," a system that requires more and more "inputs"--chemicals, machinery, special seed, livestock feed, technical information--and capital or the credit to borrow it. The diversified, self-sufficient farm has passed into history, and farmers find themselves in specialized, highly competitive industries controlled by powerful, well-organized marketing interests.

Under these pressures, farmers' costs and debts have achieved a "take-off" of their own: According to the Agribusiness Accountability Project, a farmer-consumer group based in Washington, D. C., overall U. S. farm expenses have risen 122 per cent and farmers have 355 per cent higher debts since 1952. During the same period, the prices received by the farmer have gone up only six per cent (while the retail price of food was increasing 43 per cent). Consequently, the number of small farms has been dropping and the land has been consolidated into large farms.

Farmers have been going out of business at a rate of 2,000 a week since the 1930s. During World War II we had over six million farms; today there are less than 2.7 million. This process is expected to continue. Secretary

of Agriculture Earl Butz says there will be only 1.8 million farms by 1980.

"Lack of management ability" is often given as the reason why the "marginal, inefficient" farmer loses out in today's agribusiness atmosphere. "We're primarily concerned with working with commercial farmers," says Dr. David Call, director of extension services at Cornell's College of Agriculture. County extension agents from agricultural colleges are among the farmers' most important sources of technical help and advice. "One of the most valuable services we provide, sometimes, is to help a man exit from farming," Dr. Call told me. "The guy that finally goes out usually goes out gracefully."

Concentration of economic power in farming is proceeding even more rapidly than the decline in the overall number of farms indicates. The largest 223,000 farms in the United States, only 7.6 per cent of the total number of farms, already produce slightly over 50 per cent of agricultural products, according to "Who Will Control U. S. Agriculture?" a study prepared by the agricultural schools of several midwestern universities, and coordinated by Dr. Harold Guither of the University of Illinois. "If this trend continues," says the study, "it is conceivable that within two or three decades 70 to 80 percent of total farm production could be concentrated on about 100,000 farms."

Large corporations are also buying and operating farms. Dow Chemical, for example, grows lettuce, Boeing Aircraft potatoes, and Getty Oil thousands of acres of vegetables in California. "Vertical" integration, the most significant form of corporate involvement, controls the farmer completely through contracts to buy crops at a guaranteed price. "Food processors routinely develop new seed strains for use by their hired farmers; they research and develop new machinery for crop production and harvesting, and they stipulate the timing, amount, and kinds of chemicals applied to crops that end up in their cans," according to the Agribusiness Accountability Project.

Del Monte, the world's largest canner of fruits and vegetables, has 10,000 farmers in the United States directly under contract. They have the prerogative of determining whether any given delivery is "of good quality and condition for canning." In 1972, the price of asparagus was

23 cents a pound; asparagus deemed unsatisfactory by Del Monte was bought at .0005 cent a pound. These rejects were used to make asparagus soup and asparagus cuts and tips, according to the Agribusiness Accountability Project.

Ninety-five per cent of the vegetables produced for processing are grown under contract integration. Sugar cane and sugar beets and fluid milk are even more heavily integrated. So is chicken farming or, as it's known in agriculture, the broiler industry. Ninety-seven per cent of all chickens are produced under contract integration. Ralston Purina and Pillsbury, among the large companies that dominate the broiler industry, produce chickenfeed and thus profit on the feed as well as on the end product.

Despite the Green Revolution at home and abroad, world reserves of food grains are just about exhausted, and we are living on current production. Whatever speculative economic pressures may be involved, this is a precarious situation indeed, which can be thrown off balance by crop failures or manipulation of supply and demand. Although world food supplies--with a growth rate of 2.8 per cent a year--have kept slightly ahead of world population's 2.6 per cent growth rate, the ghost of Malthus has been raised again.

"The worst is yet to come," a prominent agricultural expert told me. "Population in parts of the world where the problem is most acute is not being brought under control. That can lead to only one result--serious famine. It's already happening in Bangladesh and Africa. If Malthus was right, it's in operation now. Mother Nature's not going to be pushed around."

To compound the world food situation, some nations are responding to food shortages in new ways. "Historically," the Ford Foundation's Dr. Hardin says, "people have adjusted themselves to the food supply instead of adjusting the food supply to people. If the weather turned against you, you ate the stuff the livestock would have eaten."

However, "for the first time in the knowledge of man, the U.S.S.R. responded differently [to 1972's bad crops]. They did not liquidate their livestock, but rather somehow got together enough resources to go on the world market and buy enough cereals--some 30 million tons--to maintain livestock heads and also feed their people." The sale of one quarter of last year's U. S. grain crop to the Soviet Union has been blamed for triggering world food shortages and production cost increases.

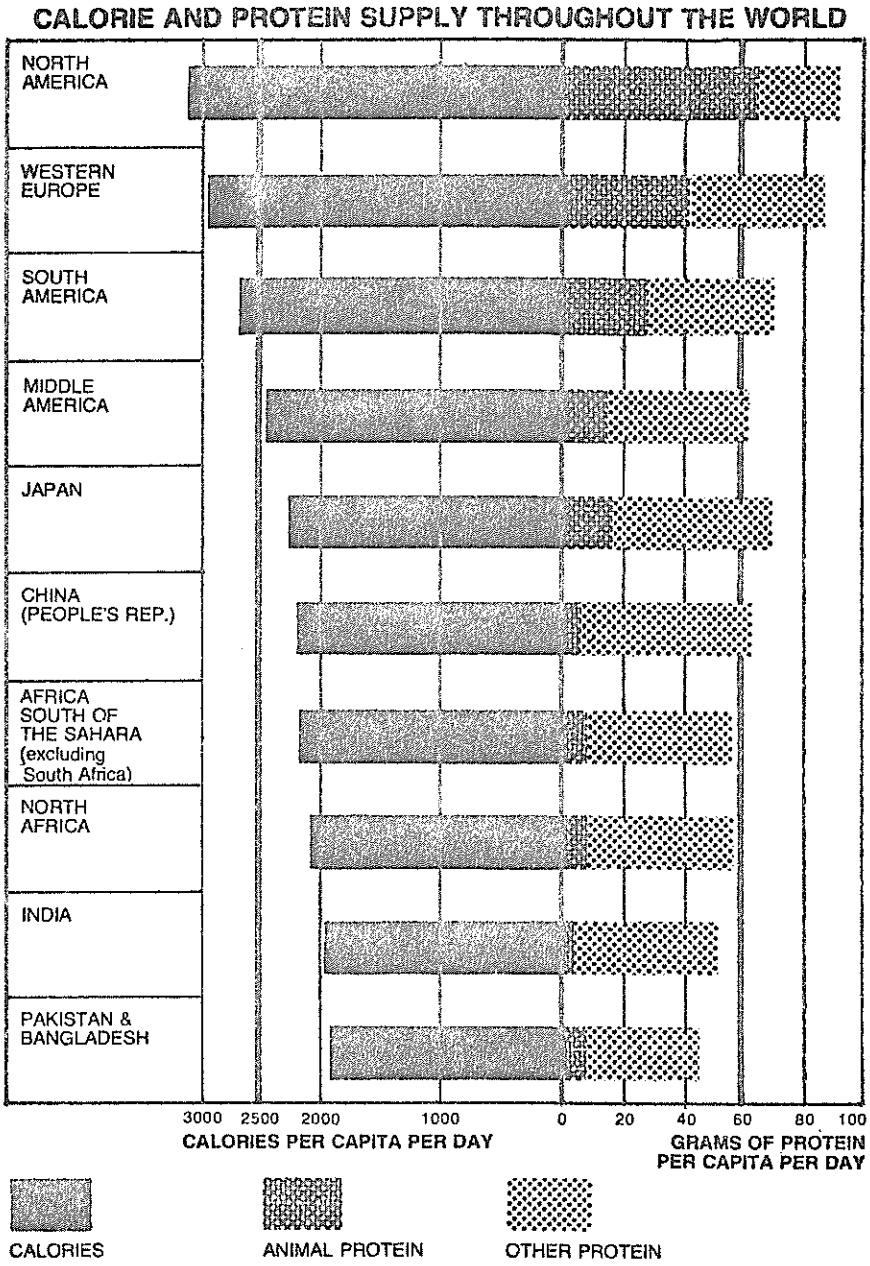
The Soviet Union made a "highly consumer-oriented response," to their grain shortage, Dr. Hardin says; that nation is attempting to upgrade the diet of its population by providing greater amounts of animal protein, nutritionally more desirable than plant protein. Generally speaking, a high protein diet distinguishes the affluent from the undernourished. This process has been going on not only in the U.S.S.R., but in all the northern industrial countries of Europe and also in Japan. In those nations, the diet is now approximately equivalent to that of the U. S. in 1940, according to Lester Brown, and consumption of meat is still going up. This kind of excess consumption of animal protein over absolute needs is what is straining world resources, say many experts, rather than a real shortage of food.

Feeding Animals

Dr. Georg Borgstrom, Professor of Nutrition and Food Sciences at Michigan State University, has calculated the food needs of the various livestock populations of the world in human population equivalents--the numbers of people who could be fed on equal amounts of food. The livestock population of the United States, says Borgstrom, consumes enough food materials to feed 1.3 billion people. Add to this our human population of about 200 million, and the U. S. has a total food population equivalent of 1.5 billion people. That's what our crops have to support. Globally, the population equivalent of all livestock being supported amounts to a load of 15 billion people, in addition to the human population of 3.9 billion.

There may be grounds for optimism in the fact that we are supporting so many livestock. Perhaps, if more of the primary foods went to people instead of animals, the world's farmland could feed many more billions of human beings. "The U. S. could no doubt feed some 800,000,000 to a billion people if a drastic switch took place in our daily food consumption to something resembling the present-day Chinese standard," says Dr. Borgstrom. But the tendency is to expand livestock herds, and for the rich countries to improve their diets at the expense of the poor nations.

Ecologists have pointed out that carnivorous animals need a longer food chain than herbivorous animals, i.e. they consume animals that consume plants. So the total primary food intake of the dominant carnivorous animals can be very large. It takes 50,000 pounds of primary plankton, consumed by marine organisms, to yield one pound of codfish, according to Dr. Borgstrom.



Diet of affluent nations vastly exceeds that of poor ones, in proteins and total calories--and may also exceed amounts needed for good health. Lines at 60 grams protein and 2,500 calories indicate basic dietary requirements for adult males.

In the race for protein, the tremendous expansion of commercial fishing, especially by Russia and Japan, may be utilizing the protein capacity of the sea to its limits already. "World fisheries are in serious trouble, largely because of overfishing," says Lester Brown. "Many marine biologists now feel that the global catch of table-grade fish is at or near the maximum sustainable level. A large number of the 30 or so leading species of commercial grade fish may currently be overfished, i.e. stocks will not sustain the current level of catch."

Moreover, the tendency of modern food production methods is to lengthen the food chain. Until the failure of the Peruvian anchovy fishery, the U. S. imported enough fish meal from Peru and Chile to meet the entire animal protein requirements of Peru--and this went into feed for chickens and other animals in the U. S. Animal protein was used to produce animal protein.

A Need for Action

The food situation, especially on the world scale, is generally regarded as critical by the experts. In the immediate future, the Farm Bill, recently passed by Congress--eliminating acreage set-asides so that almost all U. S. cropland will be production--should be of some help. However, this will add a comparatively small amount of arable land; in 1973, only about 19 million of the 350 million U. S. crop acres were withheld from use. Meanwhile, there is likely to be "rationing by price," as the Ford Foundation's Dr. Hardin says.

For the long run, much more comprehensive action seems mandatory. Says Lester Brown, "In this decade, the overriding objective of a global food strategy in an increasingly interdependent world should be the elimination of hunger and malnutrition among the large segment of humanity whose food supply simply is inadequate. To be successful, such a strategy must be designed to alter existing trends in food production and population growth while seeking a more equitable distribution of food supplies both among and within societies."