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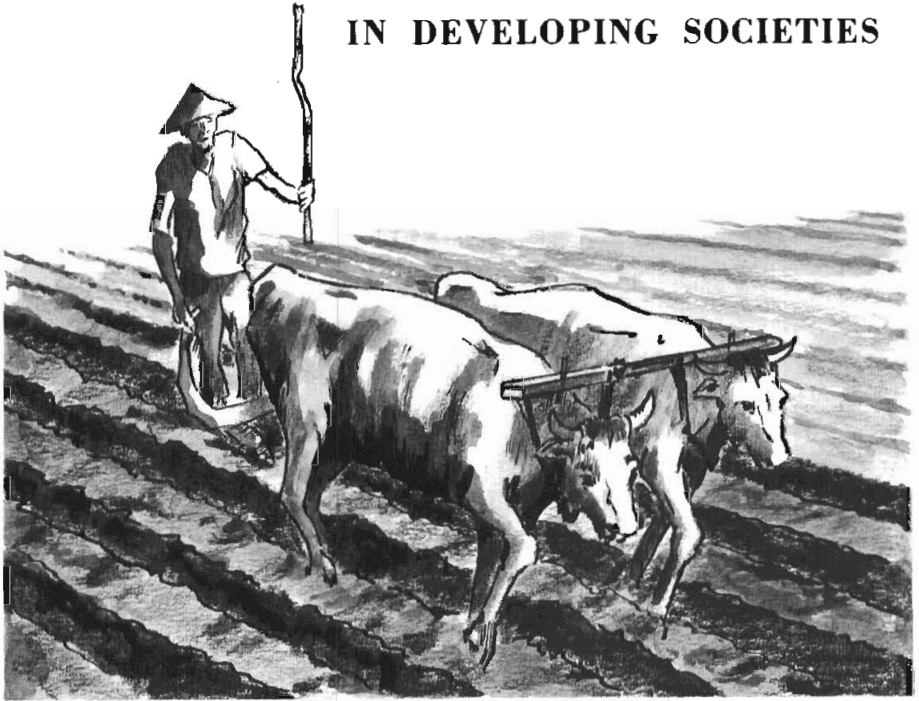
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THE ROLE OF AGRICULTURE IN DEVELOPING SOCIETIES



by

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I-INTRODUCTION

Human society in the last third of the 20th century is perhaps more concerned with agriculture than at any time within the past 150 years. Mankind, contrary to the predictions of the Rev. Thomas R. Malthus, has generally been able to feed itself. Nevertheless, the recent and continuing population explosion, if not slowed down and accompanied by an explosion in agricultural

productivity, may serve to make Malthus' prophesies come true.

More of the world's people are engaged in agricultural production and in the commerce of trade and processing of materials with an agricultural base than in any other employment. U.S. Armed Forces are now actively engaged in conflict in a developing country where the vast majority of its populace is engaged in agriculture. Similarly, agriculture is the chief vocation of the,

populace in most areas where insurgency movements may arise.

Despite a 4 percent average increase in the national product over the past decade in both rich and poorer countries, the poor nations have sustained but little, if any, rise in the level of living of their population.¹ Whereas the richer countries have had an average rate of population growth of 1.1 percent a year, the poorer lands have had an average rate—still rising—of 2.5 percent. The 3 percent annual per capita rise in the level of living in the rich countries compares with one of 1.5 percent in the poorer lands. The ratio of income in the two groups is 15 to 1.

Low levels of nutrition affect the economic productivity and political stability of nations and areas. Hungry people are characterized by Harrison Brown as "combustible."² They are willing to do almost anything to get food for their families! They have seen, through mass communications media and observations of well-to-do classes in their own nations, the material things which make for the "good life." Local leaders or even other nations do not find it difficult to exploit such situations to their political and military gain.

This paper is concerned with the importance of agriculture and its development in the Western and the emerging nations, a prognosis for agricultural development in developing nations, and the role of the United States in assisting other nations improve their agriculture. In effect, it is a sequel to two papers published in the *Naval War College Review* earlier this year.

Lt. Comdr. David W. Somers, U.S. Navy, writing on "The Place of Population Control in U.S. Foreign Policy,"³ noted that world population growth since the advent of the industrial age has assumed such proportion as to incur the term "explosion" rather than "growth."

Rises in living standards brought about by advances in technology, increased productivity, and the emergence of stable governments with consequent longer periods of peace and tranquility interacted to bring about lower death rates and to upset the former equilibrium in human birth and death rates. Advances in medicine and parasite control also contributed greatly to longer life spans.

In most developed nations the changes in their rates of population growth were gradual. Economic expansion permitted a simultaneous expansion in living standards. On the other hand, the drop in the death rate in developing countries came relatively abruptly and accentuated existing overpopulation problems in many countries. The greatest future increase in population is expected to take place in those areas of the world with the least economic capability to support it. Lieutenant Commander Somers concluded that the world has the theoretical capability to feed the doubled population expected at the end of the century, but it will require resource coordination and shifts of a hitherto unprecedented level.

Professor Allen D. Tillman in his article, "The World Food Problem,"⁴ stated that some 60 percent of the people in the world's developing countries suffer from undernutrition, malnutrition, or both. Some two-thirds of the world's people live in the emerging nations. The population explosion and rising income levels are forces which are bringing about a vast expansion in the demand for food. Some addition to the present quantity of arable land in cultivation can be made; nevertheless, estimates of this additional land vary, depending on the investment, time period, and other factors involved. Increases in food output will have to come primarily from greater yields per unit of land cultivated.

II--IMPORTANCE OF AGRICULTURE AND ITS DEVELOPMENT

Agriculture is the science or act of cultivating the soil, producing crops, and raising livestock. At the dawn of history people were nomadic hunters and food collectors who later discovered that they could improve themselves by settling in suitable places and cultivating the land. Changes in the technology and economic organization of agriculture are now taking place on a vast scale.

This section of the paper deals with man-land relationships, subsistence farming, scientific agriculture, U.S. agricultural development, and agriculture and industrialization.

Man-Land Relationships. Today many nations of the developing world can no longer feed themselves. This is a reverse of the situation preceding World War II, when the developing areas of Africa, Asia, and Latin America were net exporters of grain. Now they are net importers.

Despite progress in health which has given people in most areas of the world the possibility of longer life, comparable developments in agriculture which would bring about increases in food supply have not been widely adopted. The simple way of increasing the food supply in the past--expanding the area under cultivation--is no longer possible. Some small addition can be made to arable land in certain countries, but this process will involve high capital investments for land clearing and leveling, flood control, irrigation, and other factors. Many tropical forest lands have been found to be unsuited for commercial agricultural activity.

The other--and primary--solution of the developing countries for increasing their food supply is to raise production per unit of land area cultivated. Only the developed countries have made substantial advances in agricultural productivity; nearly all of the progress in

increasing food output in Europe and North America during the past 25 years has come from higher yields rather than expanding the area under cultivation.⁵ When changes in per acre yields over the past century are examined, the differences between those in North America and Asia are dramatic. Yields per acre in North America rose 109 percent as compared with increases of 7 and 8 percent, respectively, in Asia and in the entire less-developed world.

In developed societies a very small proportion of the population is required in agriculture for producing the food, fiber, and other products required for human consumption and industrial inputs. In 1960 half of the people of the world were the farmers, farm workers, other persons directly involved in agriculture, and their families (table I). In Asia and Africa some 60 percent of the population was in agriculture in 1960; this compared with 23 percent in Western Europe and 11 percent in North America. In all areas of the world the share of the total population accounted for by agriculture fell from 1937 to 1960. Evidence at hand indicates a continuation of this trend to the present time.

Arable land throughout the world is distributed on a very uneven basis. Despite its vast expanse, only 5 percent of the land in Latin America is arable. This compares with 49 percent in India, 11 percent in China, and 2 percent in Oceania.⁶ Of the nearly 33 billion acres of land surface in the world, only 3.5 billion acres--less than 11 percent of the total--are currently classified as suitable for cultivation.⁷ Nevertheless, only 2.4 billion acres are planted in crops in a given year. Thus some 1.1 billion acres are fallow or in temporary pastures. Some 6.4 billion acres--19 percent of the earth's land surface--are in permanent pastures and meadows.

As the population of a country

**TABLE I—AGRICULTURAL POPULATION AS SHARE OF TOTAL POPULATION BY REGION,
REPORTED 1937 AND 1950, ESTIMATED 1960**

Region	Total Population			Agricultural Population			Share of Agriculture Population of Total		
	1937	1950	1960	1937	1950	1960	1937	1950	1960
	Millions			Millions			Percent		
Geographic Regions									
North America	143	168	197	33	24	22	23	14	11
Latin America	124	163	206	77	95	113	62	58	55
Western Europe	273	278	300	76	70	69	28	25	23
Eastern Europe & U.S.S.R.	290	296	339	160	139	139	55	47	41
Africa	167	199	235	127	131	136	76	66	58
Asia	1,137	1,380	1,620	841	911	972	74	66	60
Oceania	11	13	16	3	3	3	26	22	19
Economic Regions									
Developed Regions	716	755	852	272	236	233	38	31	27
Less Developed Regions	1,429	1,742	2,061	1,045	1,137	1,221	73	65	59
Political Regions									
Free World	1,395	1,644	1,920	821	870	926	59	53	48
Communist Bloc	748	853	993	496	503	528	66	59	53
World Total	2,145	2,497	2,913	1,317	1,373	1,454	61	55	50

Source: Lester R. Brown, *Man, Land and Food*, Foreign Agricultural Economic Report No. 11 (Washington: U.S. Govt. Print. Off., 1963), p. 84.

grows, the relationship between population and agricultural land may be classified into three stages.⁸ Agricultural land is plentiful in the initial stage, and farmers can expand the total cultivated area through their individual efforts. In the second, land is brought into cultivation primarily through large-scale, principally governmental, drainage, and land clearing projects. In the third stage it is too costly to expand the area under cultivation and encroachments on farmland are made by the construction of highways, airfields, factories, and homes.

In developing countries, where there is a much greater pressure of population on the land than in the United States and other developed nations, a large share of the food consumed consists of staple foods such as grains, roots, and tubers. Man's principal foods are rice and wheat; these two grains supply 21 and 20 percent, respectively, of his total caloric intake.⁹ Corn and potatoes each furnish about 5 percent of all calories consumed. The six leading grains and various roots and tubers supply 60 percent of man's food energy.

A transition from animal to plant agriculture is inevitable as the pressure of population increases. In 1960 there were 1.8 acres of arable land per capita in the developed nations as compared with 0.9 acres per capita in the emerging lands.¹⁰ However, in Communist Asia only 0.4 acre per capita of arable land was available for agricultural production.¹¹ The primary productive use of other land in every area of the world is for pasturing livestock. Continued improvements in forage plants and in livestock genetics will contribute to an expansion from the current level of livestock production.

Subsistence Farming. Farming on a small scale, which often provides a minimum or subminimum level of subsistence, characterizes the majority of the rural population in the emerging

nations. The reduction in farm numbers in the United States from 6.8 million in 1935 to 3.2 million in 1964 is indicative of the commercialization of agriculture and the decline in subsistence farming.

A prime example of subsistence farming can be found in the developing countries. Crist¹² has estimated that some 200 million people in the tropical areas of four continents earn their livelihood through subsistence agriculture. They practice some form of "shifting agriculture," whether it be called that, "slash-and-burn farming," "forest fallow," "nomadic agriculture," or some other name. Approximately one out of every 12 or 15 persons on our planet is engaged in such hand-to-mouth farming.

This type of agriculture, which has enabled its practitioners to survive for thousands of years, is still practiced in essentially the same manner as in the years prior to the development of scientific agriculture. "Slash-and-burn farming" involves land clearing, in which tropical forest growth, with the exception of very large trees left standing but with their bark girdled to kill them, is cleared. The land is then utilized to plant crops for a period of 1 to 5 years. When yields decline to a low marginal point due to the leaching of plant nutrients and as populations of insect and animal predators build up, the land is abandoned and other fields similarly cleared. The jungle takes over the abandoned plots and the process is repeated again within a period of some 3 to 30 years.

The economy of the "slash-and-burn" subsistence farmer is a closed or self-sufficient one. He grows corn, yucca, beans, upland rice, cooking bananas (plantains), and pumpkins or squash. His principal tool is the stick used to punch a hole into the soil for planting seeds and an ax and machete. He sells in the nearest market, which may be as much as 50 miles distant, and carries on his back the goods he is

offering for sale. These may be surplus farm products and also charcoal to be sold as fuel to residents in the market area.

The land utilized in the "slash-and-burn" culture may belong to the government or to private individuals or corporations, but seldom to the farmer, who has a very low level of education. Even if the cultivator desires to acquire credit to modernize his farming operations, there is practically no opportunity to obtain loans due to the lack not only of satisfactory title to the land but also of other assets to serve as collateral. In short, the subsistence farmer leads a life which permits him to do little more than survive.

The Traditional Society. In the changing society of the 20th century the traditional patterns of behavior which formerly sufficed for the organization of agricultural production and distribution are no longer applicable. Nevertheless, the task of changing them to fit a very different sort of a world is an extremely difficult one. Whereas the relationships in a developing society are primarily those of kinship, or face-to-face contacts, those in today's industrial society are a complex organization of contractual and impersonal relationships.

The well-known anthropologist, Margaret Meade, has this to say about man-land relationships in the traditional society:¹³

When we apply change in agriculture, then, we are usually dealing with people who have such deep ties with the land itself, and for whom agriculture is not a way of earning a living but a way of life. If such people are persuaded to grow more of the things they have grown, adding to their own food and getting a cash income, this change in itself is not essentially disruptive. But when the change is from subsistence agriculture to cash crops, a number of disruptive factors enter the picture. To the superficial observer there seems to be no change, since the

people are still occupied with agriculture. But actually we now have a radical change, from *making* a living to *earning* a living. And in many societies the change is further, from a value crop, around which religious life centers, to a merely utilitarian crop. Reiffeld and Warner say of corn cultivation in south-western Yucatan: 'It is not simply a way of securing food. It is also a way of worshipping the gods. Before a man plants, he builds an altar in the field and prays there. He must not speak boisterously in the cornfield; it is a sort of temple. The cornfield is planted as an incident in a perpetual sacred contract between supernatural beings and man. By this agreement, the supernatural yield part of what is theirs—the riches of the natural environment, to man. In exchange, men are pious and perform the traditional ceremonies in which offerings are made to supernaturals. These ceremonies are dramatic expressions of this understanding'. . . .

An essential point in transforming traditional values and converting a people from a traditional to a more commercial agriculture is to demonstrate that rewards will be forthcoming and that satisfying personal relationships will be not be lost.¹⁴

Tropical Agriculture. The tropics are the source of the coffee, tea, chocolate, rubber, sugar, bananas, and countless other agricultural products which have become necessities to many people throughout the world. Most of these crops are characterized by highly organized systems of production and marketing.

Half of the world's people live in those countries which are entirely or mainly within the tropics or subtropics. Nevertheless, these nations, which comprise most of the emerging world, generate less than 15 percent of the world-wide gross domestic product.

Agriculture is the major source of livelihood for the people of the tropics. As noted earlier, some 200 million people earn their livelihood in "slash-and-burn" farming. Others are engaged

in commercial or other types of subsistence farming and many millions live in cities. Lands in the tropics have many differences from those in the world's temperate regions. Hence this treatment of some of their special characteristics.

Soils in the tropics are usually impoverished and leached of plant nutrients to a much higher degree than those in the world's temperate zones. Except in certain desert regions, nearly all areas in the tropics have high rainfall; in many places there are separate rainy and dry seasons, and in others there is rainfall the year around.

Although tropical soils frequently contain few nutrients near the surface, rain forests with luxuriant vegetations develop in areas with large amounts of rainfall. Some savanna soils of dry portions of the tropics have hardpan bases into which water does not permeate during the heavy rains of the wet seasons. There are many senile soils (i.e., soils exposed to weathering over long periods of time) in tropical countries. Soil erosion is a very serious problem in steep mountainous regions.

Given the background described, it is not difficult to see that serious problems are involved in growing crops in tropical regions. After the first year most crops do not fare well on heavily leached forest soils. Wild animals from nearby forests frequently destroy crops. Weeds, insects, and plant diseases, with no period of cold to interrupt their life cycles, are a more serious menace than in temperate zone agriculture.

As a result of this situation, crop production in tropical rain forest zones has tended to evolve either into plantation agriculture or into shifting cultivation (described earlier), where moves are made to new sites after cultivating small areas for short periods. In some areas cattle ranching is carried out on an extensive scale through periodic burning of grasslands. Estimates of the agricultural potential of the tropics vary

widely, depending on the outlook and background of the persons who make them.

Special problems exist in improving technology for the agriculture of the tropics. Although basic principles are the same everywhere, the application of these principles differs under various ecological conditions. These conditions often prevent the direct transfer of applied agricultural technology from the temperate zones to the tropics. The varieties of corn, wheat, and rice which do well in the United States have not thrived under different conditions in other lands. A long process of adaptive research must be carried out for most crops in order to breed and test suitable varieties and to promote their adoption by local farmers.

Commercial Agriculture in the Tropics. Plantation agriculture, with large-scale investments in land, water control, machinery, specialized processing and warehousing facilities, local transportation equipment and rights of way, and other facilities, characterizes the banana and, in varying degrees, sugarcane, coffee, and many other agricultural enterprises. Large-scale banana firms also own and operate ocean shipping and control integrated marketing organizations in countries where their products are distributed. In the past the large banana and other companies were at times in *de facto* control of various nations where their production activities were centered. Although numerous changes in economic and political relationships have taken place in recent years, there appears to be a reservoir of ill will among segments of the population which may give rise at a future moment to exploitation by disenfranchised groups.

The bulk of the products of the tropics is usually characterized by an inelastic demand; i.e., a small increase in quantity is associated with a proportionately larger decrease in price and

hence lower revenues to sellers. Unless offset by a diversification of farm and other products, increased supplies and lower prices work hardships on farmers, farm workers, national balance of payments, and most other facets of the exporting nation's economy. Except in a very few countries which export minerals or other basic materials, agricultural products are the major foreign exchange earner for emerging nations. In fact, most developing states are heavily dependent on one or, at most a very few products. The percentage of total exports accounted for by its primary product in various countries in the American tropics is noted in table 2.

Many small farmers in the tropics produce export crops for sale. They also grow basic food crops for their own consumption and market any surplus locally. Nevertheless, they are usually inefficient producers. Local customs and a low level of education inhibit the adoption of innovations. Lack of credit, lack of improved seed, the high costs of fertilizer and other inputs, and other factors also slow down the further development of the agricultural sector.

Much land in the tropics is utilized for large-scale production of cattle and other livestock. As in parts of our West, there is no other productive use for large areas of land in developing countries throughout the world. Large estates, especially in the Americas, have traditionally been in the hands of wealthy families. Some of these estates are operated efficiently and are probably making their maximum contribution to agricultural production. On the other hand, a very large portion could be operated more efficiently, either with a reorganization under present ownership or with a division into smaller operating units.

U.S. Agricultural Development. From the founding of our nation until the end of World War I, agricultural production increased primarily through an expansion of the land area under cultivation.¹⁵ Nevertheless, overall productivity of U.S. agriculture rose gradually during this period. A small portion of the additional production was attributable to increased use of capital and labor inputs. Changes in institutions were taking place which

TABLE 2-TROPICAL AMERICA'S DEPENDENCE ON A SINGLE CROP

Country	Crop	Approximate Percent of Total Exports, 1957-1960
Cuba	Sugar	76
Colombia	Coffee	75
Dominican Republic	Sugar	70
Guatemala	Coffee	69
El Salvador	Coffee	67
Panama	Bananas	66
Haiti	Coffee	64
Ecuador	Bananas	60
Brazil	Coffee	56
Costa Rica	Coffee	56
Honduras	Bananas	44
Nicaragua	Cotton	36

Source: William C. Paddock, "Natural and Human Resources" in Kenneth L. Turk and Loy V. Crowder, eds., *Rural Development in Tropical Latin America* (Ithaca: New York State College of Agriculture at Cornell University, 1967), p. 23.

would set the scene for future rises in agricultural productivity. These institutions included public policy which favored the family-sized and operated farm, free public schools, agricultural research and educational services, credit facilities, farmer cooperatives, improved roads, and other transportation and communication facilities.

During the 15-year period from 1920 to 1935 a slow increase in agricultural output occurred. The agricultural sector in the United States was in a depressed state throughout this period as farm prices, in comparison with prices of inputs used in farm production, declined.

In the 25 years from 1939 to 1964, agricultural output in the United States increased as much as it had in the preceding 75 years. Favorable market conditions—i.e., higher prices and expanded markets—made it profitable for American farmers to adopt the improved technology which had been developed over the years in research studies done by the land-grant colleges, the U.S. Department of Agriculture, private corporations, and other business firms. Improved machinery and other capital inputs were substituted for labor in the production process, and a substantial exodus of farmers and farm people to the industrial sector took place. A rise in productivity accounted for 75 percent of the increase in agricultural output during the 1939-64 period. The expanded use of fertilizer was responsible for more than half of the increase in crop production per acre. Other factors contributing to the rise were improved seeds, pest control, proper tillage practices, and better moisture control.

Data on trends in U.S. agricultural productivity from the 1940-44 period to 1966 are shown in table 3.

Scientific Agriculture. Scientific

knowledge, developed by mankind from

early times but on an increasingly expanded scale since the Industrial Revolution, has given those engaged in agriculture great power to manipulate their natural resource base. This scientific revolution in agriculture has moved at an accelerating rate in the United States and elsewhere in the Western World for the past 30 years and is now being extended into the far reaches of the developing world. An accompanying management revolution has also made a very large contribution toward agricultural productivity. In short, management has substituted capital for labor. The new technology adopted and adapted has increased farm output and brought about higher returns to capital and management.

The obvious success of medical and health programs in developing lands is in sharp contrast to the very slow rate of agricultural growth. A base of local doctors, nurses, medical and sanitation institutions, and other facilities was available for the formulation and promotion of health programs. On the other hand, agriculture has been faced with a different situation in assimilating the "know-how" available from other lands. The base of experimental and testing institutions to do adaptive and other research and of educational institutions to take the results of this research, along with other appropriate technical and management recommendations, to farmers in each developing country is all too often missing or incomplete. Experience in the United States and elsewhere in developed nations shows the necessity of building a scientific base for agricultural development. This is perhaps even more important for agriculture than for medicine because much agricultural research elsewhere is not directly transferable but requires a process of adaptation if progress is to be made in the farm sector.

The substitution of mechanical for human and animal energy has contributed greatly to the advancement of

TABLE 3--TRENDS IN U.S. AGRICULTURAL PRODUCTIVITY

Item	Value of Index		Percent Change
	1940-44	1966	
Index of Farm Inputs (1957-59 = 100)			
Farm Labor	191	70	- 63.4
Mechanical Power and Machinery	47	103	+119.1
Fertilizer Materials	35	185	+428.6
Cropland Used for Crops	106	93	- 12.3
Index of Farm Production (1967-59 = 100)			
Total Farm Output	78	113	+ 44.9
Meat Animals	84	116	+ 38.1
Poultry and Eggs	61	131	+114.8
All Crops	83	112	+ 34.9
Index of Farm Output per Man-Hour (1957-59 = 100)			
All Farm Output	41	161	+292.7
Meat Animals	79	145	+ 83.5
Poultry	37	211	+470.3
All Crops	41	151	+268.3
Index of Man-Hours of Labor Used for Farmwork (1957-59 = 100)			
All Farmwork	191	70	- 63.4
Poultry	164	62	- 62.2
Meat Animals	106	80	- 24.5
All Crops	206	74	- 64.1

Source: Tarheel Farm Economist, July 1968, p. 2.

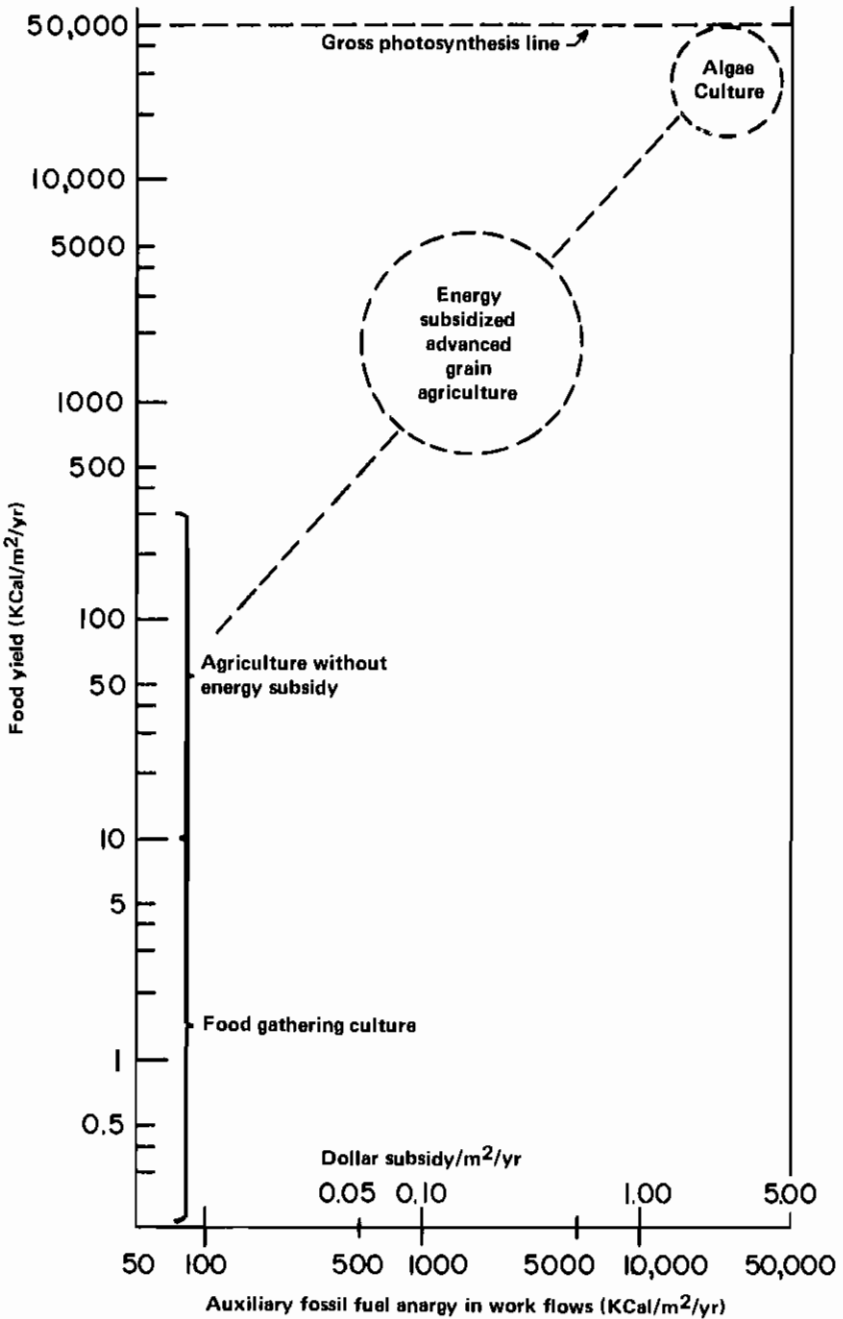
scientific agriculture. Geneticists have teamed with engineers and other scientists to develop strains of various crops and livestock which conform to the demands of the market. A prime example is the breeding of sorghum with low stalks which allow most of the plants' food energy to be used for grain production; the heads of grain ripen uniformly for easy harvesting with a mechanical combine. Myriads of examples with other commodities could be cited. Other research is required on disease and insect control, plant and animal nutrition, farm organization and management, and a host of other fields.

A prime input in bringing about increased agricultural productivity is auxiliary fossil energy. This embraces not only the petroleum used as fuel for

farm machinery, but also the energy derived from coal, petroleum, or other sources utilized in the manufacture of tools and equipment, including those utilized in processing, transportation, storage, and other areas of marketing as well as in the farm production process and in the manufacture and transportation of fertilizer, insecticides, and other inputs used on the farm.

Dense populations are supported in industrial nations because their carrying capacity (i.e., the ability of a given amount of plant surface to support a population with solar energy from earth), which is based on the continued flow of concentrated potential energy having its origin in fossil fuels, is much larger than that in emerging societies. At a future date it is possible that nuclear

Fig. 1--FOOD YIELDS AND FUEL SUBSIDIES



Source: U.S. President's Science Advisory Committee, *The World Food Problem. Vol. III. Report of the Panel on the World Food Supply* (Washington: U.S. Govt. Print. Off., 1967), p. 88.

energy may play an important role.

A diagram depicting the theoretical effect of auxiliary fossil energy on food yields is illustrated in figure 1.

A developing country, if it chooses to break away from its previous subsistence economy, must grow and process its farm products so as to perform something of economic value at a cost as cheaply as that in richer countries. Without advantages due to location, climate, or resources, it must acquire a fossil-fuel based activity, perhaps supplementing it with cheap labor, if it is to compete effectively in the world market.

The ability of a nation in our complex society to gain and hold leadership will depend more and more on its ability to control flows of food and fuel. The application of the scientific knowledge now available and that which can be acquired by continuing and future research and testing can make this planet a source of sufficient food to nourish its exploding population--if the population growth slows down substantially from its present extremely rapid rate of advance. This transformation will not occur, however, without vast efforts and costs in capital investment, research and educational services, changes in food consumption habits, and other related activities.

Agriculture and Industrialization.

The production and marketing of food and other agricultural products, whether in a developed or emerging society, involves a close and mutually profitable relationship between agriculture and industry. In the early stages of development, agriculture's surplus population becomes the source of workers for industry. In today's technical society an increasing share of agriculture's inputs come from the industrial sector. The substitution of motive and electrical power for horses and mules and human labor in U.S. agriculture is a case in point.

In any society agriculture provides the basic products required for continued human existence. It is usually the initial source of the capital--i.e., the savings above necessary consumption--required for economic growth and development and a consequent higher level of living for the members of such a society.

Economic growth in an economy is no simple process. Economic development, in essence, means a rising level of output with concomitant higher levels of living for the population. Complex and changing relationships exist between agriculture, industry, and other segments of an economy throughout the growth process.

The highly industrialized society is one in which agriculture plays a decreasingly less important relative role. For example, only 6 percent of the population of the United States was engaged in agriculture in 1965.¹⁶ This compared with 9 percent in Canada, 43 percent in Latin America, and 65 percent in Asia. Several countries, among them Niger and Nepal, had more than 90 percent of their people in the farm sector. As a result of the application of scientific and industrialized techniques, the average farmer in the United States now produces food for himself and 39 other people.¹⁷ In many developing societies the average farmer does but little more than feed himself and his family.

An efficient agriculture, aside from its ability to produce food and fiber, makes many valuable contributions to the development of an economy. With special reference to the experience of the United States, these contributions include:¹⁸

1. The release of workers to industry.
2. Lower food costs with respect to income.
3. An expanded market for industrial goods.

4. Large export earnings from farm products.

5. Sustained farm output, due to the biological nature of farm production and high fixed capital requirements, during economic depressions.

6. The meeting of wartime demands for food and fiber.

7. Assistance in the economic development of other countries.

There has been a tendency in many developing countries to identify economic development almost solely with industrialization. As a country advances in its economic development, the relative importance of agriculture declines despite a probable increase in absolute output of farm products. A number of countries have sustained euthacks in their overall growth when insufficient resources are devoted to the agricultural sector. It is becoming widely recognized that there is a close and mutually dependent relationship between agriculture and industry.¹⁹ In the developing countries a large share of industry will of necessity be processors of agricultural commodities or else be producing machinery, fertilizer, and other goods and services required as inputs in agricultural production and marketing.

III-PROGNOSIS FOR AGRICULTURAL DEVELOPMENT IN EMERGING NATIONS

The economic behavior of mankind has been classified as an interlocking of three components: technological, organizational, and cultural.²⁰ Contributing to and perhaps partly as a result of many organizational changes, many inventions and discoveries contributed specifically to the development of agriculture. In his recent book, *Impact of Western Man*, William Woodruff²¹ devotes four pages to a listing of some important developments in agriculture from 1700 to 1960. These include the seed drill, the iron plow, fertilizer, the cotton gin, genetics and animal and

plant breeding, insecticides, hormones and growth regulators, and others. Each has interacted with a host of economic, technological, and cultural factors to bring about the highly organized and productive agriculture of the United States and other developed societies.

Agricultural development in any country or region is a very complex process. It involves people willing to adopt new technology, a marketing system which does an efficient job of pricing, storing, selling, and transporting farm products, an effective system of transportation, a credit system whereby the farmer can obtain capital for inputs of machinery, seed, fertilizer, and insecticides, an educational system for the transmission of new technology, and others--in short, an *infrastructure* of essential facilities and institutions plus the desire and the will to make changes. Improvements or additions to *infrastructure* will not in themselves bring about economic growth. In essence, the components of *infrastructure* constitute a necessary, but not a sufficient, condition for economic development.

The developing nations of today, if they are to feed their burgeoning population, must move faster than the West in adopting agricultural technology. Although new technology is utilized almost immediately by today's better farmers in the United States, this has not always been the case. For example, it required 10 years after it was introduced for 60 percent of the corn acreage to be planted in hybrids.

Several areas of special concern in agricultural development will be treated in this section. The first is the important role played by institutions. The second relates to land tenure systems, a special set of institutions which affect agriculture. It concludes with an analysis of conditions required for achieving agricultural development.

Institutions Affecting Progress. Progress in the agricultural and other sectors

of any society is vitally affected by the governmental, social, economic, and other institutions which constitute its makeup. Many of these institutions grow out of the development process, and still others hinder, encourage, or are otherwise interrelated with whether or not a region, a nation, or a segment of society adopts or adapts technology and modernizes. The creation of new institutions and modifications or changes in others are usually necessary in order for a country or a region to move forward.

Dr. Erven J. Long of the Agency for International Development has set forth two propositions relative to the role of institutions in the economic development, whether with regard to agriculture or other segments, of a society.^{2 2} The first proposition is that economic underdevelopment is itself largely a consequence of institutional underdevelopment. Economic underdevelopment is a result of institutions being either nonexistent, inadequate, or improperly oriented to meet the needs of economic progress.

It should be obvious to the person who explores the organization of the institutions of a developing country to observe that they were evolved to accommodate social objectives other than progress. According to Long, it is likely that the primary purpose of the institutional structure of a developing society is survival-not of the individual but rather of the group, the society or the tribe. Long has this to say:^{2 3}

... accommodations to their environments have been made by human societies . . . [these accommodations] . . . have grown out of usage, and take the form of customs, sanctions, and laws of the society and of attitudes, motives, habits, and practices of the people. The entire institutional structure of a typical truly underdeveloped society, thus evolved to ensure survival of the group, does so by discouraging change which might threaten established order, by limiting decision making to the few conservative ruling elders rather than spreading

it broadly or entrusting it to those young enough to be apt to try out new and dangerous ideas. In short, most institutions in underdeveloped countries are characterized by a specific forfeiture of progress in the interest of survival.

The second general proposition made by Long is that countries wishing to jump into the stream of economic progress must be willing fundamentally to alter their economic institutions. This does not mean that, of necessity, institutions must be changed to make them a carbon copy of those in the United States, but rather that the institutions which came into being to insure the survival of a society must be changed, or adapted, into a new set which will put it on the pathway to change and development.

Throughout history the urban sector of a region or country has presented a set of conditions more favorable to economic development than the rural sector. In an urban society the concentration of populations makes it possible for residents to communicate with one another readily, and it is much easier to organize interested persons into political groups. As a consequence, it is usually possible to develop channels of communication for exerting pressure on the leadership which controls the allocation of resources.^{2 4}

On the other hand, a very different situation usually exists in the structure of the rural sector. A somewhat feudal form of social structure exists in the rural regions of most developing nations. Power is usually concentrated in the hands of a limited few, usually the head man, the large landlord or his agent, the priests, and a group of elders. Although communications and lines of authority within the village are highly developed, there is usually very little cross communication with other villages and with urban centers. Thus, it is extremely difficult for the farmer or other village resident to obtain informa-

tion and other assistance that could be used in improving his situation. Open channels usually do not exist from local rural communities to the national leadership to express concern about problems and other matters of interest.

Local governments in villages, and even in urban centers, in most developing countries have very little political and administrative autonomy. Decisions usually come from the top down with local administrative personnel appointed by the government in power rather than elected by local residents. Hence the government does not tend to be responsive to the problems of local communities.

Land Tenure Systems. The institutions which deal with land tenure define the status of farmers in whatever society they may be. They make up the warp and woof of the fabric of farmers' hopes, expectations, and contributions to productivity. Much is heard about land reform as being a prerequisite for an agricultural takeoff for a society to be able to feed its people, and for making a contribution to industrialization and export earnings. Land reform is not a simple concept; it has different connotations to different people.

It is generally accepted as a universal axiom that farmers desire to own the land which they cultivate. Where land is fertile and highly productive there is much competition for it, and prices are high. Tenant farmers, especially those in a developing society, have little prospect of achieving ownership. The agricultural ladder from sharecropper to tenant farmer and thence to farm owner which characterized the history of agriculture in the United States has not held true in developing societies.

Rents for land in developing societies have traditionally been extremely high. Tenants are generally heavily in debt at usurious rates of interest to landlords and other moneylenders.

Land Reform. To many people land reform, a term bandied about a great deal in recent years, is the redistribution of land, or rights in land, and nothing more.²⁵ Discussions in the Economic and Social Council of the United Nations and in the Conference of the Food and Agricultural Organization of the United Nations give to land reform the broad meaning of:²⁶

... more than redistribution of land either by breaking up large estates or by consolidation of holdings. It must include a number of measures to improve the relationship of the man who works the soil to the land he works, including opportunity for land ownership, improved conditions of tenancy, agricultural credit at reasonable rates of interest, reform of exorbitant rents and taxes, and facilities for obtaining agricultural supplies and marketing agricultural products, with emphasis on cooperatives . . .

The delineation of boundaries, registration of titles, and specification of tenure regulations are the major land tenure problems in many countries. The consolidation of small, scattered holdings has been the major feature of land reform programs in numerous parts of the world.

Proposals for land reform have been made in many countries; in some of them legislation containing many of the recommendations has been written into law. These laws have been executed with wide support of various political and economic groups in a number of countries; in others no effective action has been taken. Countries in which effective agricultural reform programs have been carried out include Japan, Egypt, Taiwan, and Mexico.

The postwar agricultural reform program in Japan made it possible for Japanese tenant farmers to acquire the lands they tilled from their landlords. Since then Japan, in comparison with her former traditional necessity to import much of her supply, has attained virtual self-sufficiency in rice. In addi-

tion to the major incentive factor of owning the land, inputs of capital by Japanese farmers have risen while those of land and labor declined. Japan has one of the world's highest rates of fertilizer use.

In Egypt over 700,000 feddans (one feddan = 0.42 hectare)--13 percent of the total cultivated area--were distributed to a quarter million families.²⁷ In the year following the reform both the area planted to cotton and total output dropped about a third. Nevertheless, yields of cotton and other crops have since sustained rapid rises. A technical assistance program with advice on production practices, including better seed and systematic use of insecticides and fertilizers, made the difference. Cooperative organizations replaced the ex-landlords by providing the new farm entrepreneurs with necessary business advice.

Though reforms in Bolivia and Iraq were dissimilar, neither was accompanied by a well-planned process of implementation, and both were followed by decreases in output of 50 percent or more.²⁸ In Bolivia big estates were divided, landlords dispossessed, and the land distributed to those persons seeking it in order to break away from the structure of a semifeudal land tenure and a caste-based society. Nevertheless, 10 years after, the reform production had failed to return to prior levels in the areas most heavily affected. Little credit and technical assistance were made available to the new landholders, and a proposed system of cooperatives was not accepted.

Despite the many cultural and agroeconomic similarities between it and Egypt, which served as a model, Iraq did not possess the system of cadastral surveys, title registration, road systems between villages, and highly developed drainage and irrigation systems as did Egypt. All of these factors mitigated against the success of the program in Iraq. Many wealthy landowners influential in gov-

ernment saw in the land settlement programs a way to assuage the landless and prevent still more drastic reforms.

Achieving Agricultural Progress. No individual, business firm, region, or country moves to a higher or more preferred position on its scale of preferences or values until it assesses its resources and takes the step-by-step action to achieve its goals. An entity, whether it be a farmer or a country, must know and evaluate the status of its soil, climate, literacy level, stock of capital, cultural pattern, value system, and the national and world market for its current and potential agricultural commodities, along with other physical, social, and economic conditions. It must consider the results of alternative responses and adaptations to these conditions. The policies and programs which embrace responses and adaptations to conditions which exist are the foundation for economic growth.

Program for Agricultural Development. No single, all-embracing technique exists for bringing about progress in agriculture in a developing region or nation. Nevertheless, the basic components of programs designed to encourage agricultural development have been delineated. With different local and national conditions it will be necessary to combine the program in varying ways and in different proportions.

The following package program to unlock the doors to agricultural progress has been recommended by a U.S. Department of Agriculture authority on foreign agricultural development.²⁹

1. Capable leadership must be available to supply knowledge, direction, and inspiration to the program and to provide management and technical assistance to farm families.

2. The central government must be aware of the need for increased food production and make adequate allocation of resources. It must also develop and support an organizational structure

that provides clear channels of authority and responsibility for achieving assigned objectives.

3. Adequate incentives (i.e., price and tenure arrangements) must be provided.

4. Adequate and timely supplies of fertilizer, pesticides, improved seeds, and other materials must be available in local areas for purchase by farmers.

5. The following facilitating programs are equally essential:

a. Manufacture or importation of adequate quantities of fertilizer, pesticides, and other materials.

b. Research results on which to build the initial field program and adequate research for continued progress.

c. Training of personnel, with special attention to training village-reared youth who are dedicated to providing assistance to farm families in modernizing their operations.

d. Elementary education in rural areas for continued improvement.

Operating experience in agriculture around the world has shown that economic increases in production do not often result from the adoption of a single practice.³⁰ Rather, substantial and sustainable increases in production of agricultural commodities usually occur as a result of adopting a package or combination of improved practices. For crops these practices include the utilization of improved varieties of seed or planting stock; use of chemical fertilizers and other measures to insure an adequate and balanced supply of available plant nutrients; practices designed to provide suitable water-air relationships in the soil; and plant protection measures. A similar combination of practices would be required for animal production to achieve an expanded and more efficient output.

Agricultural production is not only a function of seeds, fertilizer, quality of the land, cultural practices, and other factors but also of another very impor-

tant item, the weather. Thus it is often difficult to evaluate whether a relatively small increase in yields per unit of area is due to changes in one or more inputs and/or changes in the weather. At least in the initial stages of a development program, a farmer would likely not be enthusiastic in adopting a new practice which required a substantial investment if the expectation were only for a, say, 15 percent increase in yields. On the other hand, the response of a farmer to a new practice in which a doubling or tripling of yields could be expected would be very different.

The entire world can take heart in the progress being made in agriculture in a number of countries. Recent experience in 12 of 26 developing countries studied by a U.S. Department of Agriculture team showed that they have begun to increase their farm output at rates higher than those ever attained over long time periods in any of the world's more advanced nations.³¹ Many of the 26 countries studied were in the tropics and subtropics, and they differed greatly in their rural population densities, arable land expansion potentials, stage of economic development, and cultural features. Despite their progress to date, greater and sustained efforts are required not only by the emerging nations with the lowest growth rates but also by those with higher ones if they are to improve the level of nutrition of their growing populations. In addition, they must have surplus supplies to export in exchange for goods and services which can be acquired more cheaply by importing them.

Some Notable Successes. The adaptive research on crop varieties which has had the highest payoff in its application within developing countries has been that done by the Rockefeller Foundation with wheat and corn in Mexico and by the International Rice Research Institute with rice in the

Philippines. When the Rockefeller program was initiated in Mexico in 1943, Mexico's wheat yield was 11 bushels per acre.³² An improvement program resulted in the development of varieties which were stiff-strawed, short-statured, vigorous-growing, and capable of responding to heavy applications of fertilizer. Furthermore, resistance to ever-changing races of stem rust was bred into the new strains. As a result of a long education and demonstration process with the utilization of these new varieties, national average wheat production in Mexico rose to 40 bushels per acre in 1967.

Similar advances occurred in corn in Mexico as a result of the program. By 1964 average yields of 2,600 kilograms per hectare were achieved in Mexican corn production.³³ This compared with yields of 750 kg./h. in 1945. The 247 percent increase was a result not only of improved varieties of seed, but also of better cultural and plant protection practices, plus the use of fertilizer.

The rice effort was initiated in 1962. In that year the average yield of rice in Southeast Asia was 1,500 kilograms per hectare. This compared with average yields in Japan, which for many years had followed a scientific rice improvement program, of 5,000 kilograms.

Three years after the rice program started, the IR-8 variety showed up extremely well in experimental and field trials. This variety has short straw, thus making it less susceptible to wind damage and also permitting more of the plant nutrients to be used in forming the grain. It has a shorter growing period than varieties in current usage, and hence two crops a year can be grown. The new variety can be planted at any latitude in the tropics as it is insensitive to photoperiod (i.e., the relative lengths of alternating periods of lightness and darkness as they affect plant growth and maturity). It has good yields under heavy applications of fertilizer and, even without fertilizer,

yields as high as local varieties. The new IR-8 variety has a yield potential of over 9,000 kilograms per hectare. Actually, yields of 4,000 to 8,000 kilograms per hectare will make rice production a very profitable business.

Additional research and testing will likely result in further improvements in the performance of rice as well as in that of other farm commodities.

IV--IMPLICATIONS OF AGRICULTURAL CHANGE FOR THE UNITED STATES

In our complex world of today the United States has a compelling interest in the economic growth of all the nations of the world. From the standpoint of our military defense, we need well-nourished friends. Other forms of wealth are of very little value to a human being who has little or no food. Since most of the world's emerging nations are still primarily agricultural in their economic organization, the United States has a high stake in encouraging and assisting the further progress of their agriculture. Not only is agriculture the source of food for their teeming billions of people, but it is also the major source of their foreign exchange earnings.

The United States stands to gain from trade as the emerging nations develop. They will have more products, both agricultural and industrial, to exchange with developed countries. On reaching a self-sufficient stage in food supplies, our nation will be able to reduce its expenditures for food and other emergency assistance.

The statisticians usually measure economic development, whether of the agricultural or other sectors, in terms of quantitative output. But much more is involved in the process. Growth seldom occurs without previous social and political change and, once in motion, is usually accompanied by continuing political and social adaptations.³⁴ History

has shown that social, educational, and economic advancement in a country is very seldom attained without strains in its political balance. There have been many upheavals within its own society as the United States has progressed from an underdeveloped status to the sophisticated social and economic entity of the present day. It is in the best interests of the United States to encourage emerging nations to achieve changes in their societies by rapid evolution and not violent revolution.

Foreign Assistance. The United States has been heavily involved in economic assistance programs since the Second World War. Currently the Agency for International Development, the Food for Peace Program, the Peace Corps, and other agencies and programs are concerned with agricultural development in the emerging nations. Additional agricultural development assistance is being offered by the foundations, church missionary groups, private business firms, and other organizations. Vast efforts are also made by the programs of the Food and Agriculture Organization of the United Nations, the World Bank, and other international agencies for which the United States is an important source of funds. Despite the many assistance efforts to agricultural development in the emerging nations, they are but a drop in the bucket in comparison with needs.

The broad objective of foreign assistance provided by the United States is to step up the rate of economic and social progress and to build strength and stability into developing nations. There are three distinct but interrelated phases of this process:^{3 5}

1. The short-run period of the next 10 years or more in which developing countries will remain heavily dependent on supplies from food surplus nations.
2. An increased emphasis on adaptive research to develop, test, and apply new

materials and production practices to upgrade inefficient traditional agriculture.

3. The building of the indigenous base of science and technology that is essential to furnish a sustained flow of innovations for continued growth in production to meet the needs in the years ahead.

The major thing done in the development of the efficient agriculture in the United States, according to Dr. Charles M. Hardin of the University of California, has been to *build on agricultural science*; this is likely the most repeatable and adaptable of our experiences.^{3 6} While the prevalent idea is to transplant "American know-how," the heart of such "know-how" is *institutionalized science* which must be exported and helped to grow overseas. It is not generally recognized that the American farmer, with a productivity unequaled elsewhere, has a thorough and continuing program of backstopping by a system of agricultural science and technology unmatched in any other nation. Our effort, whether carried out by AID, FAO, or other agencies, must be the transfer of systems of technology which are adaptable to the cultures of developing societies.

In any program of assisting cooperating countries to establish systems of science and technology, a number of relevant functions are extremely significant. These include the development of new materials and knowledge, the transfer of innovations into use on the land, and the building of human resources to perpetuate the evolution, transmission, and use of new technology.^{3 7} While it is essential that these functions be carried out, the precise form of organization they take is less significant.

To perform the above functions the Agency for International Development sends technical assistance advisers in agriculture and other fields to work with counterpart personnel in co-

operating emerging nations. Despite many shifts in emphasis, including abrupt phaseouts of programs with high potential payoffs, the people of the developing lands have reaped numerous benefits from AID activities. One reason for changes in programs is the short-term funding AID receives. Another is that newly assigned personnel, often not fully acquainted with the background of previous programs, suspend them and initiate new ones which reflect their own background of experience and interests.

Institutions of higher education in the United States train students from developing lands in many disciplines, including the agricultural sciences. Strong efforts are currently being made in India, Brazil, and elsewhere in the developing world to upgrade their agricultural colleges and universities. Various U.S. universities, under contracts with AID, the foundations, and other agencies, are sending their professors abroad to work with the faculties there in designing and implementing training programs which will make maximum contributions to agricultural growth.

American business firms are deeply involved in agricultural development in the emerging nations. Although welcome in many areas, they face a hostile reception in others. Current literature in the third world is focused on the extent to which foreign business firms influence the planning, programing, and employment of capital investments in emerging nations.³⁸ Questions are being asked whether foreign investments benefit local peasants or local agriculture more than they benefit foreign investors and if development has different meanings to the developed and developing countries.³⁹

American businesses are not only active participants in the production, processing, and marketing of farm products in emerging nations, but they are also engaged in supplying many inputs required in agriculture. One of

the key inputs is fertilizer. Currently 86 percent of the world's fertilizer consumption is in the developed countries and only 14 percent is in the less developed areas.⁴⁰ Fertilizer use must increase if developing lands are to conquer their food deficits. U.S. business firms can make outstanding contributions to the development process by producing and marketing fertilizer in the lands in such dire need of it.

An article in *Fortune*, after stating that what the United States should be exporting is a practical version of the capital revolution which made its agriculture one of the wonders of the

BIOGRAPHIC SUMMARY



Dr. Cecil N. Smith is a professor of agricultural economics and agricultural economist in the Agricultural Experiment Station at the University of Florida. He does research in the marketing of horticultural products and foreign agricultural trade.

He recently returned from a 2-year overseas tour in Costa Rica where he served as an adviser to several Costa Rican agencies. Professor Smith was the first chief of party of the AID/University of Florida Contract in agricultural development. He has traveled widely in Central America and in other areas of the emerging world.

Professor Smith did his undergraduate work at Virginia Polytechnic Institute, gained an M.A. from the University of Virginia and a Ph.D. from the University of California at Berkeley. He has served on the staffs of Virginia Polytechnic Institute and Southern Illinois University and has been a consultant to the U.S. Departments of Agriculture and Commerce.

Professor Smith holds the rank of commander in the U.S. Naval Reserve and has had two tours of training duty at the Naval War College, the last being in May 1968.

He is currently serving as chairman of the University of Florida Faculty Committee on Salaries and Fringe Benefits, is vice-chairman of the Steering Committee of the Faculty Senate, and also serves as a member of the University Graduate Council.

world, makes this assessment of the role of business in increasing food production.⁴¹

But American businessmen, singly and in consortiums, and with the support of their government, must face the fact that the world will be unsafe unless economic, as well as political stability, is brought to the countries of the Third World. Food riots that overwhelm all order can turn threats of expropriation or destruction of American properties into reality, so that investment of billions of dollars in oil, mining, and manufacturing may in the end depend very much on a determined movement of American capital into the agricultural economies of those nations. These are practical considerations. They do nothing to lessen the humanitarian concerns involved in this astounding race between people and food.

V--CONCLUSION

The conquering of hunger, like any strategic decision in a military operation, involves after the initial firm decision of the objective to do so, a well-planned and carried out series of essential operations. Dr. W. David Hopper of the Rockefeller Foundation states it well when he said:⁴²

The firm acceptance by national political elites of the objective of conquering hunger; the wise formulation and forceful implementation of development plans to transform the foundations of national agriculture from the

wisdom and experience of tradition to the application of modern science and technology; the recognition that to build a modern agriculture will require the mobilization and expenditure of a steadily increasing quantum of resources directed to a growing multitude of activities; the understanding that to articulate effectively the component pieces of the development puzzle will require both flexibility and sensitivity to investment opportunities that arise from the dynamic of growth; the appreciation that the upward thrust of agriculture will only endure if it is supported by an underlying forward press on the basic amenities and services, especially education and research--these are, in outline, the essentials for payoff on investments in agriculture. They are much easier to state than to capture, yet they must be captured if hunger is to be conquered and banished for all time.

In summary, all of the world's emerging nations must take immediate measures to increase the food required for their hungry people. Steps must also be taken to stem the population explosion; time is running out as the fuse to the "food-population" time bomb is burning at a terrific rate of speed. In the short run the United States can supply limited stocks of food, fertilizer, and agricultural supplies. Its technical assistance will be effective if there is a will to adopt it. The long-run solution lies with the people of the world's developing societies.

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The seas are no longer a self-contained battlefield. Today they are a medium *from which warfare is conducted*. The oceans of the world are the base of operations from which navies project power onto land areas and targets . . . The mission of protecting sea-lanes continues in being, but the Navy's central missions have become to maximize its ability to project power from the sea over the land and to prevent the enemy from doing the same.

Timothy Shea: Project Poseidon, February 1961