

Food Distribution as a Guarantee for Nutrition and Health: China's Experience

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In China, agriculture, health, education, and welfare are intricately woven as part of the developmental plan. This paper focuses on the role of agriculture in social and economic development and its relationship to health programs, the strategy of food rationing and the "private plot" to improve nutrition and health, and the balance of food and population in the Chinese society.

China's nutritional experience contributes significantly to understanding the role of "energy food" in the struggle against protein malnutrition and hunger. The author has outlined the implications for the developing countries.

Introduction

The ability of the People's Republic of China in delivering health care to its 800 million population has attracted increasing attention around the globe. The deployment of indigenous personnel, known as "barefoot doctors," in health care is a relatively recent development. Many of the advances in China's health status have been attributed to these personnel and to improvement in environmental sanitation (Dimond, 1971; Sidel and Sidel, 1973; Wang, 1974; 1975; Salaff, 1973; Horn, 1969).

Less has been said, however, of the Chinese food-distribution system, which provides a guarantee for nutrition and health to the entire population. The interactions of nutrition and infection and the subsequent effects on health status have been well documented (Scrimshaw et al., 1968); Scrimshaw (1974) has further emphasized that socioeconomic development, of which improved health and nutritional standards are integral components, can only be a holistic process. In the case of China, Wen (1974) was emphatic in stating that the health status of today's China has been achieved more by nutritional improvement than by the direct delivery of medical services.

In modern China, the development of health programs has been intricately interwoven with the total social and economic development. Indeed, the Chinese rationale for family planning through delayed marriage and spaced birth, as an illustration, is

not only for the sake of maternal and child health, but also for the explicit purpose of socialist construction and economic development (Fessler, 1973; Wang, 1974). Improving the health of the people promotes social and economic development as the healthy worker produces more for society. Conversely, socioeconomic development promotes health by providing more food and income, and more health, welfare, and educational services to the people.

Infant mortality and prematurity are simple indicators of the health of a nation. The Chinese data on these aspects are extremely fragmented, as is true of all Chinese statistical intelligence. Lamm and Sidel (1973) reported that, in Shanghai, the infant death rate under the age of one year is 12.6/1000, and neonatal death is 3.2/1000. These rates compare very favorably with those of most developed countries and are better than New York City's 18.1/1000 and 13.4/1000 for white and 27.1/1000 and 18.6/1000 for non-white, respectively.

One cannot generalize data for the entire country from Shanghai. As a major urban center, Shanghai has a high concentration of skilled and professional workers; consequently, the area has a higher level of education and a higher income. It also has better medical facilities than most other areas. The Shanghai data do indicate, however, the direction in which China is heading. The evidence is that the decline from a high, pre-industrial mortality level to a lower, industrial level occurred substantially faster in contemporary China than in the United States, where industrialization occurred earlier. Early prenatal care has been credited for much of the reduction in infant mortality (Salaff, 1973). Wray (1975) also noted the Chinese policy of breast feeding as a significant factor in improving child health. The improvement of nutrition was widespread and extended to the entire population.

The manner in which the Chinese improve their nutrition should be especially interesting to health planners, health professionals, and policy makers. Although China has a limited food supply, its food distribution program of grain rationing guarantees the population a minimal caloric intake sufficient to maintain health and physical activity.

This paper focuses on (1) the role of agriculture in social and economic development and its relationship to health programs; (2) the strategy of food rationing and the "private plot" to improve nutrition and health; and (3) the balance of food and population in

the Chinese society. The remainder of the paper outlines the implications of China's experience for the developing countries.

Role of Agriculture in Social and Economic Development and Health Programs

The People's Republic of China, the world's largest country, ranks second in agricultural production, after the United States. With less than 8 percent of the world's arable land, China supports almost one-fourth of the world's population. The cultivatable land per capita in the United States is 1.9 acres; in China, it is less than .4 acres. The actual acreage engaged in farming, however, is higher in China as a result of multiple cropping. Agriculture engages 80-85 percent of the labor force and provides nearly one-half the nation's income. In addition to the food supply for an expanding population, agriculture also furnishes the bulk of raw material for an expanding consumer industry in farm products and manufactured goods for internal use and for export.

Farm Organizations

The Chinese revolution was synonymous with land reform. As an agrarian nation, its farm organization changes touched the very structure of the society.

The farm organization has undergone three stages of transformation. From 1949-1952, the traditional land-tenure system was abolished. In the class struggle, landlords were liquidated and their land and all other possessions confiscated for redistribution. Mutual-aid teams, in which peasants joined in manpower pools, were organized to assist in farm production. After paying an agricultural tax to the state government, the peasants kept their farm incomes for themselves.

In the next period, 1953-1957, the first Five Year Plan of cooperative farms was formed. Under this phase, all land, tools, and facilities were transferred to collective ownership of production teams. The peasants participated as workers and were paid according to their contribution to the cooperative farming tasks and, in some cooperatives, according to the land and tools they supplied. They also were allowed to keep a "private plot," usually adjacent to the family living quarters, to raise fruits, vegetables, and

animals for home consumption. Any surplus could be sold to the state, and these sales were a major source of private income.

In 1958, the People's Republic took the final step in the socialistic transformation by reorganizing the cooperative farms into people's communes. Designed as multipurpose social, economic, political, and military units, these communes consisted of several villages and became the basic unit of society. A commune is a three-tier organization. Below the commune level are the production brigades, and production teams headed by a Revolutionary Committee with representatives from all three levels. The committee functions as the administrative unit for the organization. Reportedly, there are 24,000 communes, averaging 5,000 households each, but some communes are considerably larger. The subunits numbered approximately 500,000 brigades and over 300 million teams.

Agricultural Policy

The first Five Year Plan, 1953–1957, emphasized the development of heavy industrial sectors nationwide, but placed special emphasis on urban areas. In the health field, therefore, most of the resources were allocated to the cities during this period. The cities received more of the health budget, medical facilities, and health personnel, while the rural areas were given the environmental and preventive measures, such as sanitation and vaccinations.

With the promulgation of the Twelve Year Plan for Agriculture Development in 1956, the Chinese chose to stress agriculture as the basis for their country's economic growth, thereby linking health explicitly to rural development. This emphasis on rural areas is also more consistent with the Chinese developmental aspect of the mass line. In 1965, Mao declared in his famous June 26 directive: "In health care, emphasis must be given to the rural areas."

China's agriculture is labor-intensive. Although mechanization has been introduced to state-owned farms and many communes, plows, hoes, spades, sickles, and draft animals remain as features of most tilled areas.

The 1956–1967 National Agriculture Development Program was formulated as the major guideline for the long-range development of agriculture. This 12-point program for agriculture in-

cluded: (1) water conservation for irrigation and flood prevention, (2) expansion of natural and chemical fertilizer input and output, (3) improvement of old-style farm tools and development of new mechanisms, (4) development and propagation of new strains of seeds for local areas, (5) expansion of multiple-cropping areas, (6) planting of more high-yield crops, (7) adoption of the best farming methods, (8) improvement of soil capacity and utilization, (9) promotion of water and soil conservation, (10) protection and breeding of draft livestock, (11) extermination of insects and plant diseases, and (12) reclamation of wasteland and expansion of cultivated areas. The plan was designed to modernize and mechanize agriculture.

Until 1958, when the Great Leap Forward was initiated, food production was on the increase, but 1959–1961 were calamity years which resulted in a food crisis. The agricultural failures during this period led many to conclude that China erred in the “mistaken policy” of favoring heavy industry at the expense of agriculture (United States Department of Agriculture..., 1964; Eckstein, 1966; Larsen, 1968; Erisman, 1972). Criticism also was strong against the communes as having failed in their basic purposes of economic activities and community organization.

According to a report of the United States Congress, Joint Economic Committee (1968), the total investment made for agriculture 1950–1959, however, does not indicate that this area was sacrificed to industrial investment. Even though less was spent for agriculture than for the industrial sector, the figures in Table 1 show the agricultural investment to be well above 20 percent of the total national investment.

The impression that outside observers had of the Chinese having sacrificed agriculture in favor of industry was due to the priorities given to importation of heavy machinery and equipment for industry during that period rather than of chemical fertilizers vital for agricultural development.

The calamities of 1959–1961 in agriculture were due to bad weather as well as bureaucratic inefficiency and mismanagement during the transition from cooperative farms to communes. The crisis in the food situation greatly heightened the need for better agriculture development, and by 1961 there was a major shift in agriculture management. The planning and management of agricultural production were returned from the commune level to the

TABLE 1
Sector Shares of Gross Fixed Investment^a
(current prices)

Sector	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Agriculture ^b	31.5	25.5	24.9	20.7	22.4	24.5	22.8	23.0	24.0	23.2
Industry, construction, and public utilities	21.0	27.7	28.7	33.0	34.4	34.3	37.8	41.3	50.9	49.8
Heavy industry	(3)	(3)	(15.0)	(17.1)	(20.2)	(24.6)	(26.2)	(29.2)	(41.1)	(40.6)
Light industry	(3)	(3)	(10.0)	(10.2)	(8.2)	(4.0)	(4.6)	(5.7)	(5.9)	(5.9)
Transportation and communications	12.3	11.8	10.3	9.4	11.0	13.8	13.8	12.6	10.0	12.2
Residential construction ^c	12.4	12.8	14.6	10.2	9.5	10.5	8.4	9.7	6.6	6.6
Service and trade	22.8	22.2	21.6	26.5	22.8	16.8	17.0	13.4	8.4	8.3
Total fixed investment ^d	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: United States Congress, Joint Economic Committee (1968).

^aSector investment are based on estimates of investment for nonproductive purposes that are subtracted from the sector allocations for State investment. All private investment other than industrial investment, handicrafts, and native transportation have been included under investment in trade although small amounts of this investment may properly have fallen under other sectors.

^bOne-third of self-financed agricultural investment is estimated to be construction and half of this is assumed to be for housing.

^cNot available.

^dSubtotals do not necessarily add to the total because of rounding.

production brigades and subsequently to the production teams.

The private plot, abolished during the Great Leap in 1958, was re-established. The government also declared an "agriculture first policy." Little information on agricultural investment during the 1960s is available during that period in which the Cultural Revolution was in full swing. It is reasonable to expect, however, that in the face of food crisis, the "agriculture first policy" allocated a larger share of state investment to agriculture than was made during the previous decade. This policy was accompanied by a restructuring of the industrial sector to produce agricultural items, such as tractors, and to import more chemical fertilizers.

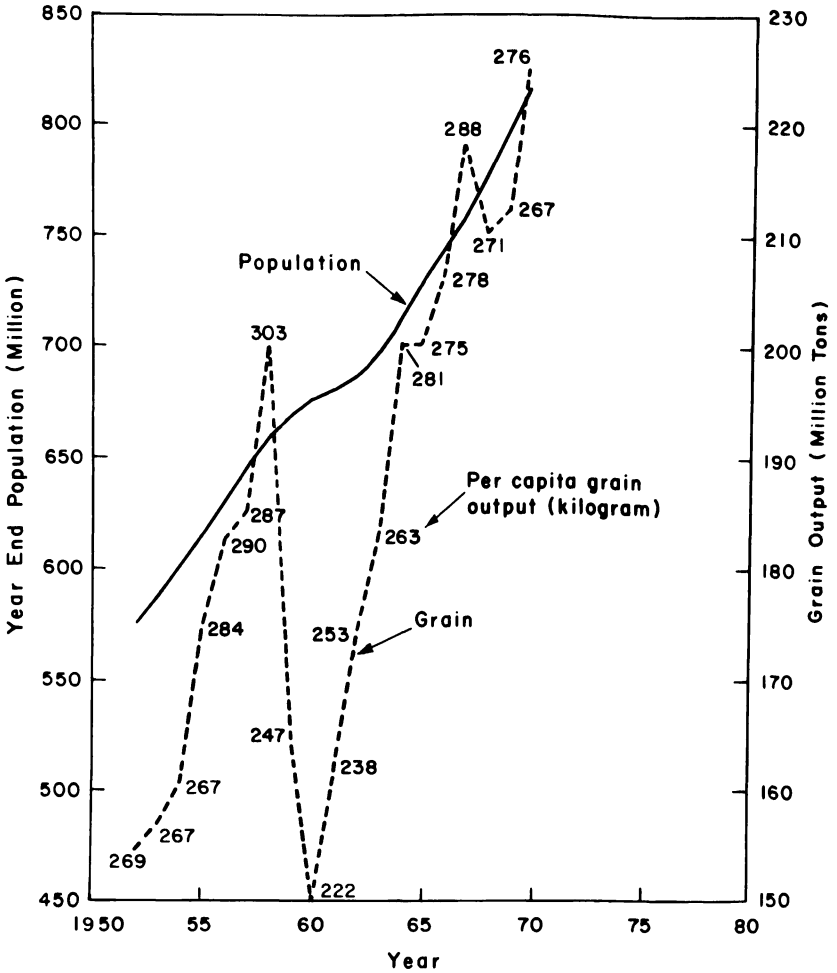
Food Production and Supply

From 1952 to 1958, the output of grain was reported to have increased from 154 million tons in 1952 to 185 million tons in 1957. As previously mentioned, the period from 1959 to 1961 was marked by severe food shortage.

According to estimates, food production again showed an upward trend by 1964. A comparison of the annual average of 181 million tons for the 1962-1966 period with that of 172 million tons for the 1953-1957 period shows a nine-million-ton increase during this interval. This increase was offset by an expanding population which passed the 700 million mark in 1964. Figure 1 shows that China's food increase is barely keeping pace with population growth.

It has been necessary since 1960 for China to import food from abroad to help feed its people. The burden on agriculture in China's economy is such that it must not only meet the demands for food and fibers for a population growing at a rate of 10-15 million each year but must also provide raw materials for a growing consumer industry and supply a large share of the export in foreign trade.

In the early 1960s, China imported grains mostly from Australia, Canada, Argentina, France, and West German, as shown in Table 2. The first shipment of 400,000 million tons of wheat registered for sale to the People's Republic from the United States was announced by the USDA on September 14, 1972. In a cautious note Wortman (1975) has reported recently that China appears to have achieved the objective of supplying enough food for all its people. There is optimism that China is fast becoming an oil-



Adapted from Victor-Bostrum Fund and the Population Crisis Committee (1971:102).

FIG. 1. Food and Population Trends.

exporting country. Oil reserves are immense and are just ready to be tapped. Agricultural exports can therefore be diverted toward domestic consumption.

The Strategy of Food Rationing and the "Private Plot" for Nutrition

The efficiency of the food-distribution system toward the improvement of nutrition and health among the Chinese people is of

TABLE 2
Exports of Wheat and Wheat Flour to Communist China,
by Country of Origin, Fiscal Years 1961-73
(in thousands of metric tons)

Country of origin	Year ending June 30													
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	
United States	0	0	0	0	0	0	0	0	0	0	0	0	0	590 ^a
Argentina	0	88	98	988	598	2,216	324	10	0	0	0	0	0	—
Australia	1,158	1,953	2,075	2,543	2,276	2,018	2,165	2,416	1,182	2,517	1,308	0	0	320
Canada	781	1,968	1,678	1,005	1,758	1,987	2,465	1,367	2,098	1,830	2,347	2,967	0	4,370
EC:														
France	0	199	870	222	399	38	71	363	257	778	0	0	0	—
W. Germany	10	384	119	0	0	0	0	0	0	0	0	0	0	—
Italy	0	1	0	0	0	23	0	0	0	0	0	0	0	—
Total EC	10	584	989	222	399	61	71	363	257	778	0	0	0	—
USSR	0	160	46	0	0	0	0	0	0	0	0	0	0	—
Mexico	0	0	0	450	0	0	0	0	0	0	0	0	0	—
Uruguay	0	0	0	0	1	0	0	0	0	0	0	0	0	—
Total	1,949	4,753	4,886	5,208	5,032	6,282	5,025	4,156	3,537	5,125	3,655	2,967	0	5,280

^aSource: United States Department of Agriculture (1972).

^bUnited States Department of Agriculture (1974).

great significance. As will be discussed later, the Chinese diet is marginal in terms of carbohydrates, proteins, and fats, and is probably quite low in some vitamins and minerals. Yet the Chinese have not suffered the fate of hunger as many have in the developing countries. Nor have the Chinese children been victimized by kwashiorkor, a disease associated with severe protein-calorie deficiency.

It is known that body protein is burned for energy when the calorie requirement is deficient. On the other hand, if caloric intake is sufficient and the intake of protein is deficient, this imbalance would theoretically precipitate the development of kwashiorkor in children. China's experience suggests that, in actuality, protein deficiency does not occur once energy requirements are met, provided a certain lower level of proteins is supplied. The Chinese case seems to support the old saying, "Look after the calories and the proteins look after themselves," often quoted by Sir Jack Drummond, Britain's former nutrition adviser to the Ministry of Food.

Grain Rationing

The Chinese rationale for grain rationing was a matter of necessity as much as it was part of a planned economy in an effort to increase foreign exchange. China must feed its people but also must engage in foreign trade for economic development. This means that portions of her agricultural products must be exported.

To accomplish this goal, in November 1953 the state began exercising control over the purchase and sale of grains. Fixed quotas were set for food stores, restaurants, and other establishments, and consumers were required to present coupons for purchases. In 1956, a food-rationing program was established for the urban areas, and regulations were set for the production, purchase, and sale of grains. Rice and wheat were rationed according to age, sex, and amount of physical activity. During this period, a ration of 833-976 grams of rice or wheat per day for heavy laborers and 417-458 grams per day for residents and children over 10 years of age was provided, according to Gluckstein (1957).

Since decision making is largely decentralized to the local level, there are variations in the amount of grain rationed in different locales, especially in rural communes. The amount of grain each person receives is a decision made by the local government, which

also sets aside a certain portion for the communal welfare fund. Thus, in some areas a newborn receives the full adult portion. Other children may be allotted half the adult portion, or whatever limit is set by the community, until they reach school age. For example, in the August 1 commune in the Northeast, children below three years of age received 50 percent of the adult portion, three- to seven-year-olds 70 percent, and older children were given the full adult portion. In many cities, manual workers received twice the amount given the office workers irrespective of sex. Sugar and oil, as well as pork, are rationed commodities in some localities. In some areas rationing may include fish.

There are two noteworthy features associated with grain rationing. First, by rationing staple foods, the chief source of energy supply in the Chinese diet, the population is guaranteed a minimal level of caloric intake. This is significant in that this control mechanism eliminated the problem of maldistribution and the subsequent possibility of widespread famine in lean years. The system also enabled China to maintain a reasonable level of vital agricultural exports. In all food areas, China's exports have resulted from saving through elimination of maldistribution rather than from surplus. China is one of the largest exporters in the world of edible fish and fish products (Banchard, 1968).

Supplement from the Private Plot

Reference has already been made to the role of private plots in the evolution of China's agricultural policies. Because of high yield on protective food, China has found it expedient to allow private ownership of the plots. Although private plots only constitute 5 percent of the tilled land, intensive cultivation by the peasants has resulted in substantial increases in foods high in nutritional values, such as meats, fruits, and vegetables. Each household is encouraged to have at least one pig and some fowls in addition to its garden. Pork is the favorite meat of the Chinese, and since the amount of pork rationed for each household can be increased 30 to 40 percent if the pigs are raised on private plots, the people have a greater incentive to raise as many pigs as possible. Moreover, pigs serve the dual purpose of being "mobile fertilizer factories" for the private plot. Human excreta and animal manure, quite valuable for fertilizing the fields, are collected and deposited in specially constructed containers and sealed for three weeks before use. The am-

monia from the excreta and the heat generated by fermentation in the sealed depository destroys disease-transmitting parasites in the feces.

Peasant use of private plots puts all possible cultivable lands to good use. The resulting contribution to the health of the peasants is immeasurable, since the plot is a main source of protective foods and its crops meet as much as 15 to 20 percent of protein, vitamin; and caloric requirements. The peasants are further motivated to work on their private plots, because any surplus may be sold to the state for cash income.

The Chinese Diet

There has been little change in diet over the generations. The Chinese diet has adapted itself to easily grown crops and is therefore quite high in carbohydrates. The major cereals are rice and wheat, rice being the staple food of the South and wheat of the North. Although wheat is grown mainly in the North, the staple diet of the Northerners is corn because of its high yield and its cheapness. The sweet potato is a popular supplement in the southern diet, with millets and sorghums the chief additions in the northern diet. Soybeans are widely grown in most areas of the country and are a significant source of protein and fat.

No systematic or large-scale nutrition survey has been made in China either before or after the revolution. The lack of trained scientific personnel and the priorities given to activities related to production and service delivery in present-day China have prevented such projects.

On the basis of the fragmented data available, Larsen (1968) estimated that the average food intake in China varies between 2,000 and 2,200 calories per person per day during good harvest years, although the level may drop below 1,800 calories as it did in the spring of 1961. May's estimate (1961) is close to Larsen's (1968), and Dernberger (1967) used the round figure of 2,000. Wen (1974) gave an average of 2,000 to 2,667 calories from carbohydrate sources alone for the adult male. Adding 15 percent to 20 percent calories from fats and proteins, the Chinese male is consuming 2,350 to 3,334 calories per day and female consumption is approximately 130 to 300 calories less. This figure is considerably higher than those reported by others. From observations made

during a recent visit to China, this author is inclined to agree with Wen's estimate, assuming he is making reference to the diet of the workers engaging in moderate to heavy physical activities.

For an individual who consumes 500 grams of rice daily, the approximate calories are about 1,800, with 40 grams of protein and little fat. It contains an estimated 120 mgs calcium and 700 mgs phosphorus. The most notable additions to the diet are thiamine and ascorbic acid, resulting from decreased consumption of polished rice and increased consumption of fruits and vegetables, including tomatoes, known as foreign squash. Riboflavin seems to be low in the Chinese diet, since the richest sources are milk, liver, eggs, and green vegetables. Milk and liver are scarce in the Chinese diet, and eggs are usually mixed in the main dish shared by the family rather than eaten whole by one person. The amount of riboflavin in green vegetables varies greatly and would take 400 to 2,000 gms to meet one's daily requirement. The low consumption of meat coupled with "common diseases" such as intestinal parasitism or diarrhea suggest that anemia may be common in some rural areas. Goiter is endemic in many parts of China, also suggesting that there is widespread iodine deficiency. There is some evidence that rickets is fairly common among infants in Heilungchiang and Shansi province.¹ The principal reason is the long winter months and the lack of sunshine coupled with local habits, which prevented exposure of small infants to ultraviolet light. Cod liver oil concentrates are in short supply and are beyond the means of most peasants, although large doses of ergosterol, which maintain a high level of vitamin D for six months, are given intramuscularly. Because of increased agricultural output and food rationing, there is no reason to believe or evidence to suggest that there is overt hunger or acute malnutrition within recent time.

Food satisfies basic metabolic and maintenance requirements as well as energy expenditure for work performance. Shortage of food, therefore, frequently means a decrease in work capacity rather than an increase of nutritional diseases. It is interesting to note that in 1960, when food shortages became acute, the Chinese extended the rest hours for their workers.

Myrdal (1965), in his study of a Chinese village, has described the foods and food preparation of the peasants. Aside from the

¹The author is grateful to Dr. W.H. Chang, Assistant Director General of World Health Organization, for this information.

staples, food sources are largely leafy and tuberous vegetables, squash, and melons. Legumes are frequently consumed; meat and fish are treats often reserved for special occasions. Generally speaking, the diet, though monotonous by western standards, is sufficient to sustain the Chinese in good health and work. This is not to say that the diet cannot be improved. On the contrary, there are reasons to believe that subclinical deficiencies are likely to exist among many Chinese. The Chinese themselves have published reports on a variety of nutritional diseases, including goiter, scurvy, rickets, and anemia, suggesting that malnutrition is still a problem (Peking Union Hospital..., 1959; Chang, 1964; Hsu and Wang, 1964; Yu, 1965; Lu, 1963; Chang and Han, 1966; Sung et al., 1960). Our interviews with health officials and physicians also indicate the existence of nutritional diseases.

During five weeks of travel in China no activities related to nutrition education in the schools or the communities were observed by the author. A review of the manuals for the training of the barefoot doctors also failed to uncover any nutrition education other than food sanitation and references to disease such a goiter, anemia, or rickets. From time immemorial, the Chinese have known hunger and famine. It is possible, then, that the lack of nutrition education may be due to present availability of food. To the Chinese, food availability may be synonymous with nutrition, and thus, education for improved nutrition is not emphasized as education for preventive medicine. The use of herbs for nutritional purposes, however, is still prevalent, as it has been for centuries in the practice of Chinese medicine. It is believed that the herbs have "hot" or "cold" as well as other properties which affect food absorption and energy circulation.

In discussing food practices in the Chinese society, one must note the universal practice of breast feeding. The working mother with an infant is given time to leave the work place to return home or to the nursery to breast-feed her child, Again, this is a very efficient means of guaranteeing infant nutrition. It is common to breast-feed until the child is one year old or older. The child also receives supplementary food, beginning at about six months of age. Milk supplement is available only to those exceptional mothers who are unable to breast-feed their infants. Mothers do not receive supplementary food rations during pregnancy and lactation since "food is so abundant."

Balance of Food and Population

An examination of the grain/population ratio for China is difficult, since there is little agreement on these figures, and adjustments have been made upward and downward. The best determination possible, for the period 1957-1970 (this period is examined because there are government statements regarding population and grain production on record) indicates that population and grain production increased at about the same rate. That is, in 1957 grain production was 185 million metric tons and grew to 240 million metric tons in 1970, according to the Chinese estimate which is slightly higher than outside estimates. Over the same period, the population increased from 645 million to approximately 800 million. Multiplying the numbers out, both sets of figures grew at an average annual rate of 2 percent. This 2 percent figure has to be used very carefully: if adjustments are made for the bad years of 1959-1961, the 1962-1970 grain-production increases is somewhat over 2 percent per year. In either case, these figures show adequate but not spectacular growth and also indicate that China has very little surplus which can be converted into new capital investments.

How then can China increase its agricultural production? Opening up new lands is not feasible, although model communes such as Tachai succeeded by dint of hard work in converting deeply eroded canyons into terraced fields. All the readily cultivatable land was brought under cultivation about 200 years ago. Better seed might help; there is some evidence that improved strains of seed are gaining. More recently there is indication that the planting of the high-yield dwarf strains of rice and wheat have been increased in many areas. In 1971 the government reported a total yield of 250 million metric tons of grains.

Since 1961, most of the increase in grain production has been due to the additional use of fertilizer. Since 1957, China has increased its fertilizer use nearly 10 times, up to 20 million tons, about one-third of which is imported. In addition, there has been a dramatic increase in the number of pigs, or "mobile fertilizer factories." Composting with the use of animal and human excrement is still the mainstay in basic soil fertilizer. Even though more fertilizer will increase production, there are limitations to fertilizer use, as it requires a great deal of water. Water is abundant in the

South, where most of the fertilizer is used. The estimates are that in southern China, an acre of land gets about two thirds of the quantity of fertilizer used on comparable Japanese land, the most productive land in the world. The use of fertilizer is severely limited by the lack of water.

The late Chou En-lai suggested that China will be using about 30 to 35 million tons of chemical fertilizer by 1975. This statement suggests that the Chinese realize they are reaching a limit in fertilizer use. An additional 10 to 15 million tons of fertilizer should increase grain production by about 30 to 45 million tons. At that point, fertilizer will have done its work and will not produce additional dramatic increases. Population growth, will not, of course, have ceased by that point and will continue to increase from 10 to 15 million per year because of the number of women in the child-bearing ages, a disturbing implication.

Irrigation of the central and northern China plains presents many problems. In the late 1950s, an attempt was made to emphasize labor-intensive projects, using the underemployed rural laborers. There was a strong push during the Great Leap Forward in irrigation and water-conservation work. But apparently this did not produce the desired results, since after 1961 there is very little mention of the successes of irrigation. One guess is that the rivers were so silty that they quickly clogged all the irrigation works. The Chinese have now embarked on a program of soil conservation, dam building and electrification, sedimentation, flood control, etc. The building of large, medium, and small dams and channeling water when needed as well as dredging waterlogged lowlands at times of excessive rain is a communal undertaking, especially in winter months when there is less to do in the farms. They estimate that the cost of "taming" the Yellow River, the Yangtze River, and several other rivers will run about 40 billion yuan (20 billion dollars), or about one-fifth of one year's gross national product. Obviously, this cost must be spread out over a number of years. The question of how the very limited resources will be spent is important here. It appears that work on these rivers will receive a high priority, while agricultural mechanization will receive a relatively low priority.

In addition to increasing grain production, the Chinese can improve the grain/population ratio by reducing the population. Over the last 10 or 12 years, there have been several major efforts at cut-

ting the birth rate. The growth rate is now somewhat under 2 percent with a goal of 1.5 percent within a decade. As might be expected, the birth rate in the cities is much lower than that in the rural areas.

There are several inconsistencies in the Chinese policies toward population control. In prior years, there was not much talk of birth control. Indeed, there was some debate in early years about whether a birth control program was desirable. These debates stemmed in part from a several-thousand-year-old habit of raising large families, and in part from the Marxist perception that the troubles of the world are caused by exploitation and not by overpopulation. There is a certain feeling that if the social ills of exploitation are removed, technology and education can somehow take care of all the other problems. This debate was revived during the Great Leap Forward when, for a brief period, having children was actively encouraged. Not until 1968 did China begin to define an antinatal policy and intensify its efforts to involve local organizations in promoting family planning. Having successfully developed the technology for family planning (Wang, 1974), it remains to be seen whether China has the determination to accomplish a feat in demographic transition as she has done in other social welfare programs without the accompanying modernization and industrialization experienced in the developed countries.

Implications from China's Experience

China's experience in agriculture and health is an integral part of its social experiment in transforming its society in the past 25 years. While China's experience is not transferable because of the political and economic system peculiar to that country, there are, nevertheless, a number of lessons which can be learned from the experience and which carry worldwide implications, especially for the developing countries. The implications are that:

- (1) China's experience has shown the effectiveness of mere caloric supplementation in relieving protein deficiency and in guaranteeing a level of nutritional adequacy for a large population. Wen (1974) has suggested that in evaluating dietary adequacy in a developing country, the use of energy sufficiency should override all other nutritional considerations. Caloric adequacy cannot be overemphasized and deserves serious consideration in terms of both nutritional and non-nutritional policy.

(2) For a developing country, every household should be assisted in the cultivation of a home garden with livestock. China's private plots were most efficient in supplying the protective foods needed for the Chinese population. Their benefit to nutrition and health is incalculable. Governments of developing countries should employ every means to motivate and help their people to grow home gardens. The provision of assistance may include extension education, supply of seeds, fertilizers, and animals.

(3) Very often nutrition-education programs are launched without appropriate consideration for the economic reality of the target population or the availability of food. Before launching a nutrition program on any scale, planners must first ask the question "Nutrition from where?" Unless this question is answered, efforts spent on an educational program are likely to be an exercise in futility.

(4) Family planning must go hand-in-hand with nutrition and economic planning. It is reasonable to conclude from China's experience, in spite of its success, that substantial nutritional improvement will not occur until population growth is controlled.

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