UTILIZATION OF HUMAN RESOURCES IN AGRICULTURE

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EVERY discussion of the relations of population and resources or of population and food necessarily starts with certain assumptions. It is proposed here to start with the assumption that the world possesses the necessary resources and that mankind possesses the necessary scientific and technical knowledge to provide adequate food for the people who now inhabit the globe. It is assumed further that this will continue to be true for the foreseeable future.

That is not the same thing as saying that mankind *will* provide itself with the food necessary for health and well being. To make that statement it would be necessary to postulate that mankind will develop the social forms that are necessary to bring about the application of existing and still to be developed science and technology, and to provide for an equitable distribution of the fruits of such activity to the people of the world. This would require some major social adjustments, possibly including some large-scale redistribution of the world's population according to the distribution of available resources.

This basic assumption might of course be debated at length. At the present time, as often in the past, many voices can be heard proclaiming that the end of the process of increasing the world's food supplies is in sight. They point out that past improvements in nutritional levels in large parts of the world have been secured chiefly through destructive use of the basic food producing resources and that this is a process which cannot continue indefinitely. They claim that through increasing control of mortality man has now assured himself the means of self-destruction, for the increases in population which are made possible as control over mortality is extended are of such an order that food production cannot possibly keep up with popu-

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lation growth. They argue that the experience of Europe which markedly increased its levels of living during the three hundred years while its population increased six-fold is not relevant to the situation in those areas in which birth rates have not been adjusted to the lower levels of mortality. There no longer are large new territories capable of absorbing the population which the expanding economy on the old continent could not absorb. Moreover, the population masses involved are so large that the increases in food production which are required to maintain present consumption levels are extremely large. For example, India's population in the middle of the twentieth century is more than twice as large as that of Europe in the middle of the eighteenth. That of China is more than three times as great. During the first half of the twentieth century Asia's population increased by nearly 7 million per year.

Broadly speaking, world food supplies have generally kept up with the increases in the world's population. There have been local droughts and famines, and there continue to be areas in which malnutrition is the rule. But in the main it is hardly to be gainsaid that the world today is producing more food and on the average is feeding the people more adequately than it did one or two centuries ago. Total world food production is currently at levels higher than those ever reached before. Though nutrition is inadequate in large areas of the world, a greater proportion have adequate food as a normal situation than was the case in the earlier period; great famines are less frequent and less widespread, and the fearful epidemics are less frequent and less widespread. There have been substantial increases in the expectation of life, a fact which is not unrelated to nutritional levels.

These statements are only partially subject to statistical demonstration, for where the requisite statistics do exist, they are a relatively modern phenomenon. For the western world some statistics can be adduced to buttress such statements and additional substantiation is to be had from scattered studies such as those assembled by Parmalee Prentice. There is little

reason to believe that this generalization is not true also for most of the other parts of the world, even those where agricultural methods have changed little during the period of recorded history.

Long-term statistical series on food production are not available. One statistic may, however, be cited as a case in point. World wheat production is estimated at 65 million metric tons per year in the period 1883–1890; in the sixty years since then it has more than doubled. The world's population increased less rapidly than that during these sixty years, and the rate of growth was still smaller for that portion of the world's people for whom wheat is a staple element in the diet.

Developments in recent years, reflecting the effects of the war, however, give grounds for very real concern for the future. Here the statistics are more adequate than for the longer time periods. For this period one main conclusion is inescapable: In countries in which the food and nutrition situation was generally satisfactory before the war it has been maintained and even improved; but in countries where people historically have had too little food, the situation has grown worse. And these countries of lowered food consumption include more than half the world's population. Some countries have not yet fully recovered from the effects of the war on their agriculture, and recovery in most countries appears to be slow.

Recently FAO assembled statements from governments indicating their plans or projections for agricultural production in 1950–1951. These plans and projections indicate that if governments and farmers are successful in their programs and if the assumptions as to weather are fulfilled, the volume of food production would be about 8 per cent higher than before the war,[2] double the increase in total agricultural production which has already occurred since the war. Since population in 1950 is expected to be 13 per cent above that for 1937, food supplies per person in 1950–1951 would be lower than before the war if only these plans and projections are achieved. The index of

[2] Excluding U.S.S.R.

production of food commodities per person, taking 1934–1938 as 100, is computed at 93 in 1948–1949. It would rise to only 95 by 1950–1951.

These figures are heavily influenced by the high levels of production in the United States and Canada. In the Far East, Europe, Latin America, and even in Oceania, production per person would be about 10 per cent lower than pre-war. If the rate of progress indicated by the 1950–1951 targets is projected into succeeding years, pre-war levels of production per person would not again be reached before 1953 in Europe and 1960 in the Far East and Latin America. Only in the United States and Canada is production per person in 1949 well above pre-war. In the United States a deliberate reduction in the total volume of agricultural production during the next two years is expected, with the result that whereas the index of food production per person in the United States and Canada in 1948–1949 stands at 123, in 1950–1951 it will have dropped to 115. This planned reduction applies particularly to grains.

In short, agricultural production is expanding at such a slow rate that the restoration of pre-war levels of supplies per person has not yet been achieved and is not likely to be achieved within the next two or three years, unless governments and farm people will move ahead more effectively and more rapidly than seems probable at the present time. Nor can restoration of pre-war levels be taken as a desirable goal. It represents simply a convenient statistical bench mark. As has been frequently pointed out, the pre-war levels of food consumption in many parts of the world are far from adequate.

These plans and projections are not predictions. The indicated outcome is, of course, not inevitable. The need for increasing production of agricultural commodities may lead to effective programs for more rapid increases. Similarly the results would be different if there should be effective programs for moving the commodities which appear to be in surplus in some areas to areas in need of such products, and the present fears of surpluses would thereby be dissipated.

A dramatic illustration of what is possible, even under conditions which in some respects are quite adverse, is supplied by the experience in the United States during the war. Total agricultural production in the later war years in the United States was about one-third greater than before the war, though approximately one-seventh less manpower was used. But fertilizer use was nearly doubled, more farmers used insecticides and machinery, and the use of some of the large machines was spread over larger areas and longer periods of time than before. The use of hybrid seed corn became virtually universal in the corn growing areas. Improvement in varieties of crops and livestock went on rapidly. There were also improvements in the methods of storage and in the efficiency of transportation. Unusually favorable weather contributed a great deal, and so did the fact that the United States entered the war period with large stocks of wheat and feed grains. But the new levels of production are not an accident. They represent rather new levels from which further increases are to be expected.

The effects of the rapid spread of hybrid corn provide one of the many dramatic stories in this situation. In 1949 farmers harvested 43 per cent more corn than the pre-war average on 7 per cent less land; yields had increased by approximately 60 per cent. Much of this increase in yield must be credited to the widespread use of hybrid corn.

In the case of wheat, large increases in productivity of labor are reflected in decreasing amounts of human labor required for its production. It is estimated that in 1820, 320 man hours were required to produce 100 bushels of wheat. By 1900 this had been reduced to 108 hours and in 1949 was only 34 hours.

Obviously such improvements in yields are part of a continuing process. A special study conducted by the Department of Agriculture, in cooperation with the Land Grant Colleges in 1944, found that under assumed conditions of employment, income, and demand, as well as under known levels of farm technology, it would be feasible to increase farm output about 43 per cent above 1935–1939, or 12 per cent above the 1945 level.

Increases in agricultural production obviously are not limited to the United States. Grain yields in Europe remained at ten bushels or less per acre from the fall of Rome until the French Revolution. With the spread of new practices and rotations late in the 18th Century, they were nearly doubled. In Germany wheat yields rose from ten bushels per acre just before 1800 to sixteen bushels by 1850. In France they went to fourteen bushels per acre and in England to something over twenty bushels by 1850. By 1934–1938 they had gone to about thirty-five bushels per acre in Germany and the United Kingdom, and to about twenty-three in France.

For the world as a whole the development and application of agricultural science is relatively young. Two hundred years ago a grain harvest that yielded four or five times the amount of seed sown was considered satisfactory, and in some parts of the world even today that is accepted as a norm. In some areas, however, a grain harvest returns fifteen to twenty times the amount of seed sown. Cows which produce 200 or 300 gallons of milk in a year were commonplace 200 years ago, and are still considered acceptable in many parts of the world. However, in some areas yields of 2,000 gallons per cow in a year are commonplace, and record yields go considerably above that level.

It would be tempting to discuss the possibilities of future developments in science and technology as they apply to food production, to speculate on the possibilities of new developments in the growing of algae, or of some of the other methods that may be developed for the more effective conversion of solar energy into food energy. Some of these developments may be reality before present techniques are fully applied and exploited. But it is not necessary to resort to such speculation; it is quite adequate to attempt to visualize what might be accomplished if improved methods already tested and in use by the more efficient agricultural operators became generally accepted in the several countries. Estimates on this basis are then estimates of physical potentialities and indicate what

could be done with present knowledge if institutional arrangements were made for effective use of soil and other agricultural resources on a sustained basis.

Salter[3] has prepared such an estimate and related it to the food requirements of the world in 1960, as estimated by FAO. These estimates are based on regional standards of nutritional adequacy as established by a group of nutrition experts and related to the estimated world population in 1960.

Using this yardstick he comes to the conclusion that from present crop land it is possible to produce virtually all of the cereals needed by 1960, more than the total volume of roots and tubers needed, and also more than the total volume of sugar required. However, the volume of fats and oils would still be short by 10 per cent, pulses and nuts by about one-third, meat by about one-fourth, milk by about two-fifths, whereas the total volume of fruit and vegetable production will be only approximately one-half of the estimated requirements.

He estimates further that it is feasible to bring into production some one billion acres of land in the tropical areas, and some 300 million acres of land outside the tropics. The assumed production level per crop acre in the tropics is equivalent to that already achieved in the Philippines, for the non-tropical soils the equivalent of that already reached in Finland. Adding the assumed production under these conditions to that considered attainable from present crop land would more than adequately provide all of the required foodstuffs, and for cereals, roots and tubers, sugar and fats and oils, the total "attainable" under these conditions would be more than double the goals used in these computations.

Two-thirds of the world's population are engaged in agriculture, and a large proportion of these live in countries where average food supplies pre-war were below the level of adequacy. If the resources are available, why then do large sections of the world's population receive so little return for their efforts to

[3] Salter, Robert M.: World Soil and Fertilizer Resources in Relation to Food Needs, Freedom from Want. *Chronica Britanica,* Summer, 1948, II, No. 4, pp. 227–235.

produce food and other agricultural products? Many answers could be given but no one answer would be adequate. The process and techniques for agricultural development are the process and techniques for general economic development. Agricultural development in any large area or region must be a part of total economic development, and increases in the productivity of agricultural workers are limited unless there are corresponding increases in the productivity of non-agricultural workers.

Much has been written in recent years on the wasteful ways in which land, water, and forest resources have been used and the need for conservation of these resources. From the shocking record some have drawn conclusions for action which are directed at conservation of the basic resources to the neglect of other elements in any pattern of resources use. In setting goals for action, four different objectives are inseparable: (1) Increased production, which the people of the world desperately need; (2) Keeping the soil at a high level of productivity; (3) Fair incomes to land users for their labor and for the use of their capital, and (4) Full use of the labor and genius of rural people. These four objectives are closely interrelated. No one of them can be reached while others lag behind, and no program is likely to be effective which seeks to carry any one of them forward without regard to the others. The goal of conservation of the soil and of other agricultural resources is one of finding the most economical uses and practices which will give sustained production and then to apply them to each unit of operation.

The more effective utilization of human resources in agriculture requires industrial development, more efficient use of land and other resources now being used in agriculture, and finding and developing new and additional land for agricultural development.

In a broad sense one of the very real barriers is the pressure of population on agricultural resources. With few exceptions, the areas in which the proportion of the population engaged

in agriculture is high are areas in which incomes are low, nutrition levels are low, and there are significant cultural and economic barriers to agricultural expansion or improvement. In the main, these are areas of high fertility, and as preventable mortality increasingly comes under control, they are potentially areas of high rates of population increase. Educational and social services are inadequately developed. Low income levels make it difficult to accumulate the capital required to increase agricultural resources or to shift to more efficient methods of agriculture which require a greater use of capital. The same elements operate to restrict the development of industrial and other non-agricultural activities.

With the growing pressure of population on land resources, there is continuing discouragement to the introduction of more efficient methods of cultivation, for labor tends to become cheap in relation to other elements of production. There frequently is a growing degree of parcellization of land holdings, thus reducing further the degree to which more efficient methods could be employed. The competition for land becomes so intense that it fosters concentration of land holdings and exploitive forms of land tenure. Such societies are also resistant to changes in methods and tend to cling to traditions and inherited values. They lack the aggressive search for the more efficient and the new which characterizes the societies ordinarily designated as progressive. The pressure of subsistence and the low value placed on human labor and on human comforts also contribute to the maintenance of established patterns of activity, the results of which can be anticipated from experience, even though an outsider could demonstrate with relative ease that certain modifications would provide more returns with less effort.

There are wide variations in the extent to which soil and other resources are now available, from country to country, and within countries. If agricultural production is measured in terms of the eight major crops which supply more than 85 per cent of the world's food intake and this production is related

to the number of persons included in the agricultural population, the large variations in productivity are clearly revealed. At the one extreme is North and Central America, for which the average production per person is six times that of the average for the world. Oceania is not far behind. For Europe the figure is only approximately double the world average, whereas in Asia it drops to one-half and in Africa it drops to one-third. The average for South America is slightly above that for the world as a whole. There are, of course, similarly, large variations by countries, and within the countries whose averages are high there will be wide variations as among the more efficient and the less efficient farmers. Instances of land being withheld from uses which would contribute most to the nutrition of the people are easily found in any country.

In part the problem is a political one. Intra and inter-national migration of population from one agricultural area to another, both to provide additional labor and for settlement of areas to be developed, offers limited possibilities. For some localities it can be of great importance, and where new lands are to be developed, as in the tropics, some large-scale migrations will be required.

Migrations like those responsible for the settlement of the North American continent or Oceania are not likely to be repeated in the foreseeable future. The very large sacrifices of income, health, and levels of living which many of the settlers were willing to make in the expectation of land ownership and future returns are less attractive to the settlers of modern times. The governments of the receiving countries, as well as those of the countries sending the migrants, generally set standards of facilities and services which may involve considerable outlays of capital if the settlement is to be effective. The modern concept of the obligations of a government to its citizens calls for a greater provision of services for health, education, communication, and transportation and other social services than those of 100 to 150 years ago. Costs of settlements have increased accordingly and costs of overseas transportation have become

an important obstacle. Costs of $7,000 to $10,000 per agricultural settler are not uncommon.

One illustration of the present situation is found in the report that the Canadian Government has concluded, that it is more economical to settle some of its new settlers in areas already occupied, even if it is necessary to purchase going farms at $3,000 to $4,000, than it would be to carve a completely new settlement out of the wilderness.

In many areas which are already settled, what is required to make more effective use of the human resources which are now available is to provide the farm people with more capital. This may mean the development of large-scale projects for land reclamation, for irrigation or drainage, for purchase of machinery or equipment, for conditioning of land, for planting, etc. It may, however, and in many cases it does, mean the provision of small-scale improvements in the availability of land or water or provision of capital to make possible the adoption on a small scale of practices already known and tested in the area. The substitution of a hand threshing machine or a simple binder for threshing by flail or by tramping out the grain and winnowing it, may represent an advance greater than that achieved by the substitution of a new machine for an older, less efficient one. A simple drainage operation and some lime and fertilizer may restore to agricultural use land that has become waterlogged and unusable. Inexpensive insecticides and tools to apply them or simple improvements in storage can provide a small farmer with more crops to use or sell. It is not to be expected that the agriculturalist carrying on practices like those which were common in the Stone Age will or should shift immediately to the most advanced practices of a highly mechanized agriculture. The effort to make that shift may lead the agriculturalist into activities which are economically less justifiable than those outmoded ones which are currently being followed. Immeasurable damage has already been done where devotees of farm practices adapted to one local situation have attempted to carry these into other situations to which they are definitely

ill adapted. A great deal of effort is required to make available to the farmers of the underdeveloped parts of the world practices and facilities which are definitely within their range of comprehension and which are adjusted to goals that are within reach. Agricultural technology in the more advanced countries has been so completely oriented to large units of operation, with high capital requirements, that very frequently the smaller scale operation has been completely neglected. Not only has the development of technology which can be applied on the smaller farms lagged behind, but there has been an even greater lag in the development of social institutions whereby the small farm holder could benefit from the newer developments through cooperative ownership and use, through custom work, through public ownership, and the like.

One of the major problems in this field is that of developing a desire for and an appreciation of the improvements that are within the reach of the agriculturalist. The pragmatic attitude toward farm practices which is characteristic of the operators in the more highly developed countries represents a favorable soil for the introduction, testing and adoption of improved techniques. In those cases the old is not revered for its own sake, but is constantly being placed in competition with the new, and each practice must justify itself in terms of the returns it yields. The fact that many farm operators have been misled into adopting the new simply because of its newness is not germane; what is important is the attitude of constant questioning and examination, and the faith in the possibility of change and improvement. Not only is this attitude lacking in many groups, but thoughtful persons in some non-Western cultures oppose its spread on the basis that it is one part of the disorganization of Western Civilization.

The adoption of improved techniques in agricultural production meets with many obstacles, even in the more highly developed countries. It is a commonplace among agricultural leaders in any country that production could be greatly increased without adverse effects upon the basic resources if

farmers could be persuaded to adopt the improved techniques which are available and which are adapted to their local conditions. Moreover, there are considerable losses after crops are actually grown. A recent estimate from Colombia, for instance, is that 10 per cent of the corn, rice, wheat, and beans grown in any one year are lost because of inadequate storage. Estimates from a number of Asian countries indicate that large quantities of rice are lost annually because of field pests and inefficient methods of harvesting, storage, and handling.

The Agricultural Extension Service in the United States and similar endeavors in many other countries are testimony to the practical results that can be achieved through securing general acceptance of improvements in the agricultural techniques. The fact that existing practices in any area are interwoven with the whole social fabric and that in some areas agricultural practices are intimately associated with religious practices, may present significant obstacles to change. However, utilization of the knowledge of the local culture and of the motivations which are operative within it has often led to successful efforts at change.

D. Spencer Hatch reports an incident from India which illustrates the nature of such obstacles and a successful approach to them. He writes:

> In order to improve the flocks and to make poultry keeping more popular, a religious taboo had to be faced frankly. Many Hindus simply would not eat eggs because in so doing they killed the life germ in the egg. To overcome this cultural obstacle, 'vegetarian eggs' had to be put on the market after the people were shown the impossible—that unfertilized eggs had absolutely no sign or potentiality of life any more than did milk from sacred cows, and that they could be eaten with the greatest safety, assurance, and profit.
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> Once this hurdle had been taken the project got in full swing. Eggs were given to village leaders who were ready to spend enough time at the Center to learn how to care for the eggs and the chickens when hatched. The pure-bred fowls which resulted

were propaganda enough. Then a Cock Circuit was organized. Any village family who would get rid of their common cocks could have a pure-bred cock for two months, during which time they had to set whatever eggs were laid. Another development was the establishment of the simplest co-operative egg marketing which, in a sense, rounded out the poultry project.[4]

It is a common mistake in discussions of the relation of population to resources, to consider population as the independent variable and to project increases of population without regard to the economic and social changes which provide the setting within which demographic processes occur. Very little is known about the basic motivations behind the persistence of the high fertility rates that characterize rural and agricultural populations. Nor is there any adequate information concerning the extent to which practices which once were rationalized in terms of economic need or in terms of the desire for a male offspring to carry on the family line and to conserve the family property are subject to modification when the original needs no longer exist. As the potentiality of mortality control becomes more and more a fact in the lives of people, an effect upon fertility seems inevitable, though we do not know today by what processes the idea of voluntary control is extended from mortality to fertility. The East African woman who discovered that babies which were nursed had a lower mortality than those which were fed with the gruel that is the mainstay of an adult diet, found also that prolongation of the nursing period, with the taboos on sexual intercourse by nursing women, had a significant effect on total fertility. The culture of any people is an integrated whole, and it is inconceivable that radical changes in one phase would not have significant effects on all others, even though the effects are slow in spreading.

One-fifth of the world's population lives in areas in which the shift from high mortality and high fertility to lower mortality and lower fertility is largely completed. In most of these

[4] Hatch, D. Spencer: Extension Experience in India, *in* FARMERS OF THE WORLD (Edited by Edmund de S Brunner, Irwin T. Sanders, and Douglas Ensminger). New York, Columbia University Press, 1945. 224 pages.

countries the control of fertility is firmly established in the culture pattern, and even the recent increases in fertility reflect the extent to which controlled fertility responds to economic and social changes. Another one-fifth of the world's population lives in areas which are well advanced in the demographic transition from high to low fertility. One after another of the countries in this group can be expected to move over into the first group.

Three-fifths of the world's population still live in areas where famines and epidemics, chronic malnutrition, and debilitating diseases are major forces in controlling population numbers. Mortality control from infectious diseases is within reach of a large portion of the population of these areas and can be expected to be rapidly adopted. Epidemic control and famine relief call for greater political stability, improvement of agriculture, and development of industry. How quickly control of fertility follows, and how readily the pattern of fertility control will be developed in the large agrarian areas is a matter on which little can be said definitely at the present time. It would be equally unrealistic to assume that this will not happen or to assume that it will develop by itself. In this field there is today a great dearth of knowledge and an urgent need for substituting concrete research for armchair speculation which may be affected on the one hand by the emergent nationalism of areas which, until recently, were colonies, or by the fears of highly developed areas which hope to preserve their superior position against the dangers of rapidly growing populations which may eventually take away the advantages that are now enjoyed.

A major obstacle to the effective use of the human resources in agriculture today is lack of knowledge, not of knowledge of what to do, but of how to do it, of the social processes by which change occurs, and by which desirable changes can be brought about within a framework of the political and social values which we hold to be fundamental. Given that knowledge, the question still remains, whether the necessary changes will be

made in economic, social, and political institutions to bring about the improvements that are within reach.