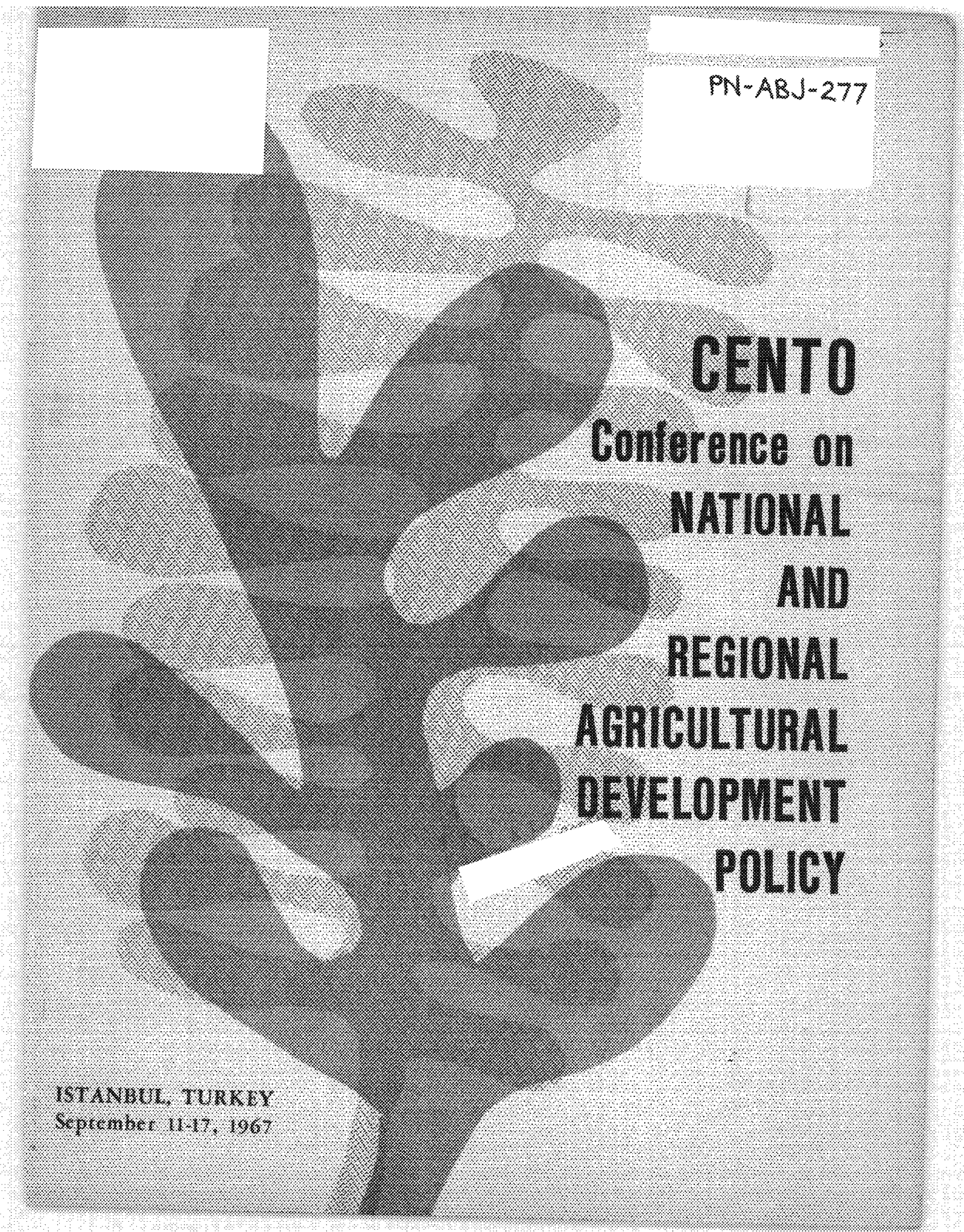

CENTO
Conference on NATIONAL AND REGIONAL AGRICULTURAL DEVELOPMENT POLICY

ISTANBUL, TURKEY
September 11-17, 1967

CENTO CONFERENCE ON

NATIONAL AND REGIONAL AGRICULTURAL DEVELOPMENT POLICY

Istanbul, Turkey
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CENTRAL TREATY ORGANIZATION
(CENTO)

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FOREWORD

The 1967 CENTO Conference on National and Regional Agricultural Development Policy held in Istanbul continued the work initially begun by a similar CENTO conference in 1963, also in Istanbul. The holding of the second conference underscored the importance attached to the subject by CENTO's Economic Committee and its Sub-Committee on Agriculture, as well as by the Office of the U.S. Economic Coordinator, which provided organizational and financial assistance. This conference, which attracted forty unusually distinguished agriculturists, economists and administrators from all five CENTO countries, has been described by the CENTO Secretariat in its annual progress papers on economic activities as "one of the most important meetings ever held under CENTO auspices for the purpose of considering agricultural problems."

It was originally intended that this conference would be followed six weeks later by a special informal meeting of the Ministers of Agriculture of the CENTO countries, who were to consider its conclusions and recommendations. Unfortunately, because of scheduling difficulties, the Ministers' meeting had to be indefinitely postponed. Yet it is significant that several of the conference's principal recommendations have already been approved by the CENTO Sub-Committee on Agriculture and by the annual meeting of CENTO Economic Experts. Specifically, it has been agreed that a Working Party on Fertilizers and a Working Party on Agricultural Research will be organized in 1968 under the aegis of CENTO for coordination and study by experts from member countries. A third recommendation, calling for the creation of an agricultural unit within the CENTO Secretariat, has been universally acknowledged as useful, but final approval is subject to a review of overall Secretariat personnel requirements, not yet completed at the time this book went to press. The establishment of such an agricultural unit within CENTO should constitute the first step towards the implementation of numerous other conference recommendations.

This book comprises: a summary of each of the twelve panel discussions with their main conclusions; country situation papers analysing agricultural production in each of the three regional countries of CENTO and presenting valuable data probably not available in any other single source, and selected papers presented at the conference by various American and British experts and considered to be of particular relevance to the problems of agricultural policy. Space limitations unfortunately prevent the publication of all of the papers presented at the conference, including many excellent ones offered by regional country experts, but it was judged that the essence of these papers emerge in the panel summaries and in the country situation papers.

Special thanks are due to the officials of the Ministry of Agriculture, Government of Turkey who served as gracious and efficient hosts for this conference and who organized and sponsored a highly instructive field trip to the Bursa area following the conference. In particular, we should like to thank Mr. Ziya Arikök, Deputy Under-Secretary of Agriculture and Mr. Ismail Şener, Chief of the Marketing Department for their key roles as Turkish coordinators. In addition, much credit must go to Dr. Frank W. Parker, distinguished American agricultural scientist, who undertook the planning and organization of the conference program, as well as to the participants from all countries, to whose expertise, knowledge and experience the success of the conference is largely attributable.

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OPENING ADDRESS

BY

DR. A. A. KHALATBARY
H. E. the Secretary General of CENTO

Delivered
BY

J. E. HARTLEY

Your Excellencies, distinguished delegates,

His Excellency Dr. A. A. Khalatbary, Secretary General of the Central Treaty Organization, in much regretting that he is unable personally to attend this opening session today, sends you his greetings, and wishes to convey his best wishes for a successful meeting.

A Conference on Agricultural Development Policy, organized by the Central Treaty Organization, was held in Istanbul in December, 1963. I will not enlarge on the pressing necessity for all countries of the world to increase the quantity and quality of their food production. This is the overall problem which faces all of you in this Conference Room, in one form or another, in your day-to-day work and responsibility.

Endorsing the importance that is attached by CENTO to all efforts that are made to improve agricultural production in the Region; feeling that there is a present need for new ideas in this field, and agreeing that a review should be made of what action it has been possible to take on the recommendations put forward at the 1963 Conference; as well as recognizing the importance of assessing the results of the many other CENTO Conferences, symposia and seminars in the agricultural field which have been held in the interval, the Sub-Committee on Agricul-

ture, Animal Production and Animal Health put forward a suggestion for a second Conference, at a high level, on Agricultural Development Policy at its last annual meeting, which took place in January.

The Economic Committee endorsed this recommendation a month or two later. The United States Government thereupon offered to attend to the overall organization of such a Conference, under CENTO auspices, and to make it financially possible for seven delegates from each regional country to attend.

Some of you will be aware that, in order to arrive at a common and acceptable objective for this Conference, a considerable amount of preliminary planning has been necessary. This was carried out in particular by Dr. Frank Parker, who travelled to the three regional countries and consulted with Coordinators in each respective country, namely H. E. Engineer Mir Haydar of Iran, Dr. Ismail Şener of Turkey and Mr. Yamin Qureshi of Pakistan. A summary of their collaboration, and their suggested program for the Conference, are contained in this handbook which you have before you. We are all of us indebted to these gentlemen for their contribution towards the success of this meeting. I will leave it to Mr. Behoteguy, the United States Economic Coordinator for CENTO Affairs, to explain to you how the Steering Committee, which met yesterday evening, suggests that delegates, by splitting up into various groups, can best tackle the wide range of subject matter and problems which they are asked to consider.

I take this opportunity of welcoming a member of the Organization for Economic Cooperation and Development, Mr. E. C. Parsons, present with us today. He will address you this afternoon and give you an insight into recent studies undertaken by the Development Assistance Committee of O. E. C. D. on the regional approach to agricultural development. I am sure we are all deeply indebted to Mr. Parsons for coming from Paris to give us the benefit of his experience, and to his Organization for generously allowing him to do so.

In making special mention of the participation in our deliberations by a member of another international organization whose objectives parallel those of CENTO in the economic field, I am by no means unmindful and unappreciative of the presence amongst us of worthy representatives from several universities in the United States and the United Kingdom, as also from the Rockefeller Foundation.

Before I close my remarks, it might be useful to recall the findings of the 1963 Conference on Agricultural Development Policy. They were admirably summarized in the following terms:

"The many agricultural problems facing the region countries might be summarized as follows:

1. Farmers do not possess sufficient information on new agricultural techniques.

2. Farmers are unable to obtain an adequate amount of agricultural credit for production purposes without undue formality and red tape and at reasonable interest rates. On the other hand, it must be recognized that credit obtained is not, in most cases, being used for production purposes.

3. Incentives to farmers to increase production either do not exist or are inadequate.

4. Prices of production means are unstable and uncertain.

5. Marketing conditions are far from being satisfactory.

6. Cooperatives are not developed.

7. Farmers are unable to obtain tools and means such as feeds, ploughs, fertilizers, etc., and chemicals (used in plant protection) required for increasing production without traveling long distances and being involved in complicated formalities which often take weeks to complete.

8. Existing facilities for the proper training of personnel at all levels are insufficient.

9. Wages paid are inadequate and personnel are not equipped with transportation and other facilities essential for the efficient execution of their duties.

10. On account of climatic conditions in the region countries, the development of irrigation systems and the improvement of land ownership are of vital importance to encourage capital investment."

The Central Treaty Organization has contributed in the intervening years in some measure towards a solution of these problems. This conference will help to point out what has been done and what remains to be done. Your findings and recommendations will be put before the Ministers of Agriculture of the member countries who, it is hoped, will convene together in Ankara at the beginning of November in order to consider them, and pass on their thoughts to the CENTO Sub-Committee on Agriculture which is due to hold its annual meeting a few days later.

At the conclusion of this conference, some of you will be able to take part in a tour of Turkish agricultural development projects in the area. The tour has been organized by the Ministry of Agriculture and I would like to conclude by expressing to H. E. the Minister our joint thanks and appreciation for this initiative.

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WELCOME ADDRESS

BY

BAHRI DAĞDAŞ
H. E. The Minister of Agriculture, Turkey

Delivered
BY
MR. Z. ARIKÖK

Mr. Chairman, distinguished delegates, observers and guests:

It is indeed a great pleasure for me to have this opportunity of welcoming all of you who are in Istanbul to take part in the CENTO Conference on Agricultural Development Policies. I extend my apologies for not being able to be among you. Nevertheless, Mr. Arikök, Deputy Undersecretary of my Ministry shall be a conveyor of my sincerest sentiments. I would like you to accept my best wishes. I strongly believe that you will reach very useful results and bring necessary recommendations for the agricultural development of regional countries.

As you may know, Turkey is endeavouring to reach the objectives set up by the first and second five-year development plans. We have to achieve a rate of increase of at least seven percent in our national income in order that we achieve a net increase of 4.2 percent per year.

To reach this target we must have 1) a sound agricultural structure 2) the best agricultural technology 3) sufficient farm inputs for increased production and 4) adequate marketing facilities for this increased production.

You are, I am sure, aware of the efforts of our Ministry and the responsibilities we carry for the fulfilment of these aims just mentioned. In view of this fact it is of the utmost importance that we should direct all our efforts to reach the goals of our five-year development plans and that a present cooperation among the CENTO countries shall also be directed toward that effort.

Furthermore, our Ministry has undertaken a study to project the demands for agricultural products and the resource requirements to meet the needs for the year 2000. This projection will, no doubt, help make clear what kind of measures to take to increase agricultural production in the years ahead. However, I can tell you that the only opportunity to increase production is by an increase in the productivity of each agricultural unit.

Two other studies of the Ministry deserve special mention here. One concerns the reorganization of the Ministry of Agriculture in order that the functions can be carried out more rationally and efficiently towards meeting the requirements of future agricultural development. The other study is about the draft amendment for agricultural reforms to be undertaken in the country. This amendment is almost ready to be submitted to the Parliament for its approval. This new amendment for agricultural reforms is designed to utilize the existing agricultural resources to provide a better tomorrow for the Turkish farmers and nation.

Mr. Chairman, and distinguished delegates, I am sure that in the course of this conference you will learn more about the development of efforts and new measures taken by the government to increase agricultural production. I strongly believe that by combining the efforts and economic potentials of our countries we will not only support the individual development plans of each member country, but also provide technical, organizational and economic means of solving many problems which would otherwise be costly and difficult to tackle by individual efforts. Thus, this Conference and cooperation among us will, I am sure, strengthen the existing traditional friendship and fraternity for the welfare of our nations.

In closing, I wish the Conference to be successful and helpful for our countries and once again I convey to you my deepest regards and respects together with my sincere thanks.

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RELATIONSHIP BETWEEN AGRICULTURAL AND ECONOMIC DEVELOPMENT

BY

DR. MAX F. MILLIKAN
Director, Center for International Studies,
Massachusetts Institute of Technology

Ten or fifteen years ago it would probably have been necessary to open this conference with a ringing declaration of the importance of giving a high priority to agriculture in development efforts. A favourite subject of debate at that time was whether development planners and administrators should focus their attention primarily on the promotion and expansion of industries of all sorts or whether agriculture was the leading sector whose effective modernization should take precedence over other parts of the economy.

The supporters of industrial development as the key to the modernization process were fond of pointing to the unquestioned statistical fact that those countries with higher per capita incomes have a smaller proportion of the labor force engaged in agriculture. Countries which have achieved levels of per capita income higher than $400 have, with a few exceptions, less than 40 percent of their labor force in agriculture, while those whose per capita incomes are below this figure, again with a few exceptions, have an agricultural labor force in excess of 40 percent. In general, there is a close inverse correlation so that the lower the income the higher the fraction of workers in agriculture. The enthusuasts for industry drew from this acknowledged statistical fact the incorrect inference that the way to raise per capita levels of income is to concentrate attention on industrial productivity.

This is, of course, a non sequitur. The fact that countries, like people, as they grow richer spend a declining fraction of their

incomes on food and devote a diminishing proportion of their man-hours to agriculture does not imply that improved productivity in agriculture is unnecessary for economic growth. Indeed, as we shall see, the statistical truth is much more correctly explained by the opposite inference, namely that it is only because of increasing agricultural productivity that man can be liberated from slavish dependence on rural drudgery. Indeed, historically a marked expansion in agricultural productivity was the central factor making possible a rapid growth of industry in Western Europe, the United States, and Japan during their periods of industrial growth. But the falacious logic of the case against a priority for agriculture did not prevent it from having considerable influence on the thinking of newly independent countries in the decade following World War II.

The proponents of rural development in these early days were equally single-minded. They were hopeful that by improved techniques and practices, like community development programs, and by an infusion of dedicated effort rural communities could lift themselves by their own bootstraps to higher levels of living and welfare more or less without reference to what was going on in the urban industrial sectors of the country. These people whom I shall call the rural romantics turned out to be as wrong in their analysis as the supporters of steel mills and textile plants. No country has exhibited substantial and sustained growth in economic welfare on the basis of improvements in agriculture alone.

It is now coming to be increasingly realized that while in some primitive societies dual economies are possible in which the traditional agricultural sector shows some modest improvement while the modern industrial sector, usually concentrated in extracting and processing raw materials for export, also moves forward with very little connection between the two. These kinds of development very rapidly bump into ceilings which prevent further growth. There is a growing awareness of the fact that continued economic development requires not only a balanced expansion of both agricultural and industrial productivity but a very rapidly growing interdependence between the two sectors.

The only apparent exception to this generalization which is sometimes cited is the Soviet Union which, from the revolution until World War II, accomplished a dramatic expansion in industrial output with a virtually stagnant or in some periods declining agriculture. The exception is more apparent than real, however, since the Soviet Union started with a cushion of a very large export surplus of agricultural

products whose diversion to domestic use sustained and made possible the industrial growth. This delayed rather than avoided the necessity for the Soviet Union to focus on agricultural productivity, a problem which has been increasingly preoccupying that country over the past decade.

In recent years the growing concern with the role of agriculture in development has had its roots in two rapidly converging sets of considerations. In the first place, an increasing number of general development economists like myself whose central interest is in finding ways of maximizing the rate of growth of per capita incomes in the developing countries have become convinced that a crucial bottleneck preventing more rapid development in recent years has been an inadequate rate of growth in agricultural productivity. This is not to say that the performance of agriculture in the under developed world has been bad during the past decade. Indeed, in comparison with the growth rates of agricultural output in the developed countries in earlier periods the recent overall record of the underdeveloped world is quite respectable. Bad weather in a few key countries has produced a crisis in the past couple of years, but the long-term trend in the underdeveloped world as a whole as well as in the three countries represented here has been markedly upward. The problem is that this upward trend has not been sufficient to meet the requirements first of a wholly unprecedented explosion in the population of the underdeveloped world and second of efforts to raise per capita incomes faster than they have ever before been raised for larger numbers of countries at once. I shall come back in a moment to a more quantitative discussion of these points.

The second set of people increasingly concerned with agricultural productivity are the food and nutrition experts who are impressed with the fact that while so far, apart from short term fluctuations, the growth in food availabilities has kept pace with the phenomenal growth in population so that there has been no mass starvation, the nutritional standards of many countries of the world are still below the minima required for good health in both quantity and quality. I do not have good information about the three countries represented at this conference, but for the underdeveloped world as a whole the President's Science Advisory Committee of the United States has recently reported that major nutritional deficiencies cannot be overcome by 1985 without a significant increase in the rate of growth in agricultural output. Reinforcing this conclusion is interesting new work on the relation between nutrition and population growth. This suggests that better

nutrition will not, as Malthus thought, simply contribute to the expansion of population but may instead ultimately reduce birth rates by sharply reducing the risks of infant mortality. What is significant for our purposes here is that those primarily interested in improved nutrition are coming increasingly to realize that this can be brought about only by generating rising per capita incomes among the lower income groups which will make it possible for them to purchase both the quantity and quality of diet they require for health. Rising per capita income in turn can be generated only by accelerating the pace of economic development in all of its dimensions, industrial as well as agricultural.

Thus these two groups, economists and others interested in rapid economic development and modernization on the one hand and nutritionists interested in the better health and feeding of the world's peoples on the other are coming increasingly to realize that they are looking at two sides of the same coin, that agricultural productivity and economic development and modernization are so intimately interconnected and interdependent that they must be regarded as parts of the same systems problem.

I thought it might be useful in launching our discussions at this conference to review in summary fashion the principle elements in these interrelationships between agricultural growth and general economic growth. These elements are familiar and I have nothing particularly novel or startling to offer in this connection, but it may be worth reminding ourselves at the beginning of our deliberations of how pervasive and extensive are these interconnections between agriculture and the other sectors of a developing economy. I would like to discuss in sequence four sorts of relations of this sort. The first are what we may call final demand relations. These operate both ways. That is they refer both to the fact that the effective demand of consumers for agricultural products, mostly food, is directly dependent on the incomes generated by all sorts of production in the economy and to the fact that in countries where the bulk of the population is still rural the demands for non-agricultural products is enormously influenced by the productivity and thus by the incomes of the agricultural sector.

The second set of relations are those that I shall refer to as input-output relations. These too operate both ways. That is to say it is true both that a significant portion of manufacturing activity in developing countries is dependent on supplies of raw materials provided by the

agricultural sector, and also that if agricultural yields are to be increased this can be accomplished only by providing very substantially increased supplies to agriculture of such inputs produced off the farm as fertilizers, pumps, tools, pesticides, and agricultural equipment.

The third set of relations of which I would like to make some mention is what I shall call employment relations. Under this heading I should like to make some comments on how the balance between agricultural and industrial growth effects the supply and demand for manpower and thus the adequacy of employment opportunities.

Finally, under the heading of financial relations I should like to discuss first the relation between agricultural growth and inflation or the behaviour of the price level, second the implications of agriculture for the country's foreign exchange position, and third the needs of agriculture and other sectors for capital and the relative capabilities of the different sectors to perform the saving necessary to supply that capital.

Looking first at demand relations, some fairly simple and reliable quantitative estimates for food demand as related to overall incomes are possible based on the fact that people at relatively low levels of income everywhere distribute that income between food and other commodities in fairly predictable ways.

First, if incomes are rising at the same rate as population, leaving per capita incomes unchanged, it is quite safe to assume that food demand will grow at roughly the same rate as both population and incomes. Since population is growing at roughly the same rates in the three countries represented here as in most of the rest of the underdeveloped world, namely at between two and three percent per year, it is reasonable to assume that a floor for the rate of growth of food demand is set by this population growth rate of two to three percent.

For people at low levels of income expenditures for food constitute the largest part of their budget. These expenditures grow, however, somewhat more slowly than per capita income itself. The percentage by which food demand grows with each one percent increase in per capita income is what we call the income elasticity of demand for food.

For most underdeveloped countries this elasticity is between .5 and .8. In other words, for rough estimating purposes we can assume that food demand will grow something like two-thirds as fast as per

capita incomes. It will grow somewhat more rapidly than this in countries at very low levels of income like Pakistan and somewhat more slowly than this in countries at higher levels like Turkey. But for rough estimating purposes we can say that if, for example, we wish to achieve a per capita growth of income of the order of three percent per year, we must expect a rate of growth of food demand per capita of the order of two percent. Adding population growth of two to three percent to both these figures, we can conclude that a five to six percent annual rate of growth in gross national product, a target not unlike that many countries have set for themselves, implies a rate of growth in food demand of four to five percent. Slower rates of growth in gross national product will slow down the rate of growth in food demand and thus the rate at which countries can achieve goals of adequate nutrition for their people. More ambitious growth rates than this require a more rapid rate of expansion of food supplies. I will speak presently about the variety of ways in which the failure of food supplies to expand can inhibit economic growth performance. What I want to emphasize here is that these two things are very closely interconnected. Economists can introduce a great many refinements into these calculations to allow for such factors as the distribution of income within the country, the age distribution of the population, the effects of changes in the relative prices of food and other commodities, and the like, but these refinements are unlikely to modify in important ways the rough orders of magnitude indicated above.

What I have said so far, of course, relates incomes to food availabilities and not to food production. These may differ because a part of food demand may be met from imports as it is in our three countries and a part of food production may be devoted to supplying export markets as is also the case with the countries of our region. There is, of course, no need for each country to be self-sufficient in foodstuffs, and indeed it is likely that efficiency will be served if there is a substantial volume of international trade in food commodities. There is, however, a strong case for arguing that agricultural production as a whole should grow at least as fast as food demand in most of the larger countries of the underdeveloped world. In the first place it can be demonstrated that taking all the underdeveloped countries as a group the increase in their food requirements over the next twenty years cannot efficiently be met by an expansion of food production in the developed countries. This is so for both physical and economic reasons on which I shall be glad to elaborate on request. Second, while individual underdeveloped countries have

marked and differing comparative advantages in the production of particular foodstuffs, it has not been demonstrated that there are sufficient differences in overall comparative advantage in agriculture to justify a decision by any of the larger countries to fail to promote its agriculture vigorously.

Finally, a justification for accepting a target rate of growth of agricultural production at least as high as the estimated rate of growth of domestic food demand is to be found in the other half of the demand relationship -- that between agricultural incomes and the demand for non-agricultural final goods. In the countries of this region the agricultural labor force constitutes 30 to 50 percent of the total working population. The employment potential of modern industry is not such as to give much promise that the absolute numbers employed in agriculture can be significantly reduced over the next couple of decades. Accordingly, if the standards of living and thus the purchasing power of the important rural segment of the population is to rise along with the average for the country, agricultural output must go up likewise.

It should not be necessary to underline the importance of this rise in the incomes of the rural population to those parts of the economy producing consumer's goods and services. Urban markets have provided the first opportunities for import substitution and consumer goods manufacture, but the rural market is a potentially large and appealing one if rural incomes can be advanced significantly above subsistance levels. This can be done only through a marked improvement in rural productivity. Thus in summary so far as demand relations are concerned agricultural and non-agricultural production are complementary and mutually reinforcing rather than competitive.

When we turn our attention from these final demand relationships to what I have called input-output relationships, that is when we look not at the final demand for agricultural products but to agriculture as a supplier of raw materials to industry, the conclusion that general economic growth must be based on rapid agricultural growth is very strongly reinforced.

What are sometimes described as the agriculture-based industries, -- those which are dependent on agricultural raw materials such as textiles, food processing, leather, paper, tobacco, and the like, -- are very much more important in the less developed than in the more developed countries. According to the FAO, these industries are

responsible for more than half of the value added by all industry in the underdeveloped world and employ nearly two-thirds of the total industrial labor force. The demand for the products of these industries, unlike that for food, grows at a rate substantially faster than the overall rate of growth of gross national product. Again, while agriculture based industries can derive their raw materials from imports as well as from domestic production, transportation and other economies suggest that there will be a strong case for producing many of the raw materials in the countries in which they are processed just as there is a more familiar case for processing them close to where they are produced. Thus if the development of agriculture-based industries is not to be inhibited by raw material shortages, as has happened quite frequently in the less developed world, that portion of agriculture devoted to supplying these industries must expand its output at a rate substantially faster than the overall rate of growth of gross national product. These conclusions hold within the underdeveloped world in spite of the emergence of synthetic substitutes for agricultural raw materials, like nylon and plastics.

I would like to emphasize that the analysis up to this point has been entirely in terms of demands within the underdeveloped world itself. The prospects for exports of agricultural products from the less developed to the more developed countries are very much more uncertain for a whole variety of reasons into which it is unnecessary to go here. But the combination of growing demands for food and of expanding demand for agricultural raw materials within the underdeveloped world provide a convincing case for the critical role of agricultural growth in economic development.

Looking at the other side of the coin, the dependence of agriculture on industrially produced inputs, I presume I do not have to underline this dependence for this audience, though there are, I regret to say, still economic planners who have not fully appreciated the full nature of the transformation through which traditional agriculture is in process of going. Traditional agriculture was not significantly dependent on industry. The traditional farmer did his best to maximize output, relying on the nutrients available in the soil and the water supplied by nature. In this part of the world there is little unused arable land which can be brought into production by traditional methods. Yields can be increased only be transforming farms into businesses which purchase most of their raw materials, (fertilizer, water, seed, and plant protection), and their equipment, (pumps, tools, sprayers, and some machinery), from the industrial sector. Thus those who base

their estimates of inter-industry relationships between agriculture and the rest of the economy on historical experience are making a grave mistake. Modern agriculture and traditional agriculture are totally different kinds of activities with totally different production functions. The modern type requires a vigorous supporting industrial environment if it is to flourish.

I would like to make only a few brief comments about employment relations. It used to be argued that substantial increases in labor productivity in agriculture were necessary in order to free manpower for a rapidly expanding non-agricultural employment. Under the influence of this doctrine some countries pushed ahead rather more vigorously than turned out to be wise with the introduction of labor saving machinery in agriculture. Over the very long run, half a century or more, this doctrine may well be valid. In the short-run, however, population growth has expanded the labor force so rapidly and the employment potential of industry has been so small that the critical problem in most underdeveloped countries has been not labor shortage but labor surplus. Thus the test of mechanization in agriculture in most of the underdeveloped world is not whether it will raise labor productivity but whether it will increase yields, that is the productivity of land which is the scarce factor in most underdeveloped agriculture.

The problem of providing employment for surplus population has become so critical that the question more frequently asked is not whether agricultural progress can release labor to industry, but whether on the contrary it can lead to an expansion of employment opportunities. Even if the adoption of labor saving machinery is resisted, the prospects for an expansion of direct employment in agriculture are not very bright. Most of the yield increasing measures presently in sight can be carried out by the labor force now engaged in agriculture, though many of them, like multiple cropping, will keep that labor force more fully engaged throughout the year.

Some kinds of public works of special utility in agriculture like feeder road construction, terracing, bunding, and the like, are labor intensive, and Pakistan has given clear demonstration of how effectively such works can be organized. However, the main way in which the modernization of agriculture can contribute to the solution of the unemployment problem is through the expansion of secondary activities serving commercial agriculture. These activities, pack-

aging, distribution, marketing, and sale of all kinds of inputs to farmers, the purchase, collection, and processing of agricultural output and the supplying of a wide variety of credit and other services to farmers as their incomes rise, are all labor intensive activities. They either do not exist or are performed at very low levels in traditional agricultural communities, but expand dramatically as agriculture is commercialized. To the best of my knowledge we do not have much information on the employment implications of these activities supplying agriculture, and it may well be that studies of this subject would suggest ways of promoting a better adaptation of rural manpower supplies to potential uses.

Coming to the fourth set of relations which I have called financial relations between agriculture and the rest of the economy, let me examine these by taking a look at what happens if agricultural growth is inadequate to support the overall growth targets which countries have set themselves. It will be instructive to examine the mechanisms by which a lagging agriculture can put brakes on what would otherwise be buoyant activity in other parts of the economy.

In the first place, if incomes are rising rapidly and food production is not keeping pace there will be an excess of food demand over food supply. For the moment, let us assume that food imports are not increased to fill the gap. In this case food prices will begin to rise. If the lag in agriculture affects commercial crops as well as food crops, there will also be price pressure on the raw materials of such agriculture-based industries such as food processing and textiles. Since food and textiles are the major items in the urban cost of living, these price pressures will spread rapidly to wages and other elements in the price structure. Governments will, in other words, be confronted with an inflationary situation.

Two remedies suggest themselves to this state of affairs. The first, which appeals to conventional banking instincts is for the government to adopt a restrictive fiscal and monetary policy, tightening credit and cutting government expenditure while maintaining or increasing tax revenues. The effects of these measures are, of course, to reduce industrial production, employment, and output. They will be effective in stopping the inflation if they cut incomes to the point where the demand and supply of agricultural products are once again in balance. But in the process growth in real output will have been restricted or brought to a halt. There are many instances in the last decade where precisely this chain of events has been set in

motion by inadequate agricultural performance. In India the proximate cause over the past two years has been bad weather, but the consequences have been just as described above.

If there is reluctance to adopt these conventional anti-inflationary measures, or if they are not severe enough to be effective, an alternative is to attempt direct price control of food stuffs and its logical corollary, some form of rationing of the scarce supplies to avoid gross inequities. This, of course, worsens the disease by reducing still further the incentives to agriculturists to expand their marketed output. Even more serious in many underdeveloped countries is the fact that these price control and rationing schemes require for their implementation an enormous amount of administrative energy and attention which, in countries where effective administration is the scarcest resource, can be secured only by diverting it from productive activities to this essentially unproductive one. Again the inevitable result is a slowing of the overall rate of growth to bring it into line with lagging agriculture.

There is a third alternative. The country's authorities can attempt to meet the gap between domestic demand and domestic supply of agricultural products by using a larger share of scarce foreign exchange resources for agricultural imports. The pressures to do this will be very great and some part of the gap is almost certain to be met in this fashion. Alternatively, if the country has been a substantial exporter of agricultural commodities for which the demand is also rising at home, exports will be diverted to the domestic market. In either case, the availability of foreign exchange for non-agricultural purposes will be sharply reduced. In most underdeveloped countries the rate of expansion of gross national product is limited by the foreign exchange bottleneck. Thus anything which reduces the availability of foreign exchange for development purposes would correspondingly reduce the rate of growth. More fundamentally the only hope countries have of ultimately solving their foreign exchange problem is to invest in domestic industry which either produces substitutes for imports or which produces exports. But these industries can be launched only with capital and in some case raw materials purchased from abroad. Thus any diversion of foreign exchange to current consumption needs not only limits current industrial activity but inhibits future development as well. Thus we are left with the conclusion than an adequate rate of growth of agricultural productivity is necessary to avoid both inflation and foreign exchange crises either of which can bring general development to a halt.

What about the contribution of agriculture to national saving and thus to the mobilization of resources needed for growth? Here the conventional wisdom is that a surplus of agricultural production over the consumption needs of the rural community is necessary in order to support the urban labor force engaged in capital formation during the long gestation period of industrial capital. In long-run terms this argument is undoubtedly essentially correct. But the problem of devising techniques for extracting savings from agriculture for investment in non-agricultural enterprises without reducing agricultural incentives to the point where agriculture stagnates is a very difficult one. Some countries with strong export markets for their agricultural products have been able by export taxation to squeeze resources out of agriculture for industrial investment, but this threatens to reduce prices realized by farmers to the point where they do not find it profitable to make the considerable investments in agriculture itself which are required to get major increases in yields.

The key to higher savings in all sectors is rapidly rising incomes, and there is a serious danger in agriculture as in other sectors of pushing tax rates so high or keeping prices so low as to kill the goose that lays the golden egg of investment in innovative practices which will increase productivity. Since the capital requirements for the modernization of agriculture itself are quite high for irrigation work, fertilizer plants, and the like, it is not clear to me on the face of it that in the short-run the agriculture sector where incomes are in general below average can make a net contribution to savings for investment in other branches of the economy. The relatively high capital requirements for the modernization of agriculture greatly increase the importance of attempting in all possible ways to attract foreign capital into the industries supporting agriculture. What is in any case clear is that unless agricultural productivity and incomes rise rapidly it is not possible for non-agricultural incomes to rise and unless productivity in all sectors goes up sharply the rate of saving and investment cannot be increased to the point at which self-sustaining growth becomes possible. In this sense at least agricultural development is necessary for the mobilization of savings to keep the engine of development operating at full speed.

In conclusion then, much as administrators would like to be given a clear indication of priorities, to be told either that they should concentrate single mindedly on agriculture and let other things take

care of themselves, or alternatively that agriculture is secondary and their attention should be focused elsewhere, the only general advice the economist can give is that growth in agriculture, in industry, in social overhead, and in related services, is an interconnected whole, — interconnected through final demands, through input-output relations, through manpower needs, and through financial mechanisms. Each country must find the proper balance in the light of its own circumstances. In this conference we shall be examining that balance for each of the three countries represented here. It is one observer's conviction that agriculture needs more persistent attention and emphasis than it has received, but that equally the same could undoubtedly be said about each of the other sectors with which it interacts. If we are to achieve and maintain over-all rates of growth which will begin to meet the aspirations of the countries of the region for a better life, agricultural progress must be accelerated. But equally the rural community can enjoy prosperity and expanding welfare only in the context of an economy whose growth spreads over all sectors, rural and urban alike.

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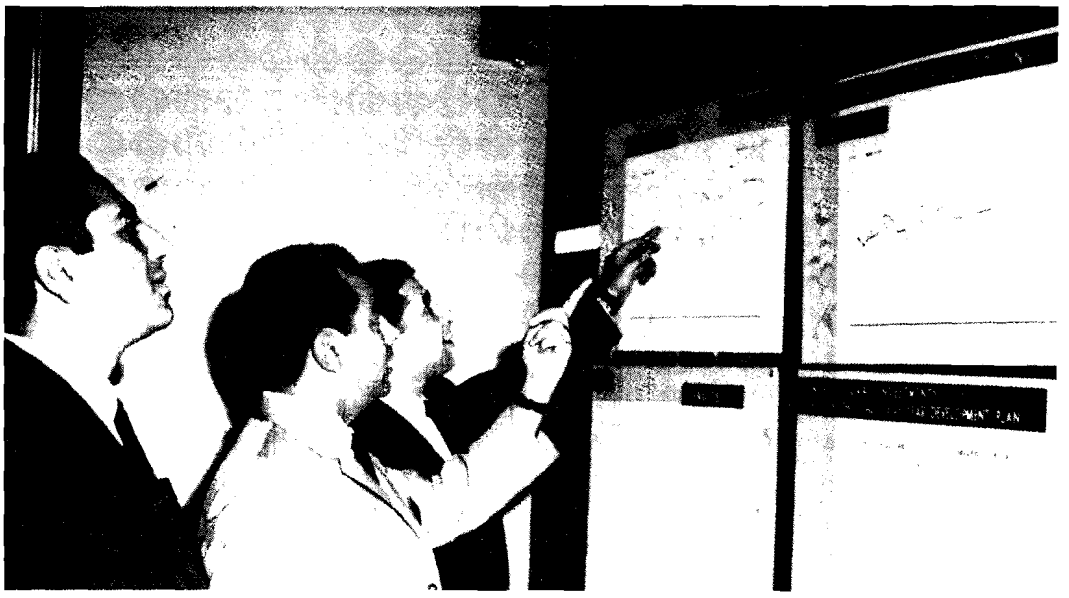
OPENING OF THE CENTO CONFERENCE ON NATIONAL AND REGIONAL AGRICULTURAL DEVELOPMENT POLICY

Registration of Delegates by Miss Olive Scancarella (center), L to R, L. L. Shields, A. W. Choudhuri, A. Jalai, K. B. Doja, L. E. Hesser.

The First Deputy Governor of Istanbul, Ekrem Gonen, welcomes the Delegates to Istanbul.

F. W. Parker, and A. H. Moseman discussing the Agenda.



A. Memarbashi, A. Assadollahi, and N. O. Shilati, (L to R) discuss Turkish production charts.

L to R, R. N. Gleason, M. F. Millikan, L. H. Hesser, M. Yamin Qureshi.

REPORT OF THE CENTO CONFERENCE ON NATIONAL AND REGIONAL AGRICULTURAL DEVELOPMENT POLICY

INTRODUCTION

A CENTO Conference on Agricultural Development Policy was held in Istanbul in December 1963 at which it was recommended that a second similar conference be held within a few years to review progress in development. A recommendation to hold this second conference was made in January 1967 at the Fourteenth Session of the Sub-Committee on Agriculture, Animal Production and Animal Health and this was approved by the Economic Committee at its Fifteenth Session in March 1967. The Second Conference, organized and financially assisted by the United States Government, was held at Tarabya, near Istanbul, from September 11 to 16, 1967. The objective was to discuss the national and regional agricultural development policies regarding crop production in the three countries. The Conference, as indicated by its name, was concerned with Agricultural Policy. In considering policy issues it was concerned with programs and questions related to programs.

CONFERENCE OBJECTIVES

The Conference limited itself to a consideration of the factors contributing towards an increase in crop production. The objectives of the Conference were well described by the Country Coordinators responsible for the preliminary planning of the Conference in the following terms.

CENTO, like FAO, ordinarily defines agriculture to include crop production, livestock production, forestry and fisheries. Largely because of the limitation of time and to a lesser extent because of the lack of adequate data on livestock production, this Conference will deal

primarily with crop production and specifically with increasing the production of food and feed grains per unit area. However, the economic principles involved are applicable to all the sub-categories of agriculture.

The basic purpose of the Conference is to analyze the experience of the developing countries, especially the region countries, in agricultural production and development. The analysis would focus on both regional and national measures and accomplishments. From the analysis and an examination of current and projected programs the Conference would develop recommendations for consideration by the regional governments. The specific objectives are:

1. To analyze the 1948-66 experience of the region countries and other selected developing countries to determine the factors that promoted an increase in agricultural production.

2. To consider the technical, economic and administrative measures the region countries might adopt to assure an annual increase in agricultural output of 4.0 or more percent from 1968 to the end of the next Plan period.

3. To consider the measures that might be taken on a regional basis to supplement national measures to attain the desired increase in agricultural output.

4. To prepare recommendations for consideration of member governments.

INAUGURAL ADDRESSES

The delegates were welcomed to Istanbul on behalf of the Governor of Istanbul by H. E. Mr. Ekrem Gönen, First Deputy Governor.

The Conference was called to order by Mr. J. E. Hartley, Deputy Secretary General (Economic) of the Central Treaty Organization. An address of welcome from H. E. Mr. Bahri Dagdaş, Minister of Agriculture, Government of Turkey, was delivered by Mr. Z. Arikök, Assistant Under Secretary, Ministry of Agriculture.

After opening statements from the Leaders of the delegations of Iran, Pakistan, the United Kingdom and the United States, Mr. Z. Arikök, Leader of the Turkish Delegation was elected Chairman. In taking the chair, Mr. Arikök proposed that the Leaders of the other delegations should act as Vice-Chairmen, as and when required, and his proposal was adopted.

An account of the proposed procedural arrangments for the Conference, discussed the previous evening by the Conference's Steering Committee, was then given by Mr. Scott L. Behoteguy, United States Economic Coordinator for CENTO Affairs, and the proposals were adopted.

The Keynote Address was delivered by Dr. Max F. Millikan, Director of the Center for International Studies, Massachusetts Institute of Technology, on the theme "The Relationshop Between Agriculture and Economic Development."

Analyses of national agricultural production in the three regional countries were presented by the Leaders of the delegations of Iran, Pakistan and Turkey. The first day's deliberations were brought to a close after the presentation of two further papers; the first on "Agricultural Development in Greece, Mexico and Taiwan" by Mr. Wade Gregory, United States Department of Agriculture, and the second on "Agricultural Development Studies of the Development Assistance Committee of the O. E. C. D." by Mr. E. C. Parsons of the Organization for Economic Cooperation and Development.

CONFERENCE PANELS

In order to cope with the wide range of subject matter before it, the Conference split up into panels in the ensuing four days. The twelve panel reports, as adopted by the Conference in plenary session, are included in this report. The panels were:

Technology

1. Food and Feed-Grain Potential
   (Short title: Food Potential)

2. Fertilizer Production, Imports/Exports, Distribution, Consumption and Future Plans.
   (Short title: Fertilizers)

3. Irrigation Practices and Development
(Short title: Irrigation)

4. Energy and Machinery Requirements for Increasing Crop Yields
(Short title: Mechanization)

5. Crop Loss
(Short title: Crop Loss)

Economics

6. Capital and Credit Requirements of Agriculture
(Short title: Credit)

7. Cooperatives and other Means of Promoting Production and Distribution of Seeds and Off-Farm Inputs and Processing of Agricultural Products
(Short title: Cooperatives)

8. Regional Cooperation and Agricultural Development
(Short title: Regional Cooperation)

9. Methods of Organizing and Administering Agricultural Development
(Short title: Methods)

10. Incentives for Production, Prices and Markets
(Short title: Incentives)

11. Promotion of Trade in Agricultural Commodities and Off-Farm Inputs
(Short title: Trade)

Technology and Economics

12. Development of Agricultural Research and Educational Institutions and Programs
(Short title: Research)

PANEL REPORTS ON TECHNOLOGY

Food and Feedgrain Potential

This Panel met on September 12 under the Chairmanship of Mr. Aziz Memarbashi (Mr. R.N. Gleason acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

The potential for increasing food and feedgrain production in the CENTO region countries is tremendous and no less than that of other regions of the world. It is estimated that the application of new technology would increase the yields of cereal crops four to five times on irrigated land and two to three times on non-irrigated land. A sustained compound five percent rate of increase annually in agricultural production for 10 to 20 years would be feasible for the CENTO region countries provided proper attention is given to development and use of a constant flow of new production inputs.

The prospects of bringing new lands under cultivation are very limited indeed. Therefore, future increases in production must come almost solely from increases in yields per unit of land. These increases in yields will result from the extensive use of improved seed and off-farm inputs coupled with the improved cultural practices and management that are essential parts of modern farming technology.

The extent to which the potential for increasing food and feedgrain production is reached will depend in a large part on the policy decisions and determination of the respective region countries. These policy decisions will involve a number of interrelated matters having a direct bearing on performance in the agricultural sector, e.g., making available the products of industry that are essential agricultural inputs (fertilizers, pesticides, equipment, etc.); making available modern agricultural technology; providing farmers incentives such as fair prices and adequate credit; and attaching appropriate recognition to agricultural pursuits, supporting and rewarding those involved accordingly.

In addition to strictly national programs and projects, many agricultural problems can best be tackled on a regional basis through cooperative efforts. The area of research and training, and the standardization of laws and regulations regarding seed, fertilizers, and pesticides, are ideally suited to this approach.

Research and training, and the development of new and improved technology, should be undertaken on a crop-oriented basis in regional projects and/or centers established for the purpose. They should cooperate with world centers such as the International Center for Maize and Wheat Improvement (CIMMYT) in Mexico and the International Rice Research Institute (IRRI) in the Philippines. Some centers may include a category of crops, e.g., cereals, and should be staffed by well-qualified persons in the various inter-related agricultural disciplines.

It is RECOMMENDED THAT:

a. a regional cereal research and training center be established similar to the one in Mexico (for wheat and maize) and in the Philippines (for rice). Recognizing that CIMMYT is currently considering providing support to the establishment of a Wheat Research Center in the Near East, it is further RECOMMENDED that the parties concerned be requested to consider also extending the scope of such a center to include other cereals;

b. the research activity on pulses in Iran be expanded to service the CENTO region countries including the training of personnel;

c. a team of experts be designated to explore the need for and possibilities of establishing regional research and training projects and/or centers for other crops, such as oil-seeds, fibres, and forage;

d. uniform regulations covering the production, certification, and distribution of seed be developed making possible the free immediate interchange of seed among the CENTO region countries;

e. the CENTO region countries review their respective fertilizer supply projections for the years ahead in consideration of the higher requirements of fertilizer in order to maximize potential benefits from improved seed and farming technology. It was strongly believed that the availability of this single production input may become the prime factor governing increased production in the years ahead; and

f. in consideration of the importance of dryland farming in the CENTO region countries, that techniques of soil moisture

conservation be developed as a prerequisite to increased fertilizer usage required in connection with improved seeds.

Fertilizer Production, Imports, Exports, Distribution, Consumption and Future Plans

This Panel met on September 13 under the Chairmanship of Dr. Mohammad Sharif (Mr. J.M. Hill acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

The CENTO countries of Iran, Turkey and Pakistan find themselves in similar situation in relation to fertilizers.

These are:

1. Fertilizer consumption has increased at a compounded rate of 20 percent or greater for each of the last six years. In each of the three countries governments have recognized the importance of fertilizers and have developed five year plans to sustain or increase this rate of increase in fertilizer consumption.

CONSUMPTION OF N, P_2O_5, K_2O

(1000 MT)

	1960	1966	1972 Projection
Turkey	20	208	900
Iran	13	56	217
Pakistan	30	200	700
	63	464	1817

2. A rapid increase in fertilizer demand is evident.

3. Construction programs to close the gap between demand and in-country production are yet to become effective.

4. Need for research on use of high analysis fertilizer, to be produced in new plants and best means of on farm use.

5. A problem of determining types of distribution systems and size to meet expanding demand and to maximize in-country production.

6. The need to know and develop the best effective educational training program for farmers, dealers, extension workers on the proper uses of fertilizers and related technology.

7. The relation of demand for fertilizers, and manufacturing plants with available foreign exchange.

8. The impact of increasingly large requirements of fertilizers for use with new improved varieties of seeds, plants and other elements of the changing agricultural technology.

It is therefore RECOMMENDED that a Regional Fertilizer Work Group be established by the three nations concerned. This Work Group would be composed of suitably qualified representatives of the three countries plus such consultants as might be deemed necessary. The Work Group would be a continuing one.

Among its many functions and responsibilities would be the following:

1. Review of the total system of planning for production and distribution of the three nations and consolidation in so far as feasible into one total system for the region.

2. Review of overall capital requirements and ability to meet these requirements on a mutual basis.

3. Devising methods for a) Joint research projects,
b) Research and technology information exchange,
c) Attracting research institutes and activities into the region to insure attention to adaptation of interrelated advances in improved varieties, soil fertility and water management and other production practices.

4. Devising methods of mutually solving the tremendous problems of education of teachers, extension personnel, fertilizer dealers and farmers in the proper use of fertilizers.

5. Devising uniform standards of regulation in each country which would protect farmers interests and would also assist manufacturers of fertilizer in facilitating inter-regional trade.

6. Investigate the possibility of trade arrangements between the three nations for raw materials, finished fertilizer product and other needed items.

7. Review the various successful distribution systems, methods, and economics and act as a clearing house of information on both successful and unsuccessful attempts.

Irrigation Practices and Development

This Panel met on September 13 under the Chairmanship of Mr. Hüseyin Yegin (Mr. L. R. Anderson acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

This report deals with the technology and services required for increasing agricultural production from existing and planned irrigation facilities.

Since ancient times people of this region have strived to overcome the inherent deficiency in precipitation by constructing irrigation dams, ganats and other structures to divert water from available sources for irrigation and domestic use. History relates the tragic story that many new problems, usually in the form of salinity and water-logging, appear where irrigation water is not properly utilized. Salt accumulation in soils represent a general problem which is most wide spread in Pakistan, but is very acute in many areas of Iran and some in Turkey. Each country has, therefore, established extension services, technical assistance, special training programs and demonstration areas in attempts to assist farmers in the adoption of practices that would maximize crop yields under irrigation and prevent additional loss of land to salinity and water-logging.

Although simple in principle, the actual practice of integrating the entire crop production program on a farm is difficult for the average farmer to adopt. Therefore, too often the carefully calculated cost-benefit ratios based on anticipated cropping patterns have failed to materialize.

The following RECOMMENDATIONS are presented to assist with the development of public policies, practices and management skills that will insure greater returns from existing and future irrigation projects.

1. Provide technical assistance to aid in increasing crop yields through integrating production practices. Programs must be developed to:

   a. Provide technical and financial assistance in farm improvement, including improved irrigation water distribution and land levelling, drainage where needed, and land reclamation from salinity. Plans and farm programs should provide for a balanced group of production inputs that will insure high crop yields.

   b. Organize and supervise water distribution so that scheduled water deliveries would assure high crop yields.

2. Provide incentives for farmers to produce more crops within the capabilities of available resources. Some appropriate incentives to consider include:

   a. Devise water charges to achieve goals appropriate to the local situation. Flat charges per hectare encourage greater water use and usually low efficiency in irrigation practices. Charges on the basis of water used encourages good irrigation practices and farm methods such as land leveling. However, if the charges are excessively high they may discourage use of adequate quantities of water.

   b. Taxes and water charges should be adjusted to provide incentives for producing high yields where charges on a variable basis are not practical. A change from charges based on yields to those based on capability of resources is recommended.

3. The governments of Iran, Pakistan and Turkey can promote increased crop production under irrigation agriculture through programs that will encourage private capital in development of underground water by removing all unessential restrictions and giving technical assistance and financial aid in well construction and equipment acquisition.

4. A regional research center be established to investigate and determine alternative methods for approaching the common problems which are delaying implementation of improved

irrigation practices and procedures. The possibility of introducing sprinkler irrigation may also be studied and if found economical should be introduced.

Energy and Machinery Requirements for Increasing Crop Yields

This Panel met on September 14 under the Chairmanship of Mr. Nossrat Shilati (Mr. Oddvar Aresvik acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

As stressed in the previous Panel Report on the potentials for increasing food grain production, it is possible to increase yields two to five times. This increase will however require improved cultural practices. This can only take place through introduction of improved equipment for land levelling, seed bed preparation, planting, threshing, etc. Improved land preparation can under certain conditions take place by increasing use of tractors and tractor equipment. In other cases in areas with small farms, it has to take place through introduction of improved bullock drawn equipment. Tests of rabi drills for sowing of wheat has shown that this use can result in a substantial increase in yield. The region countries should select suitable models of needed farm machinery as quickly as possible and initiate local manufacture on a substantial scale.

Mechanical threshing of wheat has also become more urgent because farmers growing dwarf wheat are forced to thresh two or three times the quantity of grain they previously produced and time is not available to prepare land for the kharif crop, while wheat threshing remains unfinished. For certain areas and for the larger farms combines are being introduced and might be the best solution. For other areas and for the smaller farms mechanical threshers will have to be used. Various mechanical threshers are already available in the CENTO countries. Other low cost models are available from Japan and elsewhere. A rapid testing of alternative equipment is now needed, and local manufacture of the most desirable threshers should be organized as soon as possible.

According to the population growth rate in the region countries and the possible pace of industrialization an increase of the rural labor force has to be expected. Instead of labor saving, increase of yields and production should, therefore, be the main goal for the farm mechanization in the region. Mechanization can increase yields by better land preparation, by more timely sowing, etc. In some cases even an extra crop can be possible through cultivation by tractors.

Employment possibilities will be increased by increasing agricultural production as well on the farms as in the servicing sector of the economy. By increasing mechanization in agriculture, feed and fodder previously used for the draft animals can be used for production of milk and meat and thus provide additional employment in the livestock sector. Mechanization can save human beings from the drudgery of manual labor and increase the dignity of farm work.

RECOMMENDATIONS

1. It is recommended that a Regional Farm Mechanization Working Group be established by the three nations concerned. This Working Group would be a continuing one.

2. There is a need for regional studies of the best crop and means for mechanizing agriculture including ways to maintain a proper balance between mechanization and employment opportunity in rural areas.

3. Government should encourage invention and production of mecahnical equipment by private enterprise to assist all aspects of agricultural production, harvesting, and the processing of agricultural products. The assistance should include:

    a. Assistance to inventors and machine shops in the improvement of design of equipment
    b. Evaluation of the merits of new agricultural equipment
    c. Credit for developing and manufacturing equipment
    d. Assistance in marketing of equipment.

4. A major need is a wide range of equipment to improve mechanization of small farms in order to:

    a. Improve efficiency of draft animals; and
    b. Improve efficiency of human labor.

Small power units comparable with those developed in Japan and Taiwan should be tested for this purpose.

5. The Regional Center in Iran for training in farm mechanization should be strengthened to provide research facilities

as well. Special types of equipment for irrigated as well as for dry land farming should be designed.

6. The facilities for research and training on a national basis should also be strengthened to work as a complement to the regional center.

7. A regional arrangement for manufacturing tractors and combines should be considered. Standardized parts could be produced in the various region countries.

8. Purchase and use of tractors and equipment by neighbouring farmers and custom works by private parties should be encouraged by technical advice and financial aid.

9. The region governments should consider allowing tractors and tractor equipment, combines, etc. and the necessary spare parts to be imported free of duty in order to support mechanization.

10. The firms marketing tractors, combines and equipment should be requested to provide necessary supplies of spare parts and needed servicing facilities.

11. Rural electrification deserves high priority in order to speed up agricultural development and can be used for tube wells, stationary threshers, etc. It will also stimulate the development of small rural industries which will help to absorb unemployed labor.

Panel Report On Crop Loss

This Panel met on September 14 under the Chairmanship of Dr. H.S. Hopf (Mr. J.M. Ryan acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

Proper control of insects, plant diseases and other organisms causing damage to crops is a way to increase production on the same land without increasing the input of water, fertilizer or new plant varieties. Indeed, without it, the introduction of the new high yielding varieties will not give the expected results. At the same time the dissemination of highly toxic substances among rural communities constitutes a serious hazard which must be safeguarded

against. Losses caused by pests cannot be easily estimated, and include components other than loss of yield, e.g., loss of quality, more difficult harvesting, unsaleability of the product in certain markets and, perhaps most important, the lost opportunity to grow some crops at all in certain circumstances.

The most efficient control includes the use of natural enemies of the pest and cultural methods, as well as that of conventional insecticides; the ultimate aim is to evolve a system of integrated control for each pest on each crop.

Member countries should help each other by exchange of information on the occurrence of pests and their natural enemies, by standardizing specifications of the chemicals and apparatus used in order to facilitate easy interchange, by agreeing to common residue tolerances where these are necessary, and by pooling their resources in the training of personnel and in research.

The panel members commenting upon the control efforts of their respective countries recognized the urgency of increasing the inputs of technology and personnel and to promote the spread of knowledge on pest control methods and their dangers in the rural communities. They recognized that, in common with all other inputs, the efficient use of pest control depends on the receipt by the producer of an adequate price for the commodity produced.

On the basis of the above reasoning the panel members submitted the following RECOMMENDATIONS:

1. A joint study of true losses on selected crops common to the region be made.

2. The creation of apparatus for the institution of an effective system of exchange of information on occurrences and movements of pests and their natural enemies within the region and for joint training courses.

3. A concerted effort be made to increase crop protection by aerial spraying methods. Participation from within and without the region in aerial spraying is to be encouraged in each CENTO country.

4. Member governments are invited to institute expanded consultations with each other on the subject of legislation for operator and consumer safety in the use, storage and disposal of all pesticides.

5. A system of standardized specifications for pesticides and application machinery should be developed within the region to guarantee the quality and facilitate the exchange of materials.

6. CENTO should consider sponsoring, at a future date, a Working Party on the safe use and residue tolerances of pesticides.

7. CENTO countries should sign a Convention on quarantine rules and regulations to regulate the movement of plant material within the region.

PANEL REPORTS ON ECONOMICS

Capital and Credit Requirements of Agriculture

This Panel met on September 12 under the Chairmanship of Mr. Oktay Ersoy (Mr. Wade F. Gregory, acting as Rapporteur) and submitted the following Report which was adopted in Plenary Session.

Capital needs of the agricultural and the agri-industrial sector are increasing and as new improved technology required for increased output and productivity is adopted, capital requirements will accelerate for many years. This results from the fact that most, if not all, of the improved technology requires purchased inputs as contrasted to farm produced inputs primarily used in traditional agriculture.

Not only must total capital requirements be known but the proportion of the requirements that can be satisfied domestically as well as the foreign exchange requirements must be also be determined. While this proportion was not specified for the member countries, currently and for many years considerable quantities of the new inputs required will need to be purchased outside the region. Even if manufactured in the region, considerable foreign exchange will be required to construct facilities and for the importation of some of the raw materials needed for domestic production of the new inputs.

Generally speaking, production levels on most farms are not large enough for farmers to finance the purchase of new inputs out of their current production. Therefore, the credit needs of farmers will grow at about the same rate as the rate at which they adopt improved practices. For, the new production practices cannot be instituted without using new inputs, and the new inputs must generally be purchased and for this, farmers need credit.

The primary source of agricultural credit in the region is through the agricultural banks of each country. However, the capital resources of these banks are now not large enough to satisfy immediate needs for credit and it appears highly doubtful that their resources will on present plans increase rapidly enough to meet the increased credit needs of farmers.

In discussing limitations to present systems, three factors were mentioned: 1) shortage of funds, 2) shortage of trained people to insure effective credit use, and 3) inadequate methods and procedures to service a larger volume of loans. The relative importance of these factors varied among regional countries.

The other side of the problem is that farmers often do not understand the function of credit and this makes the development and execution of adequate credit programs difficult.

It was also pointed out that the granting of subsidies for selected inputs lessens the need for agricultural credit to individual farmers but in no way lessens the capital needs of the agricultural sector and could in fact increase them.

In terms of external financing, it was pointed out that generally both multilateral and bilateral agencies have been less concerned with the agricultural sector than other sectors in economic development. The proportion of total assistance for agricultural development being in the range of about ten percent. This situation is now however changing. One of the reasons for the imbalance in capital assistance to the agricultural sector has been the undue diffusion of responsibility on the part of borrowers in requesting loans for agricultural development. As this situation improves, the proportion of capital assistance to the agricultural sector should increase.

The following suggestions were made as possible ways to increase the amount and effectiveness of agricultural credit available to

individual farmers as well as to increase the supply of capital to the agricultural sectors as a whole:

1. Private manufacturers and distributors of the new inputs (such as fertilizer, pesticide, seeds) should be considered as a source of credit. In many developed countries, manufacturers of agricultural inputs now provide credit in one form or other as part of their selling and distribution programs. These functions could quite likely be developed in the region countries to the benefit of all concerned.

2. Encourage the development and growth of voluntary savings and loan associations as a source of agricultural loan money.

3. A Regional Working Party should study the external financial requirements for agricultural development within the regional countries and of any institutional arrangements needed to meet these requirements (especially as they concern the rapidly increasing need for purchases of farm inputs and investments in the production of these inputs).

4. Agricultural Banks and cooperatives need not be the only source of agricultural credit and other sources and other forms of meeting farm credit needs should be studied and encouraged. Among these, attention should be given to the manner in which other countries meet this problem, for instance the fertilizer-rice barter program of Taiwan.

5. Since the quantity of institutional credit is less than needed, it is important to make the best use possible of it. Therefore, a system of supervised credit should be developed and used to the maximum extent possible, also loans should be for stated, specific purposes (project type loans) and, where feasible, granted in kind rather than cash.

6. Local volunteer leaders should be utilized insofar as possible in the management of government credit for small farmers.

The Development of Agricultural Research and Educational Institutions and Programs

This Panel met in Plenary Session on September 15 under the Chairmanship of Mr. Yamin Qureshi (Mr. J. R. Douglas acting as Rapporteur) and adopted the following report.

It is fully recognized by the CENTO nations that: 1) increasing food needs of the nations must be met by production within these countries, 2) most of the increased production must come from present arable lands, 3) most of the increase must be in food grains and 4) that in order to accomplish this priority target there must be considerable changes in the mix of various input factors of production as well as in economic organization and other factors.

In order to meet the minimum goals there must be incorporated into the agricultural sector many technological improvements — improvements in varieties of seeds, types and amounts of fertilizers, insecticides, fungicides, cultural methods and other farmer practices including more efficient use of irrigation water. Most of these new technological breakthroughs have been made in other areas of the world but have not been sufficiently tested and proven in the three countries area. Many other improvements may be required.

Each of the three regional nations has developed over the past years extensive research, educational and extension activities. These individual activities and programs have been fitted to their own individual situations and needs. There are, however, shortage of money, equipment and trained manpower.

In such situations where generally the needs and requirements outshadow the available supply of resources, emphasis must first be given to institution building. The institutions of the future must emphasize productive mission-oriented research, and use of this research to reach immediate national goals pertaining to food production.

It was therefore RECOMMENDED:

1. That there be established a Regional Working Party on Research which would work within the following terms of reference:

    a. Review current programs and organizations for research and extension education in the region. In this stage of the work cooperation might be considered with an agency such as OECD.

    b. Assess prospects for regional cooperation to accelerate development and use of new technology and give guidance.

c. Maintain continuing contact with all research centers of the CENTO nations to help in focusing attention on the problems most critical to the region.

d. Serve as a continuing point of contact with research and educational organizations in other parts of the world including International Centers and with organizations which might mobilize resources such as foundations, governments and international agencies, e.g. FAO and OECD.

e. Review of changing needs for and availability of specific types of research personnel.

f. Review of the need for a formal Regional Organization to coordinate research activities keeping in view comparative cost-benefit analysis.

Such a Regional Working Party would of necessity be based upon an interdisciplinary approach. It would facilitate development of improved working relationships with all governments and agencies which might mobilize resources.

Promotion of Trade in Agricultural Commodities and Off-Farm Inputs

The group noted a number of advantages of increased intraregional trade. These were larger markets for commodities which are already traded and more effective allocation of resources within the region through economies of scale and through the functioning of comparative advantage. The group noted, however, that the regional countries are basically similar in that the agricultural sector provides a large portion of their exports. Therefore, the possibilities for extensive mutually advantageous intraregional trade appear limited.

The group also noted the technical problems and difficulties involved in specific suggestions for arrangements designed to increase intraregional trade. The group stressed the need for most careful study of any proposals in this area. With these qualifications in mind, the group proposed the following RECOMMENDATIONS:

1. Investigate the possibility of expanding intraregional trade in commodities which are surplus to one of the countries, or which for some other reason, are not being exported to the extent feasible. Specific possibilities were noted in the

cases of Iranian petroleum, Pakistani jute, and Turkish livestock and timber products.

2. Form an ad hoc technical group to see if; a) any major economies of scale exist in off-farm input industries which could justify establishing them on a regional basis; b) the possibility of trade in excess supplies of agricultural inputs which might be temporarily available as region countries established large manufacturing plants to produce agricultural inputs. It was noted that for reasons of efficiency, fertilizer plants need to be established on a large scale, and therefore supplies may be temporarily in excess of domestic demand as new plants begin to operate.

3. Explore the merits of establishing a regional Agricultural Export Promotion and Marketing Board. This Board could take advantage of the fact that the region countries export many of the same products and it could therefore develop joint overseas marketing and trade promotion programs and centers. Such a board could also provide a mechanism of coordinating trade policies of the regional countries.

Incentives for Production, Prices and Markets

This Panel met on September 14 under the Chairmanship of Mr. Jalali (Mr. E. M. Gilbert acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

A variety of economic incentives are currently in effect in the three countries of the region. These include:

1. Price supports for principal crops, usually in the form of a guaranteed minimum price.

2. Government subsidies for farm inputs, such as improved seeds, fertilizer, pesticides, farm machinery, etc.

3. Special tax exemptions for farmers.

4. Village improvement programs, most notably to provide access roads to markets.

The panel addressed itself to such questions as:

a) When are incentives needed; b) What are they expected to achieve; c) What are the relative merits of price supports vs. input subsidies; and d) What fiscal measures are suitable? From this discussion, several principles and groundrules for incentives emerged, and are submitted by the panel as RECOMMENDATIONS:

1. Price supports should be restricted to a very limited number of basic and vital crops to permit the establishment of an effective working mechanism.

2. Input subsidies should be regarded as a temporary measure and should be programmed for a period of less than ten years, phased downward. The regulatory system employed should ensure that such subsidies are available to all farmers on a non-discriminatory basis.

3. Fiscal measures - Export taxes, often imposed as a revenue raising device on crops in which a country has a comparative advantage, should be discouraged insofar as such taxes constitute a disincentive to farmers and may destroy the comparative advantage. Accordingly, export bonuses for key crops should be considered as they may constitute a positive incentive.

4. Efforts should be made by governments to avoid monopoly distribution problems by not granting sole distribution rights for various farm inputs to a single organization, whether a government agency or a private firm.

5. Since a principal justification for incentive, even in periods of production increases, is the element of risk, the amount of incentive required can to some extent be minimized by reducing risk. The panel therefore recommends further study of innovators' insurance to farmers by credit agencies to offset risks inherent in new investments and new crops.

6. Governments are encouraged to strengthen information programs to farmers on prices and marketing intelligence relative to crop production. Such information if effectively disseminated constitutes a positive incentive to farmers.

Methods of Organizing and Administering Agricultural Development

This Panel met on September 13 under the Chairmanship of Mr. E. C. Parsons (Mr. L. F. Hesser acting as Rapporteur) and submitted the following report which was adopted in Plenary Session.

In each of the three region countries, the basic strategy of agricultural development is formulated by the country's Plan organization, in cooperation with the Ministry of Agriculture, within the context of overall five year plans. All three countries are in the process of undergoing transformation in the status of the economic development process. In view of the need to assure that all the various factors are available to apply the new technology in agriculture, it is particularly important to strengthen the coordination and administration of agricultural programs. A number of deficiencies still remain in the organization and administration of economic development. Following are some areas that need particular attention:

1. Agricultural research needs to be strengthened and focused on areas that will make a maximum contribution to development. In particular, more agricultural economic research is needed as a basis for program planning. Agricultural research in certain region countries is presently characterized by low budgetary support and an inadequate number of qualified personnel. Region countries should consider the use of a high-level national agricultural research body, adequately endowed with funds, with the responsibility to lead and guide the research effort.

2. In some countries of the region, a much more extensive network of extension services needs to be built up and agricultural research needs to be more closely coordinated and linked with agricultural extension.

3. Universities have a major role to play in the agricultural sector. The relationship of the respective ministries of agriculture with the agricultural universities needs strenghtening in all three countries. Universities should be encouraged to do more fundamental research that is relevant to the development process, in addition to providing continuous educational backing for the research and training efforts. This will help provide the necessary elements of suitably trained personnel.

4. A need exists for adequate coordination at the national level in the procurement of certain production requisition for agricultural development and in the allocation of foreign exchange and investment resources to support development.

5. A fuller participation of farmers in the development process needs to be obtained. A major effort should be made to mobilize local participation either cooperative organizations or through broader organizations such as the "Basic Democracies" in Pakistan. Fuller participation of farmers depends to some extent on raising their educational level.

6. Turkey and Pakistan each have recently used a campaign-type approach to introduce new varieties of wheat. Inter-country studies should be made as a means of comparing methods and approaches used in administering the compaigns, shortcomings in the approaches and results.

Regional Cooperation in Agricultural Development

This Panel met on September 13 under the Chairmanship of Mr. Ismail Şener (Mr. B. T. Inman acting as Rapporteur) and submitted the following report which was adopted at Plenary Session.

The three countries have sufficient areas of similarity in agriculture to warrant regional cooperation. Some of the more obvious of these are:

- Rainfall is generally low.
- Soils are eroded.
- Cereals, livestock and cotton are important agricultural products.
- There is a shortage of protein rich crops.
- Surplus of agricultural labor, and insufficient research resources.
- There is also potential for expanding fruit and vegetable production.
- The markets for most commodities are not adequately organized.

The following criteria were enumerated as helpful in selecting areas for cooperation:

- Efficient use of scarce resources. This is particularly important in the use of research resources and could include joint sponsorship of basic and applied research, and sharing of experiences in individual country research.

- Use of complementary raw material resources available in the different countries.
- Economies of scale in production of some inputs.
- Pooling of research resources for areas of research where outside resources are not available.

The following are RECOMMENDATIONS on desirable areas of cooperation:

1. Develop centers and sub-centers to conduct basic and adaptive research on new varieties of wheat and other cereals. This may be implemented with some outside assistance.

2. Develop a procedure for sharing of research experience in cotton production. The competitive position of cotton with other crops, and world demand for various types and qualities of cotton could be usefully studied.

3. Develop regional research on pulses and oil seeds including agronomic,nutritional, and economic aspects.

4. Develop a regional research center on soil and water use development. This would include soil classification, soil fertility, demands of various crops for water, water management, and production of crops with very low water requirement.

5. Develop procedures for sharing research experience on optimum combinations of resources in production of various crops.

6. Ask the national governments to support the improvement of agricultural statistics and timely crop estimates.

7. Consider the advisability of establishing an Agricultural Division in CENTO.

Cooperatives and Other Means of Promoting Production and Distribution of Seeds and Off-Farm and Processing of Agricultural Products

This Panel met on September 12 under the Chairmanship of Dr. M. F. Millikan (Mr. Rhodes acting Rapporteur) and submitted the

following report which was adopted in Plenary Session.

The process of increasing agricultural production in the regional countries in the future will depend largely on increasing the production per unit of area. Therefore, the traditional dependence on land and labor must be changed to include increasing amounts of non-farm inputs, and the increased production for the market will require improvements in the means of marketing.

Considering these basic facts, it is RECOMMENDED that the Governments of these countries give careful consideration to the following activities:

1. Improve the services of farmer groups by:

   a. providing improvements in education for members of cooperatives, training for their leaders and technical guidance to them in the provision of services to farmers;

   b. formation of a cooperative association for the CENTO region to provide high level training and advice to co-operatives, and

   c. provide encouragement and assistance to farmer groups in the distribution of production inputs to farmers.

2. Take steps to insure that production inputs are made available to all farmers at convenient points, considering the means of transportation available to them, utilizing both public and private sales and credit and giving consideration to the desirability of using mobile credit units. Where possible, farmers should have alternative sources of inputs, credit and advice available to them.

3. Assure the availability of adequate supplies of improved seeds and plants through, among other things, contracts with private producers, and also by promoting trade in seeds and plants and systematic exchange of information about varieties among the member countries of CENTO.

4. Promote the establishment of food processing facilities in or near the sources of supply, emphasizing the use of small plants where they are economical.

5. Provide information to existing and potential processors and dealers in agricultural products and production inputs in regard to existing and prospective changes in demand and supplies of these items and give these persons advice on investment opportunities.

6. Study the feasibility of utilizing the military service as a means of increasing the availability of qualified and trained persons to provide technical assistance to farmers, as is now done in Iran.

SUMMARY CONFERENCE REPORTS

The Conference was convened in the conviction that an increase in the rate of growth of agricultural output above levels recently achieved in all three countries of the region is essential if these countries are to reach the targets they have set themselves for accelerated overall growth of their economies. The participants reaffirmed their support of the proposition that the agricultural and industrial sectors are so interrelated and each is so dependent on the other that poor performance in any sector can hold back all the rest. Since the bulk of the labor force is engaged in agriculture in these countries and since agricultural output is generally a major contributor to foreign exchange earnings, the importance of extra effort in the agricultural field is especially great.

Turning to the problem of policies to promote agricultural growth the conference was impressed once more with the fact that no single policy or set of policies acting alone can be successful. Agriculture, like the total economy, is a system of interacting and interdependent forces to all of which governments must pay careful attention if the growth of output is to be accelerated. No one factor whether it be a physical input like seed, water, fertilizer or plant protection, or such elements of the economic environment as prices, costs, credit, and trade, or organizational devices like cooperatives, extension services, farmers unions, or government agencies, or a source of new knowledge such as a research station or a university laboratory holds in itself the key to success in agricultural development. Each of these requires all the others if it is to be effective.

The conference examined the performance of a number of other countries with outstanding records in agriculture like Mexico, Greece,

and Taiwan to see whether lessons applicable to the CENTO countries could be learned from these experiences. They found wide variation in particular solutions from country to country, but observed that in each case all of the elements described above as critical had been dealt with in one way or another. There were important differences in the relative roles of governments, private agencies and cooperatives and the techniques employed for dealing with each of the elements of the system were of many different sorts. But in no case was success achieved by concentrating on one or a few of the critical variables or in the face of poor performance along any one of the many facets of the agricultural system.

AGRICULTURAL PRODUCTION POTENTIAL OF THE REGION

There has been a steady growth in agricultural output in the CENTO region countries, to which new land and water resources as well as increased productivity have contributed. Prospects for bringing new lands under cultivation are limited and future increases in production must come almost totally from more intensive cultivation of present arable lands.

Potentials for increasing production may be assessed by the critical evaluation of experience from within the region as well as from selected developing countries where rapid progress has been made in the past two decades. The CENTO countries can and should participate more fully in the agricultural production revolution that is evolving in other parts of the world from the development and use of new technology together with the more intensive use of the off-farm inputs of fertilizer, pesticides and machines.

The short-strawed, widely-adapted Mexican wheats, with their exceptional capability to utilize high levels of fertilizers to produce yields that are several-fold those of local varieties are already being used in Pakistan and Turkey. These varieties with properly adapted cultural practices, soil fertility and water management, furnish the same potential growth as was achieved in Mexico where national average yields per hectare increased from 750 kilograms in 1945 to 2,600 in 1964.

The rice variety IRRI-8, developed by the International Rice Research Institute, has produced yields of 6,000 to 10,000 kilograms per hectare in the Philippines, and field tests in the past

year furnish evidence of a similar high yield potential of this variety in Pakistan.

Resources in the form of high yielding varieties of all major cereals with wide adaptation, new information and materials for disease and pest control, and knowledge about soil fertility and water management are available for modification through adaptive research. Effectively used, they can bring about fourfold or greater increase in productivity of the major food crops grown under irrigation in the CENTO countries.

Prospects for increasing productivity of non-irrigated wheat, maize, sorghums and millets, and other rainfed crops are similar to those for irrigated crops with excellent possibilities for doubling yields. This can be achieved in many areas through use of higher yielding varieties, improved practices for moisture conservation, soil fertility and pest control. High yielding hybrids and synthetic varieties of maize, sorghums and millets are available from cooperative research in other countries to supply a wide base of germ plasm for testing and adapting to agricultural environments in the CENTO countries.

Practices for weed control and moisture conservation developed in the Pacific Northwest region of the United States could be an important factor in doubling yields of rainfed or dryland wheat in the region.

Major emphasis in developing new technology for increasing production has been placed on the cereals, including wheat, rice, maize, sorghums and millets. Cooperative research to improve productivity of the pulses was initiated in Iran in 1963 and the extension of this project to the other countries in the region would supply potential benefits from the improved practices already identified, which show promise of boosting yields of some pulse crops by 50 to 100 percent.

Little progress has been made in the improvement and production of forage and feed crops in the region. The potentials for rapid and substantial progress from expanded research are, therefore, exceptionally good and regional collaboration in such studies would accelerate progress in development of new materials and practices.

The high yielding new varieties and production practices for the major cereals furnish the base for large increases in productivity

over the next five years as these new inputs begin to be exploited. It is anticipated that this new technology will be a major factor in causing farmers to shift from subsistence to commercial agriculture and to demand not only dependable supplies of essential off-farm inputs but also a continuing flow of new technology. This is the experience in the agriculturally advanced nations as well as in Mexico and some other developing countries.

However, a sustained growth rate of five percent for the next 10 to 20 years will be achieved only if continuing attention is given to development and use of additional new production inputs, through an expanded and strengthened program of production-oriented agricultural science and technology.

The record of achievement in agricultural growth in other countries furnishes encouragement relative to potential in the CENTO region but it also provides guidance on the importance of relevant inputs, policy changes and actions that will be necessary to cause growth to be sustained at the five percent annual increment.

ESSENTIALS FOR AGRICULTURAL DEVELOPMENT

Achievement of the relatively ambitious goals for increased food production will depend largely on positive policy decisions and operational programs in each country relative to:

- the development and application of new technology,
- the availability of off-farm inputs such as improved seed, fertilizers, pesticides, and machines,
- the development of human resources, and
- incentives to farmers, including appropriate price policy, adequate credit, and improved markets.

Significant changes in strategy for agricultural development are occurring in Pakistan and Turkey where greater emphasis is now placed on the new high-yielding cereal varieties and integrated production practices. This productive new technology introduced from Mexico and the Philippines will be a major factor in increased crop output for the next five years. To insure sustained growth beyond that time it will be necessary to provide for a continuous flow of new and more productive materials and knowledge into the region.

The new technology resources from research around the world should be channeled into the CENTO countries on an orderly basis, for evaluation, adaptation and use, through regional research and training projects and centers. The establishment of a regional center for cereals warrants full support and the cooperative project supported by the United States Agency for International Development on pulse improvement, initiated in Iran in 1963, should be extended to the other countries in the region. Joint attention to research on oilseed production, on fibres, on soil and water management and on other commodity or problem areas would accelerate the development of new technology. These projects would require relatively modest investments but should be supplied with well qualified scientific personnel and with modern laboratory and field research facilities.

The high yielding wheat and rice varieties will require higher levels of fertilizer application if production targets are to be achieved. Fertilizer requirements are being recalculated and special attention must be given to meeting the greater demands, including foreign exchange requirements. Other off-farm inputs such as pesticides and machinery must be supplied.

Regional collaboration should be explored for developing supplies of pesticides; in development of laws and regulations to facilitate interchange of fertilizers, pest control chemicals and seeds; and for accelerating increases in seed stocks of new varieties. Special attention will be required to improve marketing and distribution systems for the massive quantities of fertilizers that will be required in this region in future years.

The advent of commercial agriculture will require a specialized competence in research and in extension. Education programs must be designed for training of scientists with conceptual and leadership capability in designing research on factors inhibiting production, as well as for extension personnel who will be required to understand the significance of combinations of new inputs and practices adapted to specific farming conditions. The perpetuation of the usual academic and "training-tour" programs will not suffice and agricultural education more precisely focused on development and change must be substituted.

The association of education programs with the practical or adaptive research programs on improvement of varieties and production practices has been most effective in improving motivation

and in assuming problem orientation of agricultural workers of the developing nations. CENTO agronomists have benefitted from such training at the International Maize and Wheat Improvement Center in Mexico in recent years. The development of similar centers as regional facilities in CENTO countries for improvement of cereals and other commodities would greatly facilitate the training of research and extension specialists for the region.

Special attention is required to the strengthening of national systems of research and education for agriculture to insure the self-help capability for substantial growth that will come more and more in the future from science and technology.

It has been amply demonstrated that farmers respond positively to economic and other incentives, such as support prices for crops, subsidies on inputs, adequate agriculture credit and improved marketing systems. Under certain circumstances, it may be appropriate to use support prices, announced well in advance of planting time, as an inducement to increase production of one or two specific crops. Alternatively, or in addition, it may be appropriate to subsidize certain inputs notably those that are somewhat unfamiliar to farmers. Increased availability of agricultural credit and improved marketing systems are obviously essential items for sustained agricultural growth.

REGIONAL APPROACH

The Conference recognized that the three countries were similar in agricultural resources and farming systems and had many of the same agricultural development problems. It concludes that in certain fields the advantages and economics of a regional approach are great, provided it is used to strengthen national institutions and programs. In other fields the potential benefit and economies may be small but should be explored. The experience of other regions that have used a regional approach might be carefully examined.

RECOMMENDATIONS

The Conference recommendations, both of a regional and national character, are given in detail in the reports of the twelve panels. Those reports also summarize the findings that led to the recommendations.

The panel recommendations calling for regional cooperation have been consolidated and should be considered by each of the region governments.

General Recommendations

As already indicated, the Conference concluded that a regional approach to some of the subjects would lead to increased efficiency and substantial economies and the method of developing the regional approach are important matters of policy.

The following Conference recommendations, which are suggested for the consideration of the Agriculture Ministers, therefore, are primarily concerned with subjects that are believed to merit a regional approach and with means of conducting regional studies and projects on a continuing basis.

1. The region countries should develop regional studies and projects in agricultural research and research training; agricultural education; the production and marketing of seed, fertilizer, pesticides and farm machinery; and in the development of common standards and regulations for agricultural commodities and inputs. The possible benefit of developing the regional approach in such subjects as capital and credit, cooperatives and trade should be carefully examined. The following two recommendations are the most fully developed proposals for a continuing regional approach to major agricultural problems.

2. A continuing Working Party on Agricultural Research should be established with the following terms of reference:

    a. Review current programs and organizations for research and extension education in the region. In this stage of the work, cooperation might be considered with an agency such as OECD.

    b. Assess prospects for regional cooperation to accelerate development and use of new technology and give guidance in determining mission oriented priorities.

    c. Maintain continuing contact with all research centers of the CENTO nations to help in focusing attention on the problems most critical to the region.

d. Serve as a continuing point of contact with research and educational organizations in other parts of the world including International Centers and with 'donor' organizations such as Foundations, Governments and International Agencies, such as FAO and OECD.

e. Review of changing needs for and availability of specific types of research personnel.

f. Review of the need for a formal regional organization to coordinate research activities based upon cost-benefit analysis.

3. A Regional Working Party on Fertilizers should be established with the following terms of reference:

a. Review of total system planning for production and distribution of the three nations and consolidation insofar as feasible into one total system for the region.

b. Review of overall capital requirements and ability to meet these requirements on a mutual basis.

c. Devising methods for (i) Joint research projects, and (ii) research and technology information exchange.

d. Devising methods of mutually solving the tremendous problems of education of teachers, extension personnel, fertilizer dealers and farmers in the proper use of fertilizers.

e. Devising uniform standards of regulation in each country which would protect farmers' interests and would also assist manufacturers of fertilizer in facilitating inter-regional trade.

f. Investigate the possibility of trade arrangements between the three nations for raw materials, finished fertilizer products and other needed items.

g. Review the various successful distribution systems, methods, and economics and act as a clearing house of information on both successful and unsuccessful attempts.

4. The CENTO Secretariat and the Region Countries should examine the need for regional working groups on other subjects, including capital and credit requirements for agricultural development, agricultural economics and planning, and trade in agricultural commodities.

5. CENTO should organize a conference on national and regional livestock, forestry and fisheries development policy in 1968/69 to complement the work of this conference which has concerned itself mainly with crop production.

6. CENTO should establish an agricultural unit within the Secretariat for the closer coordination and better implementation of CENTO's agricultural activities.

7. Each Minister of Agriculture should consider designating a senior officer to handle CENTO Region Affairs. This officer's responsibilities should include a periodic review of the implementation of the recommendations of this and similar conferences that have been endorsed by the governments.

RECOMMENDATIONS OF A REGIONAL ASPECT

After careful consideration of the many and sometimes overlapping recommendations put forward in the panel reports, and conscious of the Organization's present resources, the Conference drew up a consolidated list of recommendations, given hereunder:

Formation of Regional Research and Research Training Units

1. A cereal research and research training center for wheat and other cereals common to the region.

2. The existing research activities in Iran on pulses to be extended to include the requirements of the other region countries.

3. A regional center for soil and water use development.

4. A regional cooperative association to provide high level training in cooperative management.

5. The existing Regional Center in Iran for training in farm mechanization to provide research facilities as well.

Establishment of Specific Working Parties

1. A continuing Working Party on Agricultural Research

2. A Working Party on Fertilizers

3. A Working Party on Seed to examine future supplies of improved seeds and plants, their interchange within the region and connected regional regulations.

4. A Working Party to study the need for a regional research and training center and/or training projects for oilseeds.

5. A Working Party to study the external financial requirements for agricultural development and the ways to meet them in the region countries.

6. A Working Party to study the merits of establishing a Regional Agricultural Export and Marketing Board.

7. A Working Party to study the best usage and means of mechanizing agriculture, including the possibilities of manufacturing tractors, combines and other agricultural machinery within the region.

8. A Working Party to study the safe use and residue tolerances of pesticides.

9. A Working Party on Pests; to study the creation of apparatus for an effective system of exchange of information on occurrences and movements of pests and their natural enemies within the region, and for joint training courses.

10. A Working Party to study the need for a regional research and training center and/or training projects for fibres, particularly cotton.

Recommendations for Consideration by the Appropriate CENTO Body

1. The establishment of an Agricultural Information Center for

the diffusion of information on agricultural research activities, agricultural statistics, crop estimates, and any other agricultural information of interest to the three regional countries.

2. The utilization of military service as a means of increasing the availability of qualified and trained persons to provide technical assistance to farmers, as is now done in Iran.

3. The establishment of an agricultural unit within the CENTO Secretariat for the closer coordination and better implementation of CENTO's agricultural activities.

4. Inter-regional diffusion of information on the methods used in administering, and the results obtained from, the campaign-type approach to introduce new wheat varieties.

Regional Standardization and Regulatory Measures

The Conference felt that much could be done in this field and put forward the following recommendations:

1. The institution of standardized specifications within the region for pesticides, fertilizers and seeds in order to guarantee quality and facilitate exchange.

2. The adherence to a Convention on Quarantine Rules and Regulations to regulate the movement of plant material within the region.

NATIONAL RECOMMENDATIONS

Many recommendations of a general or specific nature of a national character are to be found in one or other of the panel reports. Regional Governments are invited to study these and consider their implementation where appropriate.

Those recommendations which appeared of major importance and priority for the better coordination and development of the region's agricultural activities were singled out from the above consolidated list and appear in the Summary Report prepared for the Regional Ministers of Agriculture.

ACKNOWLEDGEMENTS

The Conference expressed its appreciation and gratitude to the Government of Turkey for acting as host to the Conference and for the generous hospitality extended to the delegates.

The Conference also expressed its thanks to the United States Government for the role it played in organizing and financing the Conference, and its appreciation for the excellent facilities and organization provided.

The Conference adjourned with an expression of appreciation to the Chairman and to the Vice-Chairmen for their leadership and able help towards the smooth working of the Conference; and to the Secretariat for its efficient servicing of the meeting.

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PANEL MEETINGS

AN ANALYSIS OF IRANIAN AGRICULTURE PRODUCTION 1960-1966

BY

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Changes in the main agricultural products of the country will be discussed in this paper. Lack of adequate data on some of the crops limits this discussion to the period between 1960 and 1966. An attempt will be made to describe briefly the significance of the agricultural sector in the economy of the country. This will be followed by an explanation of the technological factors, and economic and government policies causing the changes in agricultural production over this period. Several tables at the end will summarize quantitative data concerning each product.

THE TOTAL VALUE OF AGRICULTURAL PRODUCTS

The amount, changes and the ratio of the total value of agricultural products are indicated in Table 1 below:

TABLE 1
TOTAL VALUE OF AGRICULTURAL PRODUCTS 1960-1965
(In million rials)

Year	Agriculture Added Total Value	G. N. P.	Ratio of Agriculture Added Value to G. N. P.	Percent change over 1960 value
1960	83,200	301,900	27	100
1965	108,600	416,500	25	130

As shown in Table 1 the total agricultural value has increased 30 percent during 1960 to 1965. There has not been a smooth steady rate of growth in agriculture, due to adverse climatic factors during 1962-1963. As might be expected the rate of increase has not been the same for every product. Some crops such as sugar beet and rice have increased by 272 and 48 percent respectively, as compared to milk and eggs which show an increase of 10 and 17 percent. It is worth noting that, because of the rapid progress in the industrialization of the country, while the total value of agricultural products increased in amount, the ratio to Gross National Product has decreased by 2 percent.

Rural Population

According to the general census of 1965 and the agricultural sampling survey of 1960 rural population in 1960 amounted to 14.6 million which was 65.6 percent of the total population of the country. The general census of 1966 indicates that rural population has increased to 15 million and decreased in ratio to the total population of the country by 4.6 percent.

Studies in Iran show that while the country's population has an annual increase of 2.6 percent, the rural population increases annually by 1.7 percent as compared with 4.4 percent in urban areas. The increasing rate of migration from the rural areas to the cities is largely responsible for the higher ratio of increase in urban population.

Labor Force in Agriculture

According to the studies made by the manpower section of the Plan Organization in 1956, 56 percent of the total labor force of the country was engaged in agriculture. This ratio has dropped to 47.6 percent in 1966. Decrease in the ratio of the labor force engaged in agriculture is consistent with the decrease in the ratio of the rural population, but studying the composition of population indicates that most of the rural population migrating to the cities is in the younger age range.

Investment

Unfortunately, there is no reasonable data concerning investment in agriculture by the private sector. However, based on the necessary expenses needed for cultivation some estimates have been made, capital investment as well as variable costs for most of the crops grown in the country. These estimates made by the Plan Organization are shown in Table 2.

TABLE 2

INVESTMENT IN CROP CULTIVATION BY THE PRIVATE SECTOR AND THE GOVERNMENT 1960-1965
(In million rials)

Type of Investment	1960	1961	1962	1963	1964	1965
Government Investment	385	558	773	957	1,625	4,396
Private Capital Investment	16,736	17,428	17,191	16,773	18,459	17,860
Private Current Investment	41,538	42,542	42,609	43,125	44,943	45,805
Total Investment	58,659	60,528	60,572	60,855	65,027	68,061
Percentage Changes of Total Investment Based on 1960 Investment	10.0	103.18	103.76	103.74	110.85	116.02

As shown in the above table, investment in agriculture has been steadily increasing since 1960. This is due to the expansion of the area under cultivation rather than intensification of farming, as no data is available on the extent of the latter.

CHANGES IN TECHNICAL FACTORS

Water and Irrigation

Over the period 1960-1965 some big irrigation projects such as the Mohammad Reza Shah Dam (Des), Amir Kabir Dam (Karadj), Shahbanou Farah Dam (Sefid Rud), and Shahnaz Dam (Hamedan), have been completed. As a result six billion cubic meters of water have been brought under control. Completion of irrigation networks of some of these dams, and the drilling of wells, has resulted in the expansion of the lands under cultivation by 400,000 hectares over the above period. It has also improved the irrigation methods and use of water in another 200,000 hectares previously irrigated.

TABLE 3

TYPES OF AGRICULTURAL CREDIT LOANED BY THE AGRICULTURAL BANK 1960-1965
(In million rials)

Type of Credit	1960	1961	1962	1963	1964	1965
Long-term Credit	389	97	56	583	120	487
Medium-term Credit	390	193	192	150	195	461
Short-term Credit	970	940	1,133	2,594	3,816	4,531
TOTAL CREDIT	1,749	1,230	1,381	3,327	4,131	5,479
Percentage Change Based on 1960 Total Credit Granted	100	90.32	78.95	190.22	236.19	313.26

As shown in the table the amount of credit loaned by the Agricultural Bank has increased 213.26 percent. Most of this credit was loaned on short term basis for farm equipment. These loans had to be paid back within six months or one year.

Farmers' Cooperatives

In 1960 there were 711 farmers' cooperatives with a membership of 293,140 and capital of 151 million rials. The farmers' cooperatives have increased remarkably over the period 1960-1966 and especially since the execution of land reform. By 1965 the number of farmers' cooperatives had increased to 6,066 with a membership of more than 891,807 persons. These cooperatives, with a capital of 686 million rials, have helped farmers with credit, marketing, and purchasing of farm equipment and household goods.

Agricultural Marketing

In general most of the agricultural products in Iran lack an elaborate marketing system. Poor marketing favours only pre-buyers and middlemen and discourages producers because of low income, at the same time discouraging consumption of the products because of high prices. Marketing of agricultural products has to be improved if we are to depart from an economy of self-sufficiency to a commercial economy. Slow improvement in agricultural marketing in Iran is one of major bottlenecks for progress in agriculture. Measures to improve the situation that have taken place over the period 1960-1966 can be summarized as follows:

- Research and study on major agricultural crops have been made in collaboration with the Food and Agriculture Organization experts in Iran.

- Short courses in agricultural marketing have been offered in Hamedan, Rezaieh and Nishabour. Iranian experts in collaboration with those of United States AID and the Food and Agriculture Organization have conducted different classes to train producers as well as the wholesalers, and other people concerned with the marketing of the products.

- Studies have been carried out and preliminary drafts prepared for laws and by-laws concerning the marketing of agricultural products.

- The Bureau of Standardization has standardized some of the export products such as raisins, dried fruits, rice and pistachio nuts.

- Packing of some crops such as dates has been improved.

- Weekly publication of prices of major crops are being issued.

- Canned fruit factories in Azarshahr and Isfahan, Meshad and Khoramshahr, have been expanded and improved.

- Publications concerning import and export of major agricultural products have been issued to encourage investment to build cold-storage for perishable foodstuffs and warehouses for others.

- Two cold stores in Tehran and Khoramshahr have been established by private investers. Preparations to build another in Isfahan are in progress, and establishment of supermarkets in different parts of Tehran, and other major cities, are among other measures being taken.

- Funds have been allocated to complete eighteen cereal elevators, each of 19,000 tons capacity, in ten different parts of the country.

- Preparations have been made to build metal elevators in some wheat producing areas.

Changes in Policy Measures

The most significant policies taken over this period affecting agricultural production are: 1) Implementation of the Land Reform Law which completely changed the land tenure arrangements, 2) establishment of farmers' cooperatives, and 3) substantial increases in the capital of the Agricultural Bank which has been used mostly for short-term loans.

The Land Reform Program

It is certain that the honourable CENTO delegates are fully aware that a sound and profound land reform program is crucial both for economic development as well as for humanitarianism in most of todays' underdeveloped countries with agrarian economies. The land reform program in Iran and its implementation have already been discussed at different international conferences, and as this program must have been brought to your attention previously, I prefer in this paper, to discuss some of the accomplishments and results expected from the land reform program in Iran.

It was estimated that before the implementation of the law the landlord/peasant system operated in more than 55 percent of the farm units. Landless peasants were considered to be tools for farming and had no rights. In broad terms, the tenure arrangements on most of the large and small private holdings alike could not be considered desirable for economic growth and economic democracy.

The share of the products accruing to the respective landlords was either collected directly by the landowner, by agents, or through intermediary renters who sublet to the peasant cultivators. "Standing rent" or a predetermined quantity of produce was exacted in some cases. In the usual Muzars or sharecropping system, the rental share depended on the crop grown, or who supplied the oxen, and extra hired labor, or the fertility of the land, availability of water and a number of local customs. Frequent reference was made to the practice of land, labor, water, work stock, planting, and seeds, each being accredited with one-fifth of the product, but the exceptions to this system were so numerous as to limit its usefulness as a guide. The landlord's share ranged from extremes of 10 percent to 87.5 percent of the product.

Except in a few areas in which effective credit of cooperatives was functioning, interest rates for farmers were extremely high. The

Islamic prohibition against the charging of interest often resulted in the use of artifices to accomplish the same purpose. Pre-buying of grain, for instance, was widely practised. In typical cases, the buyer who may, or may not have been the landlord would buy the tenant's share of the crop two or three months before harvest, paying about one-fifth of the probable market price after the price had recovered following the seasonal decline at harvest time. In about six months, therefore, the lender could receive interest equivalent to 800 percent.

In short the tenure system had these main implications:

- An extremely high percentage of tenancy prevailed in Iran, a condition that was never conducive to high level agricultural production, to the growth of selfreliance among the people, or to the building however slowly, of citizenship responsibility.

- The tenure system contributed very materially to a maldistribution of income that not only penalized the peasants directly, but also prevented the establishment of a middleclass income group. Lack of a middleclass restricted markets and discouraged manufacturers and other producers from expanding output to take advantage of the cost savings of volume production. Thus, as long as there existed no real demand curve, but rather two widely separated demand plateaux, the country was geared to high-cost, high-priced, low-volume, production.

- Despite the existence of comparatively enlightened tenancy legislation, enforcement was lacking, rents were generally high, and the take of intermediaries and money-lenders was out of all proportion to their contribution to production. This, in addition to unfair distribution of income, had contributed to the transfer of funds by the landlords and others from the rural areas to the cities.

- Qualified observers believed that the Iranian peasants were reconciled to their fate and probably posed no serious threat to the established order, although the fact could not be ignored that the sons, and occasionally the daughters, of peasants were receiving more education, going into the army, and otherwise acquiring an independence of judgment that made them capable of reacting against intolerable circumstances.

- Gradual migration of the landlords to the cities during the last century, and the fact that some of the merchants and business-

men in the city had land in the country, because of the prestige attached to owning villages, had given rise to absentee landlord conditions; lack of soil conservation practices, poor farm management, inadequate investments and inclination to change were all noticeable.

On January 6th 1962, at the Farmers' Congress, the Shahanshah Ariamehr, our noble leader, presented six reform articles on which our present social, economic and agricultural developments are firmly founded.

One of the six articles was the Land Reform Law and the abolition of the feudal system in the feudal areas of the country. Originated by His Majesty, The Shah, to promote the social and economic standards of his people, these articles when put to a national referendum were met with great popular support by the whole nation.

The first phase of the land reform program limited holdings of big landlords to one village and provided for the rest of their estates to be divided among farmers who had until then been working on the land. But this phase of the program did not solve the basic problems of tenancy, as the feudal system still persisted in the villages retained by the landowners. Furthermore, the difference created among those who received land and the majority of peasants who had been left without land, was neither fair nor wise. The second phase of the Land Reform Law was put into action.

Three new items were introduced in this phase:

- Based on the last three years average net income of his property, the owner could lease his land for a period of 30 years to the farmers of the same land.

- The owner could sell his land to the farmers of the village upon mutual agreement.

- The owner could distribute the agricultural lands of his holdings among farmers of the village based on the rate of share owned by each.

One other item in the new law called for the formation of agricultural cooperative organizations formed by the farmers and the landowners. Each cooperative was to be directed by three people, one

designated by the farmers, one by the landlords and a third mutually selected by both parties. In the case of disagreement among the parties, the third member could then be appointed by the Ministry of Agriculture.

A statistical supplement to this report illustrates the effective application of the Land Reform Law throughout the country. In view of the short time that this program has been in operation, results are highly satisfactory.

From the beginning of the implementation of the Land Reform Law, January 9, 1962 to this date, 14,834 villages at a purchase price of approximately 8.8 million rials have, in the first phase of distribution, been purchased from landlords, Crown Lands and Public Domains, and distributed among approximately 587 thousand peasant families.

Since the implementation of the second phase of the Land Reform Law, 52,818, almost 99 percent of the villages and farms have been leased to peasants for cash rental for a period of 30 years, or sold to them by mutual agreement, or divided between peasants and owners on the basis of customary ratio of landlord-peasant shares. A brief account of economic and social results obtained from the implementation of land reform may be given as follows:

1. Distribution of land among farmers has brought security of tenure to the farmers in villages.

2. The amount of instalments to be paid by the farmers to the government for distributed lands is usually much lower than the shares which they used to pay to the landlords. Such payment for the land is not a heavy burden on the farmers. The transfer of funds from the rural areas to the urban areas is thus reduced. Moreover, once the farmers have paid for the lands such transfers will stop.

3. Reduced appraisal values of the lands purchased from landlords on the basis of the taxes levied and regional indexes, have been a factor in reducing the highly inflated prices of real estate, and has encouraged investment in agricultural activities.

4. Tenure of land by peasants, as owners, has caused an increase in production of summer cash crops which is a profitable source

of income. In the old system the landlord often did not permit the peasants to produce vegetable crops such as tomatoes and peas etc. as collection and checking of production were rather difficult.

5. As a result of farmers being able to make their own decisions, creation of orchards, woodlots and planting of forage crops such as alfalfa, clover etc. are being increased in the villages. Formerly the landlords did not allow their peasants to produce such crops in order to avoid granting them any "Root Right."

6. Formation of rural cooperative societies has created a feeling of mutual assistance and cooperation among the farmers, and the credit allowed to the peasants by the cooperatives enables them to be independent of advance buyers and pedlars.

7. One of the many results of the land reform program was that it gave stimulus to the rural population to solve and take care of their own problems. This sudden change in the philosophy of the villagers helped the government to widen the scope of its technical and budgetary assistance to the rural people, in order to meet their increasingly growing demands in every aspect of life.

   Farmers have realized the necessity of cooperating, they are learning the wisdom invested in the philosophy of "self-help." It is because of this realization that farmers are participating more in their own community development. According to the data given by the Rural Development Organization, during 1960-1962 just before the execution of the Land Reform Law, farmers invested 55 million rials in 291 projects for village development based on 50/50 percent aid projects granted by the government. During another three years, 1964-1966 in the course of the execution of the Law the farmers invested 128 million rials in 746 village development projects, which is an increase to 240 percent.

8. Table 4 showing loans granted by the Agricultural Bank for drilling wells reveals another indication of better participation by farmers in increasing their products since the execution of the Land Reform Law.

9. The desire to maximize income from agricultural resources has urged farmers to make more effective and appropriate use of fertilizers, insecticides and better planting practices, which have all resulted in a rapid growth in agricultural production.

Farmers' Cooperatives

As was mentioned earlier more than 5,355 cooperatives were formed with 535 million rials capital over this period. Through these cooperatives farmers have been able to purchase, at a lower price, their farm materials such as fertilizer, seeds, and machinery. They have also been successful, in some areas, in establishing a well organized marketing system. Agricultural credit cooperatives have been very helpful in providing farmers with short-term loans. The cooperatives' activities have created a desire to help each other. They have eliminated the pre-buyers and therefore the farmers benefit through the advantages of this action. The cooperatives have provided an organized channel for the government to invest in villages.

Agricultural Credit

The Agricultural Bank, over this period has improved its personnel, and expanded its network and activities to different parts of the country. The capital of the Agricultural Bank has been increased by 200 percent. Contrary to the period before 1960 when most of the credit was given to the large landlords who spent it on non-agricultural activities, since the implementation of the Land Reform Law an average of 85 percent of the loans have been used as short-term credit to enable the farmers to provide their farms with essential materials. Long-term credit projections indicate a growing tendency toward medium and long-term loans requested on the part of the farmer. Therefore, the Agricultural Bank can easily claim a major contribution in the increase in farm products in the country. Table 3 indicates the amount and distribution of credit given by the Agricultural Bank since 1960, Table 4 shows another indication of how the farmers have been using credit provided by the government to drill wells and provide water, the most crucial factor of production in the Middle East.

TABLE 4

LOANS BY THE AGRICULTURAL BANK FOR DRILLING WELLS AND REPAIRING QNATS, 1960-1966

Iranian Year Beginning March 21st	Thousands of Rials	No. of Deep Wells	No. of Semi-Deep Wells	No. of Shallow-Deep Wells	No. of Artesian Wells	Total No. of Wells
1960-61	352,660	92	85	79	14	270
1961-62	278,239	137	546	50	7	740
1962-63	252,062	109	469	127	20	725
1963-64	311,879	250	864	330	15	1,459
1964-65	765,238	264	1,772	620	16	2,672
1965-66	640,183	-	-	-	-	2,202*

* The passage of the Water Rights Bill 1965-66, has limited well drilling practices.

Changes in Agricultural Production, 1960-1966**

In this part information regarding production, yield, consumption, import and export of each agricultural commodity during the six years of the study are reported.

The calculations are based on the following assumptions:

1. The export and import figures are taken from the year book of Foreign Trade of Iran, 1960 to 1966, published by the Ministry of Finance.

2. The amount of seed and planted area in 1960 is based on the agricultural statistics of 1960 and for subsequent years is based on the area under cultivation in each year as reported by the Provincial Agricultural Departments.

3. Due to lack of statistics on annual carryover stocks, this has been estimated and then taken into consideration.

4. Consumption is estimated as production plus import minus export and minus the amount of seed which has been planted in each year.

** All of the information here is based on "Economics of - Iranian Agriculture (1960-1965)", published by the Ministry of Agriculture by Eng. Resa Moghaddam.

5. Population is based on the report of the National Census of Iran in 1957 and estimated with 2.5 per cent rate of increase per annum. (Recent Review by G.O.I. indicates Population Growth Rate is now 2.6 percent).

6. Per capita consumption is based on the total consumption figures divided by the population in each year.

7. The wholesale and retail prices are based on the prices which have been collected by the Agricultural Economic Departments in the provinces of Iran.

8. The value of each product is based on the home production figure multiplied by the wholesale price each year. The 1960 value of each product is considered to be the base value.

TABLE 5

PRODUCTION OF SUGAR BEET, 1960-1966

Year	Production - ton	Index
1960	706,804	100
1961	810,440	114.6
1962	859,592	121.6
1963	866,000	122.5
1964	1,028,000	145.4
1965	1,411,000	199.6
1966	1,975,000	279.4

TABLE 6

PRODUCTION, EXPORT, IMPORT, CONSUMPTION OF TOBACCO, 1960-1965

Year	Production	Export	Import	Consumption
	Tons	Tons	Tons	Tons
1960	16,222	559	72	15,744
1961	18,930	293	54	18,691
1962	18,572	320	4	18,248
1963	11,558	193	1.3	11,366
1964	19,336	188	5	19,153
1965	25,963	95	2.6	25,870

TABLE 7

AMOUNT OF PRODUCTION, EXPORT, IMPORT, CONSUMPTION, POPULATION, PER/CAPITA CONSUMPTION, AVERAGE WHOLESALE AND RETAIL PRICES OF WHEAT

1960-1966

Year	Production Tons	Export Tons	Import Tons	Seed Tons	Consumption Tons	Population	Per/Capita Consumption Kg.	Wholesale Price Rials Kg.	Retail Price Rials Kg.
1960	2,923,657	3	479,480	455,788	2,947,352	20,914,881	140	6.5	--
1961	2,869,119	1.2	182,511	401,200	2,650,430	21,437,753	123	6.65	--
1962	2,754,740	13	138,679	401,180	2,492,227	21,973,692	113	7.86	--
1963	2,468,140	262	135,175	401,190	2,201,863	22,523,039	97	7.41	--
1964	2,622,578	5	526,087	401,220	2,748,340	23,066,112	119	7.95	9.49
1965	3,647,713	0.2	215,259	521,120	3,341,857	23,863,263	141	8.44	9.50
1966	3,963,723	--	219,774	600,000	3,583,497	24,254,864	144	7.9	8.70

In the export and import of wheat the amount of flour and bulgar has been taken into account.

TABLE 8

PRODUCTION, EXPORT, IMPORT, AMOUNT OF SEED, CONSUMPTION, WHOLESALE AND RETAIL PRICE OF BARLEY, 1960-1966

Year	Production Tons	Export Tons	Import Tons	Seed Tons	Consumption Tons	Wholesale Price Rls. per Kg.	Retail Price Rls. per Kg.
1960	808,471	626	24	120,557	687,412	4.18	---
1961	802,343	1,495	2	120,492	480,358	4.28	---
1962	765,292	35	5,000	120,400	649,543	4.36	---
1963	740,442	70	5,000	120,505	624,867	4.71	---
1964	718,439	1,998	6,168	120,602	602,052	5.24	5.73
1965	935,454	361	101	187,090	748,104	5.31	5.8
1966	1,080,400	28	1,443			4.1	4.77

In the export and import of barley the amount of flour and bulgar has been taken into account.

TABLE 9

PRODUCTION, EXPORT, IMPORT, CONSUMPTION, POPULATION,
PER/CAPITA CONSUMPTION, WHOLESALE AND RETAIL PRICE OF RICE, 1960-1966

Year	Production Tons	Export Tons	Import Tons	Seed Tons	Consumption Tons	Per Capita Consumption Kg.	Wholesale Champa Kg.	Price Sadri Rls.	Retail Kg. Champa	Price Rls. Sadri
1960	47,200	562	6,599	35,297	443,740	21	12.15	22.99		
1961	400,000	146	11,286	32,095	399,045	17.6	16.08	25.21		
1962	566,700	79	19,408	41,230	544,799	24	15.2	24.25		
1963	573,973	1,775	933	43,841	529,290	23.5	12.53	24.15		
1964	615,200	9,232	1,369	47,480	570,358	24	13.2	24.58	17.66	27.1
1965	681,335	3,904	47,818	56,777	668,472	28	17.82	25.8	18.37	27.58
1966	700,000	1,449	13,495	60,000	654,046	28	17.50	27.2	19.4	29

TABLE 10

PRODUCTION, EXPORT, IMPORT, AVERAGE WHOLESALE AND RETAIL PRICE OF COTTON

Year	Production Ginned Cotton Tons	Export Tons	Import Tons	Cockers Kg. Rls.	Filestani Kg. Rls.	American Kg. Rls.	Native Kg. Rls.	Native Kg. Rls.
1960	109,398	55,910	19	44	43	41	39	--
1961	125,395	60,921	45	45	44	45	41	--
1962	101,194	52,435	23	42	42	44	40	--
1963	133,993	72,834	8	43	42	44	39	--
1964	121,342	68,624	16	43.19	42	41	38.15	41
1965	147,133	105,575	44	41.88	42.11	39.21	38.51	40.6

TABLE 11

PRODUCTION, EXPORT, IMPORT, CONSUMPTION, POPULATION, PER CAPITA CONSUMPTION OF TEA, 1960-1965

Year	Production Tons	Export Tons	Import Tons	Consumption Tons	Population	Per Capita Consumption Kg.
1960	6,648	134	9,720	16,234	20,914,881	0.77
1961	10,922	367	5,818	16,373	21,437,753	0.76
1962	11,934	51	5,852	17,735	21,973,692	0.80
1963	12,479	25	5,856	18,310	22,523,039	0.80
1964	10,450	27	5,685	16,108	23,086,122	0.69
1965	12,608	339	9,697	22,530	23,663,263	0.90

Vegetable Production

Due to lack of statistics on the production of vegetables and other summer crops from 1961 to 1964, in this report the production figure of 1960, which is based on the Agricultural Census, and the production figure of 1965 which is based on the report of Agricultural Departments have been studied.

The production of vegetables was 194,739 tons in 1960 and has increased to 377,146 in 1965. The average rate of increase was 19 percent per annum.

The figures for foreign trade of Iran shows that export has increased from 1,264 tons in 1960 to 19,833 tons in 1965. The import has decreased from 91 tons in 1960 to 19 tons in 1965.

The per capita consumption has been increased from 10 kg. in 1960 to 15 kg. in 1965.

The value of production was 973,695 thousand Rls. in 1960 and 2,640, 015 thousand Rls. in 1965. The wholesale price was 5 Rls. per kg. in 1960 and 7 Rls. in 1965.

Meat and Milk and Egg Production

The production of mutton and goat meat was 169,000 tons in 1960 and 193,000 tons in 1965, the average rate of increase being 2.8 percent per annum. The production of beef was 60,000 tons in 1960 and 76,000 tons in 1965, the rate of increase being 5.2 percent per annum. The production of hunting meat and pork was 12,500 tons in 1960 and 12,700 tons in 1965.

In this report the different meats have been divided in two categories, red meat which consists of mutton, lamb, pork, hunting meat and white meat which consist of poultry and fish.

The total production of red meat according to the statistics of the Animal Husbandry Organization and the Plan Organization was 241,500 tons in 1960 and 281,700 tons in 1965. White meat was 26,000 tons in 1960 and 48,000 tons in 1965.

Per capita consumption of red meat was 11.5 kg. and white meat 1.3 kg. in 1960 and red meat 12.2 kg. and white meat 2 kg. in 1965.

TABLE 12

PRODUCTION, EXPORT, IMPORT, SEED, CONSUMPTION AND PER CAPITA CONSUMPTION OF PULSES, 1960-1965

Year	Production Tons	Export Tons	Import Tons	Seed Tons	Consumption Kg.	Per Capita Consumption	Wholesale Price Beans	Price Peas
1960	73,174	1,260	1,338	5,623	67,609	3.23	17.4	18.54
1961	85,214	6,503	45	6,591	72,160	3.36	13.447	17.45
1962	91,482	9,827	468	7,000	75,123	3.41	14.37	13.08
1963	102,125	7,561	24	7,300	87,288	3.87	17.53	14.89
1964	100,500	881	211	7,500	92,330	4.	20.52	21.92
1965	112,623	3,679	112	7,800	101,256	4.37	19.1	20.47

TABLE 13

PRODUCTION, EXPORT, IMPORT, PER CAPITA CONSUMPTION, WHOLESALE PRICE AND VALUE OF PRODUCTION, 1960-1965

Year	Production	Export Tons	Import Tons	Consumption Tons	Per Capita Kg.	Wholesale Price Rls.	Value of Production 1000 Rls.
1960	194,739	1,264	91	193,566	10	5	973,695
1965	377,145	19,833	19	357,331	15	7	2,640,013

TABLE 14

STUDY OF THE CHANGES OF PRODUCTION OF FRUIT AND ITS RATIO TO 1960 VALUE
1960-1965

Kind of Product	Production of 1960-Ton	Production of 1965-Ton	Changes 1960-1965 Ton	% Change Ratio 1960-1965	Average % Change per annum
Apple, etc.	60,000	100,000	40,000	50	13.3
Citrus	80,000	110,000	30,000	37	7.5
Apricot, etc.	130,000	200,000	70,000	34	10.7
Dates	280,000	300,000	20,000	14	1.4
Figs, etc.	130,000	150,000	20,000	15	3
Almond	25,000	42,000	17,000	68	13.6
Pistachio	6,000	9,000	3,000	60	12
Walnuts	8,000	15,000	7,000	87	17.4
Grapes	400,000	500,000	100,000	25	5
Olive, and other	131,000	174,000	43,000	32	6.5
TOTAL	1,250,000	1,600,000	350,000	28	5.6

TABLE 15

STUDY OF PRODUCTION, EXPORT, IMPORT, CONSUMPTION, PER CAPITA CONSUMPTION OF FRUITS, 1960-1965

Kind of fruits	Year	Production Tons	Export Tons	Import Tons	Consumption Tons	Production Consumption Kg.
Fresh)	1960	451,000	259	8,458	459,199	22
Fruits)	1965	624,000	1,058	483	623,425	26
Grapes	1960	400,000	1,511	-	398,489	19
	1965	500,000	843	-	499,157	21
Dates	1960	280,000	29,146	4,435	255,340	12
	1965	300,000	27,520	-	272,480	12
Citrus	1960	80,000	30	1,928	81,898	3.9
	1965	110,000	-	371	110,371	4.6

Meat and Milk and Egg Production

The production of mutton and goat meat was 169,000 tons in 1960 and 193,000 tons in 1965, the average rate of increase being 2.8 percent per annum. The production of beef was 60,000 tons in 1960 and 76,000 tons in 1965, the rate of increase being 5.2 percent per annum. The production of hunting meat and pork was 12,500 tons in 1960 and 12,700 tons in 1965.

In this report the different meats have been divided in two categories, red meat which consists of mutton, lamb, pork, hunting meat and white meat which consist of poultry and fish.

The total production of red meat according to the statistics of the Animal Husbandry Organization and the Plan Organization was 241,500 tons in 1960 and 281,700 tons in 1965. White meat was 26,000 tons in 1960 and 48,000 tons in 1965.

Per capita consumption of red meat was 11.5 kg. and white meat 1.3 kg. in 1960 and red meat 12.2 kg. and white meat 2 kg. in 1965.

TABLE 17

STUDY OF THE CHANGES IN ANIMAL PRODUCTS
1960-1965

Kind of Production	Production 1960-Ton	Production 1965-Ton	Changes Ton	Percentages Total	Percentages Average
Mutton	169,000	193,000	24,000	14.8	2.8
Beef	60,000	76,000	16,000	26.6	5.3
Hunting meat	12,000	12,000	-	-	-
Pork	500	700	200	40	8
Fish meat	20,000	25,000	5,000	25	5
Caviar	150	150	-	-	-
Poultry	16,000	23,000	7,000	44	8.8
Egg	41,000	48,000	7,000	17	3.4
Milk	1,500,000	1,650,000	150,000	10	2
Honey	2,000	3,000	1,000	50	10
Silk	1,550	1,500	-	-	-
Sheep wool	25,000	35,000	10,000	40	8
Camel wool	6,000	6,000	-	-	-
Sheep skin-pieces	7,600,000	9,700,000	2,100,000	27	5.4
Cow skin-pieces	500,000	600,000	100,000	20	4
Intestine	7,850,000	9,700,000	1,850,000	23	4.6
TOTAL TONS	1,853,200	2,073,350	220,150	12	2.4
Pieces	15,950,000	20,000,000	4,050,000	26	5.4

The wholesale price of mutton was 45 Rls. in 1960 and 67 Rls. in 1965. The wholesale price of beef was 32 Rls. per kg. in 1960 and 45 Rls. in 1965. The price of poultry was 60 Rls. in 1960 and 74 Rls. in 1965 the price of fish meat was 50 Rls. in both years. The price of fish meat from the Caspian Sea was 80 Rls. per kg. and the fish meat of the Persian Gulf was 35 Rls. per kg.

There are about 150 tons of Caviar produced every year in the Caspian Sea area. The average wholesale export price was 140 Rls. per kg. in 1960.

The production of milk was 1,500,000 tons in 1960 and 1,650,000 tons in 1965. The average rate of increase of production was 2 percent per annum. The price of milk was 7 Rls. in 1960 and 75 Rls. in 1965.

The production of eggs was 41,000 tons in 1960 and 48,000 tons in 1965.

STATISTICAL SUPPLEMENT

The following is data on the executive activities of the first and second phases of the Land Reform Law since the inception of the program on January 6, 1962:

First Phase

- 14,834 villages have been purchased and turned over to the farmers.
- 587,566 families of farmers have become landowners.
- there are 2,918,283 persons in the above families.
- the value of the lands purchased was 8,878,595,462 rials.

Second Phase

- 202,359 petty landowners leased their lands.
- 1,076,775 persons became leaseholders.
- 3,220 persons were landowners who upon mutual agreement with the farmers sold their lands.
- 45,985 farmers purchased land.
- 14,187 farmers sold their portion of land to the landlords.
- 4,392 landlords purchased the above portions.
- 7,346 villages have formed joint cooperative units.
- 725,525 mechanized agricultural farm units have not been covered by the Land Reform Law.

- the legal situation of 2,315,950 farmer families has been settled. This represents 11,415,236 persons.

Up to May of this year in the executive part of the second phase of the Land Reform Law covering 530,748 villages and 17,962 farmlands, 99.5 percent of the target had been attained, i.e. 19,644 farmlands and 520,818 villages had been distributed, and only the position of 218 of the former and 922 of the latter remained to be clarified.

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ANALYSIS OF NATIONAL AGRICULTURAL PRODUCTION IN PAKISTAN

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In this paper an attempt has been made to analyse the trend in agricultural production since the year 1947-48. Various factors contributing towards increasing productivity in agriculture have also been discussed. A brief review has also been made of the present state of agriculture in Pakistan and of the role it plays in the overall development of the economy so that analysis of agricultural production could be appreciated in proper perspective.

AGRICULTURE IN PAKISTAN

Agriculture is the basic industry in Pakistan which employs about 75 percent of the civilian labour force. It also accounts for about 85 percent of the total export earning and contributes about 46 percent to the Gross National Product. About 87 percent of the population lives in the villages and are dependent on agriculture in one way or the other. Agriculture in Pakistan suffers from underproduction both in terms of yields per worker and per unit area. With the heavy dependence on agriculture for livelihood and consequent pressure of population on land, availability of land per agriculture worker in Pakistan has been quite low i. e. 3. 33 acres (in East Pakistan 1. 51 acres and in West Pakistan 5. 53 acres). As a result, income from the farm has not been adequate to provide the farmers with the basic necessities of life. Development of agriculture has, therefore, been very essential to ensure economic well-being of the large farming populace. Apart from such humanitarian consideration, development

of agriculture has been required to facilitate steady growth and development of industries, which in turn could ensure increasing supply of consumer goods to the farmers so as to provide the latter a strong incentive to boost agricultural production.

CHARACTERISTICS OF PAKISTAN'S AGRICULTURE

Pakistan has a total geographical area of 233.9 million acres, East Pakistan having 35.3 million acres and West Pakistan 198.6 million acres. Despite vast differences between the landed area of the two Provinces which is roughly estimated to be in the ratio of 1:5.7 the difference between cultivated areas of the two Provinces is not much; the ratio is only 1:2.1. In East Pakistan, with her rich deltaic soil, aided by heavy annual precipitation averaging about 69 inches and pressed by a heavy population, intensity of land use has gone up to 93.9 percent. West Pakistan lies in an arid and semiarid zone and has scanty rainfall with average annual precipitation being 13 inches which ranges from about 4 inches in the southern to 34 inches in the northern regions; raising of crops in that Wing is mostly dependent on artificial irrigation systems except in the hilly regions in the north which are rainfed. Vast tracts of land in West Pakistan are still to be brought under cultivation and accordingly the intensity of land use has been only 61.2 percent.

PATTERN OF LAND UTILIZATION

A review of area statistics shows a rising trend since 1947. During the year 1947-48 the total cultivated area of Pakistan was 58.3 million acres which rose to 69.7 million acres during 1965-66. The increase in the total cultivated area was mostly confined to the Western Wing because of the larger availability of culturable waste there. The total cultivated area in that Wing was 36.3 million acres in 1947-48 and it rose to 47.4 million acres in 1965-66 as against 22.0 million and 22.3 million acres in East Pakistan for the respective years. Besides increase in the total cultivated area, the total cropped area also increased significantly. During 1947-48 it was 54.0 million acres but it increased to 68.8 million acres by the year 1965-66 showing an increase of 27.8 percent. Increase in cropped acreage has been registered in both the Wings of the country. Intensity of cropping also went up accordingly. In East Pakistan it increased from 130.2 during the year 1947-48 to 136.8 during the year 1965-66 and in West Pakistan

it increased from 108.9 to 112.9 during the same period. The area sown more than once, which was only 8.2 million acres during the year 1947-48, also rose to 12.4 million acres during the year 1965-66.

CLASSIFICATION OF CROPS

The various crops raised in Pakistan may be divided into four main crops, namely foodgrains, cash crops, oil seeds and others i.e. pulses, fruits, vegetables, etc.

An analysis of total acreage shows that during 1947-48, 65.2 percent of the total cropped area was under foodgrains, 11.3 percent under cash crops 3.2 percent under oil-seeds and 20.3 percent under others. With few exceptions the percentage distribution as stated above has practically remained static over years as is evident from the previously mentioned percentages. This is also indicative of the predominance of foodgrains in the cropping pattern of the country, followed by cash crops.

The increase in the cropped acreage of 1965-66 over that of 1947-48 was 28 percent in case of foodgrains, 34 percent in cash crops, 12 percent in oil-seeds and 26 percent in vegetables, fruits and others. This shows that the increase in respect to cash crops has been highest followed by foodgrains. The prominence of cash crops may be assigned to greater demand by the expanding industries as well as for export which assured more economic return from the cash crops.

PATTERN OF AGRICULTURAL PRODUCTION

A review of agricultural production of the country for the period 1947-48 to-date shows a rising trend for almost all the crops, particularly foodgrains and cash crops. A brief description of each group is given.

Foodgrains

Rice - Rice occupies about 80 percent of the cropped areas in East Pakistan and about 11 percent in West Pakistan. The total acreage under rice in Pakistan increased considerably during the period under review. This is partly due to new area brought under plough and

partly due to transfer of certain land from other crops to rice. During the year 1947-48 the area under rice was 20.96 million acres. The acreage under the crop during the year 1966-67 rose to 25.90 million acres, showing a rise of 23.5 percent. The production rose to 10.77 million tons this year as compared to 7.42 million tons in 1947-48, showing an increase of 45.1 percent. Increase in production generally was, however, more than increase in acreage which indicates that various improved inputs contributed towards increased per acre yield. With the introduction of high-yielding International Rice Research Institute (Manila) variety the increase in production is likely to register a sharp rise in the years to come. The quin-quenniumwise area and production of rice during 1947-48 to 1966-67 are as follows:

Average of	In thousand acres *	In thousand tons
First quinquennium (1947-48 to 195152)	21,835	7,988
Second quinquennium (1952-53 to 1956-57)	22,716	8,390
Third quinquennium (1957-58 to 1961-62)	23,789	9,385
Fourth quinquennium (1962-63 to 1966-67)	25,695	11,100
1966-67	25,897	10,767

Wheat - Wheat is grown almost wholly in West Pakistan. During 1947-48 the total area under wheat was reported to be 9.85 million acres which rose to 14.18 million acres during 1966-67, indicating an increase of 44.9 percent. Wheat production also increased from 3.32 million tons to 4.12 million tons during the same period, showing a rise of 23.9 percent indicating thereby that yield per acre did not increase. This trend of decrease in yield per acre appears to be due to the adverse effects of waterlogging, salinity and drought. Production is, however, likely to register a sharp rise as the existing varieties are gradually replaced by the newly introduced high-yielding Mexican varieties of wheat. The area and production of wheat during the period 1947-48 to 1966-67 were as follows:

* 2.47 acres = 1 hectare

Average of	In thousand acres	In thousand tons
First quinquennium (1947-48 to 1951-52)	10,422	3,627
Second quinquennium (1952-53 to 1956-57)	10,732	3,221
Third quinquennium (1957-58 to 1961-62)	11,926	3,793
Fourth quinquennium (1962-63 to 1966-67)	13,127	4,180
1966-67	14,188	4,121

Other foodgrains - During the year 1947-48 the total acreage under other foodgrains namely, maize, sorghum, millets and barley, which are grown mainly in West Pakistan, was 4.46 million acres and the production 0.99 million tons. The area as well as production of these crops was reported to be 5.3 million acres and 1.3 million tons respectively in the year 1965-66, showing an increase of 18.8 percent and 31.3 percent respectively over the year 1947-48. The increase in acreage as well as production has been mainly confined to maize. These crops, however, are considered as coarse foodgrains and any increase in their acreage and production has been mainly due to the shortage of principal foodgrains in the country.

Cash Crops

Cotton - Cotton is one of the important foreign exchange earning crops of Pakistan ranking next to jute. About 98 percent of the area under this crop is in West Pakistan of which 87 percent is under Pak Upland type and 13 percent under Desi (indigenous variety). The remaining 2 percent of the area is in East Pakistan where Comilla Desi variety is raised. While in East Pakistan cotton is grown in rain-fed areas, in West Pakistan 98 percent of the area is irrigated. With increased demand from the growing textile industries in the country as well as for export both the area and production of cotton have increased. While in 1947-48 the area was 3.1 million acres and production 1.06 million bales, by 1966-67 the acreage rose to 3.98 million acres (i.e. 28.1 percent increase) and production to 2.57 million bales (i.e. increase of 47.8 percent). The following table will show the area and production during 1947-48 to 1966-67:

Average of	In thousand acres	In thousand tons
First quinquennium (1947-48 to 1951-52)	3,002	1,236
Second quinquennium (1952-53 to 1956-57)	3,347	1,652
Third quinquennium (1957-58 to 1961-62)	3,413	1,707
Fourth quinquennium (1962-63 to 1966-67)	3,716	2,300
1966-67	3,875	2,573

Jute - Jute is the principal foreign exchange earner of Pakistan. For this very reason it is termed as "Golden Fibre." Its cultivation is confined to East Pakistan. The area under this crop was 2.06 million acres in 1947-48 which rose to 2.16 million acres in 1966-67. The production, however, went down from 6.84 million bales to 6.40 million bales during the same period. The competing crops of jute are autumn rice and sugarcane. With increase in the acreage under rice and sugarcane due to the 'Grow More Food Campaign' as well as to higher market prices the area and production of jute has continued to fluctuate from year to year as in evident from the table below:

Average of	In thousand acres	In thousand bales
First quinquennium (1947-48 to 1951-52)	1,797	5,598
Second quinquennium (1952-53 to 1956-57)	1,396	5,422
Third quinquennium (1957-58 to 1961-62)	1,609	5,836
Fourth quinguennium (1962-63 to 1966-67)	1,867	5,818
1966-67	2,165	6,400

Sugarcane - At the time of Independence, Pakistan was a net importer of sugar. Vigorous efforts were made to increase the production of

sugar by establishing more sugar factories and the cultivation of sugarcane has thus gone up rapidly. The area under sugarcane was 0.69 million acres in 1947-48 which rose to 2.02 million acres in 1966-67, showing a spectacular increase of 192.7 percent. The production of cane has also registered a sharp rise during this period. While its production was 8.71 million tons in 1947-48, it increased to 29.71 million tons during 1966-67, thereby indicating a phenomenal rise of 241 percent. The following table will show the area and production of sugarcane from 1947-48 to 1966-67:

Average of	In thousand acres	In thousand tons
First quinquennium (1947-48 to 1951-52)	713	9,522
Second quinquennium (1952-53 to 1956-57)	916	12,197
Third quinquennium (1957-58 to 1961-62)	1,324	15,814
Fourth quinquennium (1962-63 to 1966-67)	1,733	25,592
1966-67	2,018	29,705

With the increased availability of sugarcane the production of sugar also rose from 35,919 tons in 1948-49 to 465,366 tons in 1965-66. And Pakistan has by now become self-sufficient in sugar production and has even developed some export potentials.

Tea - Tea, an important commercial crop, is grown in East Pakistan only. The acreage and production of tea show a rising trend since 1947-48 when its acreage was 70,000 acres and production 28.10 million pounds which rose to 95,000 acres and 64.50 million pounds respectively during 1966-67. The acreage has, therefore, increased by 35.7 percent and production by 123 percent during this period. The increase in the acreage and production has been more rapid from 1959-60 onwards which is due to the renovation of depleted gardens and government's compulsory program of 3 percent annual increase in the area. One of the factors for increase in production has been the increased yield per acre which was 4.9 maunds in 1947-48 and rose to 8.3 maunds during 1966-67. The area and production of tea during 1947-48 to 1966-67 are given below:

Average of	In thousand acres	In million pounds
First quinquennium (1947-48 to 1951-52)	73	37
Second quinquennium (1952-53 to 1956-57)	75	53
Third quinquennium (1957-58 to 1961-62)	77	51
Fourth quinquennium (1962-63 to 1966)	88	59
1966-67	95	64.5

Tobacco - Tobacco is another important cash crop and grown in both Wings. As a result of increasing demand from the cigarette industries with consequent rise in prices the acreage and production of tobacco has gone up rapidly since Independence. The acreage increased from 161,000 acres in 1947-48 to 253,000 acres in 1965-55 i.e. a rise of 57.1 percent. The production rose from 132 million pounds to 302 million pounds during the same period, showing a phenomenal increase of 129 percent. This increase has been registered mostly in West Pakistan. The area of production of tobacco during 1947-48 to 1966-67 are given below:

Average of	In thousand acres	In million pounds
First quinquennium (1947-48 to 1951-52)	171	152
Second quinquennium (1952-53 to 1956-57)	195	186
Third quinquennium (1957-58 to 1961-62)	203	207
Fourth quinquennium (1962-63 to 1966-67)	231	248
1966-67	251	N. A.

Oil-Seeds

The area under various oil-seeds was estimated to be 17.19 lakh acres during 1947-48 and production 3.25 lakh tons which rose to 19.03

lakh acres and 3.64 lakh tons respectively during 1965-66. The area thus rose by 10.7 percent and the production by 12.0 percent. However, the area and production of rape seed and mustard, sesamum and linseed did not show much improvement and indicated only a slight increase over 1947-48 in spite of greater demand. It was mainly due to the fact that these crops are very susceptible to pests and diseases and economic returns are also comparatively lower. The production of ground-nuts and castor seeds has, however, showed a remarkable increase. The reason for this increase is that these oil-seeds have some commercial uses and with the establishment of various industries the demand for them is continually on the rise.

Others

Pulses - The area and production of pulses has not shown much improvement. The total area under pulses was 17.15 lakh acres during 1947-48 which rose to 18.73 lakh acres during 1965-66. The production of pulses which was 4.38 lakh tons came down to 3.95 lakh tons during the same period. While the area under the crops has somewhat increased the production has slightly gone down. The increase in area works out to be 9.2 percent while the decrease in production comes to 9.8 percent. The reason for the downward and erratic trend in area and production of pulses may be assigned to diversion of area to more remunerative crops and cultivation of pulses on comparatively poorer lands which, coupled with seasonal variations, affected production of pulses.

Vegetables

Potato - Cultivation of potatoes has gained importance during the past decade. Prior to 1955-56 area and production figures for the crop were not maintained separately in East Pakistan. Figures of West Pakistan show that the area under the crop during 1947-48 was only 7,000 acres which increased six times by the year 1965-66 when it was 42,000 acres and production during the same period rose from 0.76 million maunds to 4.11 million maunds. In East Pakistan the area went up from 64,000 acres in 1955-56 to 150,000 acres in 1965-66 and production from 3.38 million maunds to 17.5 million maunds during the same period.

Other vegetables - The total area under other vegetables shows somewhat of a downward trend. The total area in 1947-48 was reported at 719,000 acres which went down to 567,000 acres during 1965-66. The same is true of production which was reported to be 41.1 million

maunds during 1947-48 against 40.7 million maunds during 1965-66. The decline in acreage and production may be attributed to the fact that the area under vegetables was diverted to higher paying crops.

Fruits

No statistics in respect to area was maintained up to the year 1957-58. However, the available data from 1957-58 onwards shows a tremendous rise in both the acreage and production of fruits. The total area under fruits during 1957-58 was 180,000 acres which increased to 693,000 acres during 1965-66, showing an increase of 285 percent. The production of fruits has also continued to increase simultaneously in both the Wings mainly due to bearing of newly planted fruit plants. The total production of fruits went up from 23.1 million maunds in 1957-58 to 78.2 million maunds in 1965-66, indicating an increase of 238.5 percent.

ANIMAL HUSBANDRY PRODUCTION

Livestock plays an important part in the development of a balanced agriculture and it accounts for about 21 percent of the entire value added to agriculture. Improvement of this sub-sector was accorded due emphasis to improve the dietary level of the people as well as to ensure increased draft power. Due to various development measures the value of livestock products increased from Rs. 2,975 million in 1947-48 to Rs. 4,248 million in 1966-67, registering a rise of 43 percent.

FISHERIES PRODUCTION

Fisheries products constitute about seven percent of the total value added to agriculture. Pakistan has large fisheries resources, both inland and marine. Development of fisheries has been taken up both by the Central and Provincial Governments. As a cumulative effect of various development efforts, the value of fisheries products rose from Rs. 866 million in 1947 to Rs. 1,382 million in 1966-67, in increase of about 60 percent. The production of fish went up from 2.43 lakh metric tons in 1952 to 4.12 lakh metric tons in 1966, showing a rise of 69.5 percent. Foreign exchange earnings from the export of fish and fish products increased from Rs. 12.3 million to Rs. 82.0 million during the same period indicating an increase by about 567 percent.

FORESTRY PRODUCTION

Pakistan at present has 10.3 million acres of land under forests which constitute about 4.5 percent of the total land area. Forest products also contribute about 0.7 percent of the gross value added to agriculture. Various measures have been undertaken by the government to develop the forest wealth of the country. As a result, the total area under forest increased from 6.4 million acres in 1947-48 to 10.3 million acres in 1965-66, showing a rise of 60 percent. The value of forest products rose from Rs. 71 million to Rs. 150 million during the same period, indicating a more than 100 percent increase.

TOTAL VALUE OF AGRICULTURAL PRODUCTS

Total value of agricultural products including livestock, fisheries and forest products rose phenomenally from Rs. 14,669 million in 1949-50 to Rs. 22,629 million in 1966-67, showing an increase of 54.3 percent. The Gross National Product, on the other hand, increased by 84.7 percent during the same period, indicating thereby a comparatively higher growth rate in other sectors of the economy, especially in manufacturing. Accordingly, the contribution of agriculture to Gross National Product fell from 60 percent during 1949-50 to 45.7 percent during 1966-67. This decrease has been quite steady throughout the post-independence years, which is a healthy sign of economic growth as economy is being gradually diversified and thereby strengthened.

FACTORS CONTRIBUTING TOWARDS INCREASED AGRICULTURAL PRODUCTION

Increased agricultural production has been achieved in Pakistan mainly as a cumulative effect of judicious policies vigorously pursued by the government to ensure a greater supply of various production requirements to the farmer and to provide increasing expectations of higher economic returns for rapidly raising his output.

Agriculture in Pakistan was a victim of centuries of neglect. Even in the early period of Independence not much headway could be achieved in increasing productivity. Apart from the bottlenecks in the administrative setup inherited from the foreign rulers which was not properly attuned to the developing needs of this newly emergent nation, various existing socio-economic and political organizations

were not conducive to achieving the desired pace of development. It was only during the post-revolution era under the dynamic leadership of President Ayub, which also coincided with the Second Plan period, that new frontiers were explored to evolve an agrarian and administrative setup which could bring about accelerated momentum in agricultural development.

In the following paragraphs a review has been made of the various important factors affecting increased national agricultural production. These factors have been discussed under the following three broad categories: 1) New Farming Technology, 2) Economic Factors, and 3) Government Policies and Administrative Measures.

It may, however, be added that such broad categorization is beset with some practical difficulties as the various factors are closely inter-linked with one another.

INFLUENCE OF NEW FARMING TECHNOLOGY

Technological innovation in agriculture through the application of fertilizers, introduction of higher yielding and disease-resistant crop varieties, plant protection measures, improved farm machinery and appliances etc. has greatly contributed towards increased agricultural production.

Fertilizers - The use of fertilizer was quite insignificant in the early fifties. As a result of vigorous extension drives to popularize its use, coupled with liberal import and increasing internal production, the consumption of fertilizer has been rising rapidly. The government has been heavily subsidizing the sale of fertilizers to the extent of 35 to 50 percent of its sales value which has provided great incentives to the farmers to use fertilizer. The amount spent by the Central Government on subsidy to fertilizer rose from Rs. 7.7 million in 1955-56 to Rs.78.3 million in 1966-67. As a result of various promotional measures the consumption of fertilizers in terms of nutrients increased from 1.31 lbs. per acre in 1959-60 to 5.27 lbs. in 1965-66.

Improved seeds - A number of high-yielding and disease-resistant crop varieties have been evolved by agricultural scientists during the last 20 years. The production of improved seeds has been greatly increased through the establishment of a large number of seed farms and through registered growers. Supply of seeds has been greatly accelerated

through Agricultural Development Corporations. Seeds of high yielding International Rice Research Institute rice (giving yield between 75-100 maunds per acre) and Mexican Wheat (with yield upto 60 maunds per acre) have been improved and a vigorous extension drive undertaken to popularize these varieties.

Plant protection - There was practically no plant protection service at the time of Independence. The Provincial Governments were only doing some propaganda and demonstration work. It was only from 1953 that large-scale pest control was organized by the Central and Provincial Governments by pooling their resources. Increasing emphasis has since been given to expand these services. As a result, the area covered by plant protection services rose from 2.00 million acres in 1954-55 to 6.5 million acres in 1965-66.

Mechanized appliances - Mechanized farming is being increasingly encouraged by the government to bring to the progressive farmers the benefits of modern technology. East Pakistan having predominance of small holdings, hand-operated tillers are being encouraged there. In West Pakistan, the size of holding is somewhat bigger and the amount of virgin land to be brought under cultivation large. Accordingly, the pace of introducing mechanized appliances has been greater. The Agricultural Development Bank, aided by an International Development Association credit, worth 27 million dollars has contributed greatly towards rapid mechanization of agriculture in the country.

Irrigation - Desirable increase in agricultural production could not be achieved unless a controlled supply of irrigation water is assured to the farmers. A number of dams like Ghulam Muhammad Barrage, Guddu Barrage, Taunsa Barrage, Kotri Barrage and Warsak Dam have been constructed during the post-independence period. A number of other dams are in the various stages of construction. The Indus Basin Project, which comprises construction of two dams, namely, Mangla on the river Jhelum and Tarbela on the river Indus, has also greatly facilitated assured supply of irrigation water. The construction of Mangla Dam has already been completed and the work on Tarbela Dam is progressing satisfactorily.

Similarly, in East Pakistan a number of irrigation projects have been started, of which the Ganges Kobadak Project, Teesta Barrage, Monu River Project, Dacca-Narayanganj-Demra Irrigation Project etc. may be mentioned; some of them have alreday been completed. Furthermore, the Ground Water Development and Pump Irrigation

Project completed in 1965-66, will irrigate about 1.86 lakh acres in the northern districts of East Pakistan. The East Pakistan Agricultural Development Corporation has also a large fleet of power pumps numbering about 4,000 units to irrigate mostly the area under rice.

As a result of vigorous implementation of irrigation development programs, the irrigated areas have increased phenomenally from 21.55 million acres in 1947-48 to 28.69 million in 1964-65.

Reclamation and drainage - In West Pakistan, due to extensive networks of irrigation canals without corresponding development of facilities for drainage gave rise to menacing problems like waterlogging and salinity. About 0.7 to 1.0 lakh acres of rice irrigated lands are thus going out of cultivation annually. Vigorous efforts have, therefore, been launched by the government to recover these lands through large scale installation of tubewells and construction of drainage canals, both open and undergorund. For reclamation of these affected area, Salinity Control and Reclamation Project (SCARP) was initiated in 1959. It has been spread over a number of project areas under which thousands of tubewells were installed. As a result, the water level in the affected areas is going down rapidly and more areas are once again being made fit for cultivation. Furthermore, tubewells have also ensured an increased supply of water for irrigation purposes and accordingly, the crop productivity in the project areas is going up phenomenally.

ECONOMIC FACTORS

Credit

The farmers are increasingly being advanced agricultural credit for purchase of their various production requirements. This has been all the more essential in view of the meagre savings available with our farmers for reinvestment. Institutional sources of credit were hardly in existence at the time of Independence. Taccavi loan (state credit) was no doubt being supplied but that too was inadequate and mostly to meet the emergency needs of the farmers. Cooperatives were not properly developed. It was only during the Second Five Year Plan period that a real breakthrough was attained in the field of agricultural credit. The Agricultural Development Bank of Pakistan was established during 1960-61 by merging the former Agricultural Development Finance Corporation (established in 1952) and Agricultural Bank of

Pakistan (formed in 1957). The loan operation of the Bank was streamlined and simplified to facilitate speedy loans to farmers. Credit has been linked with marketing. The bank also ensures that loans advanced by it are productively used. The bank with its 114 offices advanced about Rs. 678.6 million up to March, 1967. The amounts advanced by it rose from Rs. 70.5 million during the First Plan to Rs. 396.8 million during the Second Plan, showing an increase of about 463 per cent. Furthermore, an International Development Association (IDA) credit worth 27 million dollars was arranged for the bank to finance the foreign exchange component of loans for importing agricultural machinery.

Increased quantum of state credit (Taccavi) was advanced to the farmers to rehabilitate them at the time of distress as well as to supply production requirements. During 1949-50 Rs. 6.7 million was supplied as Taccavi loans which increased to Rs. 59.6 million during 1964-65.

The development of cooperatives has also contributed much towards raising crop productivity. The cooperative movement has been strengthened and revitalized so as to enable the Cooperative Societies to meet the growing requirements of the farmers for production credit. The State Bank of Pakistan has been supplying credit on a gigantic scale to the Agricultural Development Bank and Cooperatives for subsequent loaning to the farmers. The total amount sanctioned to these two institutions was Rs. 416.3 million during 1965-66 (ADBP Rs. 222.0 million and Cooperatives Rs. 194.3 million). Apart from supplying agricultural credit, the Cooperative Societies have afforded opportunities to the farmers for adopting improved farming practices and for better marketing of their crops.

Economic Returns from Crops

The government is particularly conscious that the farmers must be assured fair returns from crops to induce them to increase crop productivity. Accordingly, statutory minimum prices for major exportable commodities like jute have been fixed. The pruchase prices of sugarcane, another important cash crop, has been fixed by the government so that the farmers get economic returns for this commodity. Procurment prices of the major food items like rice and wheat have also been raised by the government to ensure better returns to the farmers. The higher procurement prices of wheat and rice, which have recently been fixed, will be operative for a period of three

years which will ensure better returns over a longer period.

Better Marketing and Storage Facilities

The Department of Marketing Intelligence and Agricultural Statistics in the Center and Agricultural Marketing Directorates in the Provinces are running training programs in handling products of different commodities and in introducing grading of wool, hair, hides, skins, etc. which are mainly exported. Storage facilities for agricultural products, especially food crops, have been greatly expanded, particularly in the public sector. A large number of cold storage plants have been established in the private sector. This has insured an even supply of the commodities stored and assured higher returns to the growers. Liberal credit facilities have been arranged for establishing more cold storage plants. Similarly, marketing structures are also being reorganized to offer better marketing facilities to the growers. A number of regulated markets have so far been established to facilitate organized marketing of the farm products.

State Subsidy

It has been duly recognized by the government that in order to encourage improved methods of farming various production requirements of the farmers should be made available to them at subsidized prices at the initial stages. Accordingly, the main production inputs like fertilizer, seed, etc. are made available to the farmers at subsidized costs. Plant protection services are rendered free of cost.

Fiscal Policies

The government has adopted fiscal policies to help farmers get economic returns from their produce. Export duties on major crops have been drastically reduced so that these benefits could accrue to the growers. Accordingly, the export duty on cotton which was ranging between Rs. 40 to Rs. 300 per bale during 1948-49 to 1950-51 was reduced to Rs. 10 per bale from 1964 onward. Similarly, export tariff on jute, which varied from Rs. 15 to Rs. 35 during the years 1947-48 to 1951-52, was lowered to Rs. 10 from 1964 to-date. Export of tea, hides, skins and wools has been exempted altogether from the payment of export duty.

GOVERNMENT POLICY AND ADMINISTRATIVE MEASURES

The First Five Year Plan, made the first concerted move to identify the correct strategy for agricultural development and planned efforts were initiated; but due to organizational drawbacks and lack of proper policy directions not much progress could be achieved during that period. During the Second Five Year Plan and onwards development of agriculture took place at an accelerated pace. Increasing allocation was made for agricultural development. Allocation for agriculture in the public sector was raised from Rs. 1,510 million during the First Plan to Rs. 2,520 million during the Second Plan period. This allocation has been further increased to Rs. 4,115 million during the Third Plan. Furthermore, increased allocation was made for water development to ensure greater supply of irrigation water. Simultaneously, the entire organizational setup was made dynamic to implement the programs pertaining to agricultural development. Two Agricultural Development Corporations were set up in 1961, one in each Wing, with the revolutionary idea of expediting agricultural development through such decentralized semigovernment organization and to promote commercial aspects of agriculture. These Corporations have been entrusted with the supply of various production requirements of the farmers. They have also undertaken intensive development works in the project areas. In West Pakistan the Small Dam Organization has been brought under the administrative control of Agricultural Development Corporation and it has been constructing a number of small dams in the hilly regions for supply of irrigation water. Likewise, Water and Power Development Authority, one in each Wing, was established in the year 1958-59 as a semi-autonomous body to undertake water and power development program. Both these institutions have met with phenomenal success in their respective fields.

Removal of Control

The government has recognized the importance of and necessity for developing a free market mechanism with the right to interfere as and when necessity will arise. Various restrictive measures which tend to affect agricultural production are being removed gradually. This has helped create a suitable climate enabling the farmers to make suitable agro-economic decisions without facing the restriction of controls. Accordingly, the licensing of jute acreage which was considered to be of doubtful utility and was in operation since 1940 was abolished in 1960. Procurement policy has been revised so that the government can retract from commercial operations. This

was essential to give incentive to private enterprise and to free the government for undertaking more fruitful operation. With that end in view, compulsory procurement of wheat and rice was abolished and attractive floor prices for these commodities were fixed. Similarly, distribution of fertilizers, which was one of the main functions of the Agricultural Departments, is being gradually transferred to the private sector.

Government Policy on Agricultural Research, Extension and Education

The government has fully recognized the importance of agricultural research, extension and education in the development of agriculture. Various measures have been adopted from time to time to strengthen, revitalise and expand facilities for these vital services. Research facilities have been greatly expanded, both qualitatively and quantitatively, in conformity with the growing requirements for research. Extension services have also been greatly reorganized to make them discharge their functions more efficiently and speedily. These services were previously overburdened with supply functions. With the transfer of these functions to Agricultural Development Corporations, the extension staff is entrusted exclusively with advisory services to the farmers. Increasing number of demonstration blocks have been set up to help the farmers to adopt improved agricultural practices. Farm Broadcast Programs have been initiated from the leading radio stations for inducing the farmers to undertake improved methods of farming.

To improve the standard of agricultural education in the country, two Agricultural Universities, one in each Wing, were set up in 1961. These universities, apart from producing qualified graduates to meet the growing requirements of technical personnel, have also added increased mementum to agricultural research and extension. Agricultural-oriented subjects have been included in the curriculum of secondary and lower secondary schools to instil agricultural bias among the students.

Land Tenure Policy

It has been duly recognized by the government that the farmers must have adequate incentives to improve agricultural output and the land tenure system must conform to that objective. There should be adequate security of expectations so that the farmers can undertake medium and long term investments to develop their resources. With those ends in view, various land reform measures have been introduced

in Pakistan. In East Pakistan, the land tenure system was a legacy of the foreign domination where under the dead weight of the Permanent Settlement Act, enforced in 1793, all incentive of farmers towards agricultural development were smothered. This system gave rise to a plethora of intermediary rent-receiving interests which in some cases spread up to 50 or more between the original zamindar and the actual cultivator and the latter had to bear the entire burden of supporting these intermediaries and therefore, had to pay exhorbitant rents. This system also gave rise to various socio-economic evils. In order to mitigate these evils and to make the land tenure attuned to the requirements of a developing agriculture, the East Bengal State Acquisition and Tenancy Act was passed in 1950, according to which all the rent-receiving interests were abolished on payment of compensation and the farmers were brought directly under the State. The land thus belongs to the government but the farmers have been assured full occupancy right. The future emergence of intermediaries has been prevented by forbidding subletting. A ceiling of about 37 acres was fixed on individual holding. Lands in excess of this limit were taken by the government on payment of compensation and distributed among the farmers having uneconomic holdings and among landless cultivators. It was, however, subsequently realised that this limit on holding was not conductive to giving adequate incentives to farmers, especially in undertaking mechanized cultivation. Accordingly, the ceiling was later raised to 125 acres. Furthermore, the system of land assessment was rationalized and provision was made for consolidation of holdings.

Similarly, in West Pakistan various tenancy improvement reforms were introduced from time to time to improve the relationship between the landlords and the tenants and to give the latter more security, but most of them remained ineffectual. It was only when the Revolutionary Government of President Ayub came to office that the most radical land reform was introduced in 1959. Under this reform, ceiling on individual holding was fixed at 500 acres for irrigated areas and 1,000 acres for unirrigated areas and the lands in excess of such ceilings were taken by the government on payment of compensation and distributed among the tenants. All Jagirs were abolished without any payment of compensation except those holding Mukhadim Rights. (These Jagirs were generally given by the British Government as gifts to their local supporters for the services rendered by them.) Occupancy tenants were given ownership right and the tenants full security to operate their lands. Proper regulatory measures were enforced to effectively implement this land reform. Consolidation of holdings progressed at a very rapid pace as per ordinance of 1960 which made it obligatory for the farmers to

consolidate their holding. Accordingly, the total area consolidated during the Second Plan period was 7.8 million acres and during the Third Plan period an estimated area of 1 million acres will be consolidated annually.

Rural Works Program

The Institution of Basic Democracies has been highly instrumental in bringing rapid transformation of the rural areas through the Works Program. The rural masses have been closely associated with the planning and developing their agricultural resources. Under the Rural Works Program heavy amounts are being spent annually to develop rural infra-structure through the construction and repairs of roads, irrigation canals, drainage, embankments, etc. This has, therefore, ensured increased supply of irrigation water as well as development of better communication and consequent greater marketing facilities to the farmers. Furthermore, this has offered great employment opportunities to the rural labor during off season. A sum of Rs. 650 million was spent on this program during the Second Plan period and an allocation of Rs. 2,500 million has been made for this program during the Third Plan period.

Coordination Among Various Organizations

Proper coordination has been effected among all the organizations engaged in agricultural development. Two High Powered Agricultural Policy Committees have been set up, one in each Wing, under the Chairmanship of the Provincial Governors and including high officials from the various departments to give policy guidance, coordinate and intensify development efforts in agriculture. Top priority has been given to attain self-sufficiency in food production by the end of the Third Plan period i.e. 1970 and the whole government machinery has been set in high gear to attain this objective.

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DEVELOPMENTS IN AGRICULTURAL PRODUCTION IN TURKEY FROM 1948 TO 1966

BY

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INTRODUCTION

Turkey shows great variations in climate, soil and geographical conditions and as a result many different kinds of crops including sub-tropical plants such as bananas, citrus, cotton and tea are grown.

During 1948-1966 the percentage of farm population to the total population was reduced. However, because of the high rate of population increase, the number of people engaged in agriculture increased. This large farm population is one of Turkey's important problems.

According to surveys made by the State Institute of Statistics in 1950 and 1963 both the farm population and the number of farms have increased. This means that holdings were reduced in size. In 1950 the average size of a holding was 77 decares; this dropped to 48 decares by 1963. There is no law in Turkey preventing fragmentation of farm land and, because of the Turkish inheritance laws, holdings have been divided into very small plots. According to the survey made by the State Institute of Statistics in 1950 the average number of plots for each holding was 6.6. Where farms are so small and fragmented, modern farming methods cannot be used.

According to data on national income, agricultural income has been increasing continuously. However, because of the higher

increases in the other sectors, the percentage of agricultural income in the total national income dropped from 53 in 1948 to 36 in 1966.

MAIN REASONS FOR AGRICULTURAL GROWTH SINCE 1948

Principles of the Turkish Agricultural Policy

a. Turkey is an agricultural country with a continuous high rate of population increase. Her goal is to increase agricultural production without harming the natural resources to better feed the population, to meet the ever-growing raw material need of industry and to develop exports of agricultural products.

b. Another goal of the Turkish agricultural program is to raise the standard of living of the farm population by increasing income.

Foreign Aid and the Market Situation

After the Second World War Europe needed large quantities of agricultural products, and Turkey had unused land potential. To reach the goals set up for utilizing the available land potential the first need was mechanization. With mechanical equipment, agricultural production could be increased rapidly by putting some of the unused land into production and agricultural products could be supplied to European markets.

Turkey signed an Economic Cooperation Agreement with the United States of America and at the same time joined the European Economic Cooperation Organization in Paris on April 16, 1948. In accordance with these agreements, members of the OEEC prepared joint development programs. Under the agreements Turkey was supplied tractors and other agricultural equipment. With the help of these tractors Turkey was able to cultivate unused land and increase the production of wheat and cotton which were badly needed in European markets. While Turkey was increasing agricultural exports, European countries were able to pay for agricultural imports with farm machinery and other industrial products.

CHANGES IN LAND UTILIZATION (1948-1965)

It can be seen from Table 1 that during this period acreage of fields, vineyards, orchards and forests were increased while area for

pasture, meadow and unused lands decreased. According to Table 1 fields increased by 9,941,000 hectares while pasture and meadowland decreased by 10,092,000 hectares. During the same period horticultural land and forests increased by 797,000 and 92,000 hectares respectively, while unused land decreased by 372,000 hectares.

Percentages of various types of land in the total area are given in Table 2. During 1948-1963 the percentage of fields increased from 17.7 to 30.4; horticultural land from 2.0 to 3.0; and forests from 13.5 to 13.6. At the same time percentages of pasture and meadow decreased from 49.3 to 36.1 and unused land from 17.3 to 16.8.

Changes in cultivated areas are given in Table 3. During this period the total cultivated land increased by 71 percent. Increase in fields was 72 percent and in horticultural land 53 percent. The reason for this higher increase in fields is that they could be cultivated with a smaller labor force and less capital, and field crops can be produced much quicker. Another reason was that horticultural lands are usually on slopes and hills which are difficult to exploit in a short time.

Areas of industrial crops increased by 119 percent; oil seeds by 73 percent; cereals by 61 percent and pulses by 32 percent. An interesting point to be noted is that the fallow area has increased rapidly during this period. This means that farming techniques did not develop as fast as the increase in acreage and some of the land became unfertile, and had to be left fallow.

In horticultural land, olive orchards increased by 132 percent; vineyards by 49 percent and fruit and vegetable areas by 24 percent. One of the reasons for this high increase in olive areas is the fact that in addition to the new plantations, millions of wild olive trees were grafted.

CHANGES IN PRODUCTION AND YIELDS

Changes in the Turkish population, agricultural production and yield during 1948-1966 are given in Table 4. As can be seen from the Table, the population increased by 60.5 percent. Agricultural production increased 156.1 percent. But the increase in yield was below the population increase. This explains why agricultural production increases in Turkey are due to increases in acreage rather than to increases in yield. One of the factors that limited production increases during 1954-1962 was periodic drought.

The relation between the population and food in the world is becoming more important. Therefore, it was found essential to study population and production relations of Turkey during 1948-1966. The production indices of food items for 1948 to 1966 are given in Table 5. According to Table 5, increase in total food production during this period has been 145 percent. This means that the rate of increase in food production was less than the rate in general agricultural production. The main reason for this is the great demand for industrial crops both in local and foreign markets. During 1966, increase in total food production was more than double that of the increase in population.

Table 6 shows that during this period all kinds of crop production showed increases; however, the rate of increase was not uniform throughout the period. In general, the highest rate of increase took place during 1951-1954, then a steady period followed until 1958, after which it accelerated again. The reason for a very high rate of increase after 1951 was the fact that with the newly imported tractors most of the unused land was put into production; also weather conditions were very favorable. The reason for the steady situation during 1954-1958 was the unavailability of new land for production. The production increases after 1958 were due to developments in production factors such as fertilizer, irrigation, agricultural credits, etc.

Table 7 shows that during this period total field crops production was increased by 152 percent and horticultural crops by 172 percent.

The highest increase among the field crops was in industrial crops which was 592 percent. The main reason for this high increase was the greater demand after 1951 for industrial crops like melons and watermelons.

Industrial crops next in importance were oil seeds with 168 percent, cereals with 81 percent and pulses with 56 percent.

The highest increase among the horticulture crops was in citrus with 704 percent. This was followed by olives with 299 percent, nuts by 185 percent, fruits by 159 percent and grapes by 55 percent. The reason for these great increases in citrus and olive production was a greater demand in local and foreign markets.

CROP PRODUCTION IN TURKEY

Cereal Production

Cereal production is the leading farming operation in Turkey in area sown and income produced. Among cereals, wheat and barley are the main crops. In general, cereal production is dry farming and the yield and production depends mainly on weather conditions. Natural disasters, diseases and insects also play important parts in the final production. Cereal production and yields are given in Table 8, the indices in Table 9. The Tables show that both the production and yields vary greatly. Increase in cereal production was due to increase in acreage rather than increase in yield. According to Table 9 some of the high increases during the period were: 105 percent in wheat and 98 percent in barley for 1963; 57 percent in corn for 1960 and 176 percent in rice for 1961. When Table 8 is studied it will be noticed that cereal yields in Turkey are lower than the world levels and show great variations. However, the yields during the last few years have increased.

The area sown to cereals showed rapid increase from 1950 to 1955 but after that the rate of increase was slow. The reason for this, as already explained above, was the importation of tractors and opening of unused land. By 1955 almost all of the available land was put into cultivation and any increase in cereal production after that year was mainly due to increase in yield.

Production of Industrial Crops

After cereals the second most important group of crops, as far as the areas sown and income produced are concerned, are the industrial crops. Tobacco and cotton are the most important export crops of Turkey and are included in this group.

Production of the main industrial crops and their yields during 1948-1966 are given in Table 10 and the indices in Table 11. It will be noted from Table 10 that variations in yield are not as large as they are in cereals. The reason for this is the fact that most of the industrial crops are grown under irrigation with fertilizer and they do not depend on weather conditions as much as cereals.

Some of the main increases in industrial crop production during the period were as follows: 551 percent in cotton and 285 percent in

potatoes for 1966; 548 percent in sugar beets and 133 percent in tobacco for 1964. The main reason for these large increases in the production of cotton, sugar beets and potatoes was the greater demand for these crops. The reason for a smaller increase in tobacco production is the limited demand for this crop in the local and foreign markets and also the policy of the Turkish government to improve the quality of tobacco rather than increase production.

Fruits and Nuts

Four other important agricultural crops of Turkey are hazelnuts, grapes, olives and citrus. Table 12 shows that large variations in the production of hazelnuts have taken place over the years. It can be noted that a good crop is followed by a poor crop. One of the reasons for this is the lack of fertilization in hazelnut orchards.

CHANGES IN THE PRODUCTION FACTORS

Main production factors which increased agricultural production during 1948-1966 are: agricultural credit, farm machinery, fertilizer, good seeds, good plants and vine stocks, irrigation, good weather, plant protection, land distribution, agricultural investments and extension. We will discuss the changes in these production factors individually.

Agricultural Credit - In Turkey, the credit need of the agricultural sector is very large. The only public institutions giving agricultural credit are the Agricultural Bank of Turkey and the Agricultural Credit and Marketing Cooperatives supported by this bank. Because the funds of these credit institutions are limited and some farmers have no title-deeds for their land to show as guarantee for the money they borrow, many farmers have to seek other sources of credit at very high rates of interest. This has a negative effect on the increase of agricultural production. Total agricultural credits distributed by the Agricultural Bank during 1948-1966 are given in Table 13. Of the total credit distributed during this period, 39.4 percent was given directly by the Agricultural Bank, 27.3 percent by the Agricultural Credit Co-operatives, 30.6 percent by the Agricultural Marketing Cooperatives and 2.7 percent by other sources as seed credits.[1] The Agricultural Bank distributes some credit through the Agricultural Credit and

1. This data was obtained from the Agricultural Bank.

Marketing Cooperatives in order to help the development of these Co-operatives. According to Table 13, the total amount of credit distributed annually has increased 17 times but still supplies only half of the farmers' credit need. According to a study made in Denizli province in 1965 farmers get 55.16 percent of their credit from the above mentioned public sources and the remaining 44.84 percent from merchants and private individuals. [1]

After 1948 farmers were encouraged to buy tractors and other farm machinery by being supplied credit at only 2.5 percent interest.

The purpose of supplying seed credit by the Agricultural Bank is to provide good seed for the farmers to increase their production.

Utilization of Farm Machinery

During 1948-1966 all kinds of farm machinery were introduced into Turkish agriculture. Tractors played the most important part by opening up the unused land and increasing the cultivated acreage. As can be seen from Table 13, during 1948-1966 the number of tractors increased from 1,756 to 54,668. [2] During this period the percentage of land cultivated by tractors increased from 0.9 percent (1.4 percent of fallow land is not included) to 17.2 percent (26.9 percent if fallow land is not included).

During this period, the number of tractors and the areas cultivated by tractors have shown an orderly increase. The highest rate of increase was from 1949 to 1953. During these five years the numbers increased more than 19 times. The increase continued until 1955 and then had a long steady period until 1962. Since 1962 the increase in the number of tractors has continued. The trend of increase in the number of tractors and the increase in the acreage of land cultivated by tractors are very similar. On the other hand pastures and meadows have decreased at about the same rate.

Fertilizer Utilization

Fertilizer is the most important factor in the increase of yield and production. In Turkey where the cultivated area has reached

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1. Ministry of Agriculture Planning and Economic Research Organization, A Socio-Economic Study of Farming in Denizli Province, page 52, Ankara 1957.
2. According to the State Institute of Statistics, the number of tractors during 1966 is 63,807.

its maximum level and cannot be increased further, fertilizer utilization is essential for production increase.

It is estimated that about 120 million tons of farm manure is produced annually. About 85 million tons are collected in the barns and the rest left in pastures and fields. Of this 85 million tons, only 10 to 15 million is used as fertilizer and the balance as fuel.[1] It is a known fact that farm manure helps increase the fertility of soil but also improves the physical characteristics of the soil. Since Turkish soils are poor in organic matter, farm manure utilization is even more important. Farmers must be supplied with sources of fuel other than manure.

Turkey is one of the last countries in the world in the rate of fertilizer consumption. However, a great increase in chemical fertilizer utilization has taken place during the last few years.

Production, import and utilization of chemical fertilizer during 1948-1966 are given in Table 13. During this period chemical fertilizer consumption per hectare increased from 1.3 kilograms to 52 kilograms. Even this development does not prevent Turkey from being one of the countries of least fertilizer use.

Table 13 shows that chemical fertilizer utilization increased rapidly after 1961, as soon as it was understood by everyone that production and income can be increased by using more chemical fertilizer. Greater demands for agricultural crops also help to promote the utilization of fertilizers.

Utilization of Better Seeds, Fruit Plants and Vine Stocks

To increase yield and produce good quality products it is essential to use high yielding seeds that are free from weeds and are resistant to poor weather conditions and diseases. During 1948-1966 seeds of tobacco, cotton, sugar beets, potatoes and many other vegetables were produced or improved and propagated at the Ministry of Agriculture Institution to be distributed to farmers.

The quantity of cereal seeds distributed to farmers during 1950-1966, and the indices are given in Table 14. As can be seen from the Table the largest quantity of cereal seeds distributed was in 1954

1. Calculated by the Fertilizer Study Group of the State Planning Organization, in the Second Five Year Plan.

(234,195 tons, an increase of 569 percent), and the smallest quantity in 1949 when 18,352 tons were distributed (an increase of 48 percent).

Table 15 shows that during this period the amount of seed cleaned and chemically treated increased three times and reached 25.4 percent of the total seeds used. Of course the goal is to clean and treat all seeds.

Distribution of fruit plants - Ministry of Agriculture nurseries raise and distribute all kinds of young trees such as pistachio, olive, citrus and other fruit trees. The number of plants distributed during 1948-1966 and the indices are given in Table 14.

Distribution of vine-stocks - After the destruction of vineyards by phylloscera the Ministry of Agriculture raised American type vine-stocks (resistant to this disease) and distributed them to farmers. The number of vine-stocks distributed during this period and the indices are given in Table 14.

Irrigation of Farm Land

In a country like Turkey, where the climate in general is dry, irrigation is very important. Through irrigation the output can be increased by higher yield and also by producing more than one crop a year.

According to the agricultural census done by the State Institute of Statistics in 1950, the total irrigated area in Turkey was only 827,000 hectares. The second agricultural census done by the same Institute 13 years later in 1963 showed that the total irrigated area increased to 1.7 million hectares. This means that during 1950-1962 the irrigated area was only doubled. However, the rate of increase during the last few years has been much greater. According to data supplied by the State Hydraulics Department, the area irrigated during 1963 was 114,695 hectares. It was increased to 135,008 hectares in 1964, to 161,202 hectares in 1965 and to 199,906 hectares in 1966.

Weather Conditions

In general, Turkey is in an arid area and her land under irrigation is very limited; therefore, agricultural production depends mainly on weather conditions. In addition to poor weather conditions periodic droughts also play an important part in production. A periodic

drought started in 1954 and lasted until 1962. During this period production was very low.

Plant Protection

One of the main factors reducing production in Turkey is diseases and insects. Plant protection activities in Turkey have gained importance during the last few years. The amount of insecticides and pesticides used are given in Table 15. The amount was only 2,589 tons in 1952 and increased to 37,822 tons by 1966.

Land Distribution to Farmers

A new law, "Land Distribution to Farmers" was introduced in 1945. In accordance with this law some of the state land was distributed to farmers who had no land or not enough land to make a living. As can be seen from Table 15, 2 million hectares of state land was distributed during 1948-1966; most of it was distributed between 1950 and 1960.

Agricultural Investments

Farming needs investment to be profitable. Data on private investments in agriculture during this period were not available. Only the amount of public investment in agriculture is provided to show the importance given by the state to this sector. Table 15 shows the amount of public investments in agriculture during 1948-1966. These investments have increased about 22 times during this period. The rate of increase was greater after 1963, the first year of the First Five Year Development Plan.

Agricultural Extension

Agricultural extension played an important part in the increase of agricultural production by supplying the farmers with the latest information, showing and teaching better methods of farming and helping to solve agricultural problems. Agricultural extension work in Turkey is done by the "Technical Agricultural Organization." This Organization was first established in 1943 in a few of the provinces and gradually extended to other areas. By 1963 its establishment was completed in all provinces. When this Technical Agricultural Organization is supplied with more personnel, more equipment and more transportation, its effect on the increase of agricultural production will be much greater.

TABLE 1

LAND USE PATTERN (1948 - 1966)

(in thousand hectares)

Year	Field Crops	Vineyards Orchards & Vegetable Gardens	Meadows and Pastures	Forests	Other[1/]	Total Area
1948	13,900	1,508	38,330	10,492	13,468	77,698
1949	13,264	1,535	38,940	10,492	13,467	77,698
1950	14,542	1,466	37,806	10,418	13,466	77,698
1951	15,639	1,565	36,611	10,418	13,465	77,698
1952	17,361	1,666	34,789	10,418	13,464	77,698
1953	18,182	1,707	34,297	10,418	13,464	77,698
1954	19,616	1,760	32,441	10,418	13,463	77,698
1955	20,998	1,810	31,009	10,418	13,463	77,698
1956	22,453	1,876	29,489	10,418	13,462	77,698
1957	22,161	1,909	29,748	10,418	13,462	77,698
1958	22,765	1,919	29,134	10,584	13,296	77,698
1959	22,940	2,018	29,014	10,584	13,142	77,689
1960	23,264	2,060	28,658	10,584	13,132	77,698
1961	23,076	2,139	28,767	10,584	13,132	77,689
1962	23,215	2,201	28,598	10,584	13,100	77,689
1963	23,913	2,207	28,257	10,584	13,097	78,058[2/]
1964	23,843	2,249	28,286	10,584	13,096	78,058
1965	23,845	2,305	28,232	10,584	13,096	78,058
1966						

TABLE 2

LAND USE PATTERN (1948 - 1966)

(percentages)

1948	17.7	2.0	49.3	13.5	17.3
1949	17.0	2.0	50.1	13.5	17.3
1950	18.7	1.9	48.7	13.4	17.3
1951	20.0	2.1	47.2	13.4	17.3
1952	22.3	2.2	44.8	13.4	17.3
1953	24.1	2.1	42.8	13.4	17.3
1954	25.2	2.3	41.8	13.4	17.3
1955	26.9	2.3	40.0	13.4	17.3
1956	28.9	2.4	38.0	13.6	17.3
1957	28.5	2.4	38.2	13.6	17.3
1958	29.3	2.5	37.5	13.6	17.1
1959	29.4	2.5	37.4	13.6	17.0
1960	29.9	2.7	36.9	13.6	16.9
1961	29.7	2.8	37.0	13.6	16.9
1962	29.9	2.8	36.8	13.6	16.9
1963	30.6	2.8	36.2	13.6	16.8
1964	30.5	2.9	36.2	13.6	16.8
1965	30.4	3.0	36.1	13.6	16.8
1966					

SOURCE: State Institute of Statistics

Table 2 computed from the data given by State Institute of Statistics.

1/ Consists of cities, towns, villages, wasteland, lakes and marshes.

2/ Change in total land area is due to recalculation rather than to an actual increase.

TABLE 3

LAND USE INDICES (1948 - 1966)
1948=100

Year	Cereals	Pulses	Industrial Crops	Oil Seeds	Fallow	Total Fields	Vinevards	Gardens and Orchards	Olive Grove	Total Gardens	Grand Total of Cultivated Land
1948	100	100	100	100	100	100	100	100	100	100	100
1949	93	95	101	107	97	95	104	100	103	102	96
1950	102	105	142	127	106	105	105	87	107	92	104
1951	109	105	168	158	106	110	111	89	127	104	112
1952	122	109	181	166	126	125	121	91	138	110	123
1953	137	115	179	159	131	135	125	92	143	113	133
1954	140	115	175	156	145	141	129	93	152	117	139
1955	150	125	193	167	154	151	132	95	160	120	148
1956	153	124	200	173	179	162	136	98	169	124	158
1957	151	127	200	167	176	159	139	99	172	127	156
1958	155	128	206	167	181	164	132	100	185	127	160
1959	157	130	220	167	179	165	144	102	194	134	164
1960	160	137	222	165	180	167	141	105	198	137	164
1961	159	141	210	166	180	166	140	112	212	142	165
1962	161	140	205	160	182	167	144	115	216	146	170
1963	162	135	214	157	195	172	148	116	219	146	169
1964	161	135	232	173	192	172	149	117	230	149	170
1965	161	132	219	173	193	172	149	124	232	153	171
1966											

SOURCE: Calculated from the data provided by the State Institute of Statistics

TABLE 4

AGRICULTURAL PRODUCTION, ANNUAL YIELD AND POPULATION INCREASES IN TURKEY (1948-1966)

Year	Population[1] Thousands	1948=100	Indices of Agricultural Production and Annual Yield (1948=100)[3] Production	Yield
1948	20,056	100.0	100.0	100.0
1949	20,497	102.2	78.0	81.4
1950	20,947	104.4	92.9	91.8
1951	21,634	107.8	133.8	93.8
1952	22,219	110.7	153.5	114.5
1953	22,818	113.7	174.0	129.8
1954	23,433	116.8	142.6	104.6
1955	24,065	120.0	163.0	111.9
1956	24,771	123.5	169.2	113.1
1957	25,498	127.1	189.5	127.7
1958	26,247	130.9	210.7	138.7
1959	27,017	134.7	217.8	140.4
1960	27,755	138.3	226.8	143.5
1961	28,442	141.8	203.9	129.7
1962	29,148	145.3	217.9	137.8
1963	29,873	148.9	243.5	151.9
1964	30,621	152.7	238.6	148.8
1965	31,391[2]	156.5	231.3	144.3
1966	32,190	160.5	256.1	

SOURCE:

1/ State Institute of Statistics

2/ The population of 1961-66 calculated from 1965 Census.

3/ Agricultural production includes the production of cereals, pulses, industrial crops, oil seeds, fruit, nuts, olive, tea and citrus, calculated from data provided by the State Institute of Statistics.

TABLE 5

PRODUCTION INDICES OF FOOD ITEMS*
1948-1966 (1948 index = 100)

Year	Food Production Index	Year	Food Production Index
1948	100	1958	200
1949	77	1959	212
1950	96	1960	214
1951	129	1961	198
1952	144	1962	208
1953	159	1963	227
1954	133	1964	230
1955	155	1965	223
1956	163	1966	245
1957	174		

SOURCE: Calculated from the data provided by the State Institute of Statistics.

*(1) In calculating the production of food items the data provided by the State Institute of Statistics are used as a basis and the following crops are included in the totals: Cereals: wheat, rye, corn, and rice; pulses: broad beans, peas, chickpeas, dry beans, lentils, kidney beans and other pulses; industrial crops: potatoes, sugar beets, onion, garlic, etc.; oil seeds: all kinds of oil seeds except opium gum; total production of fruits, nuts, citrus, olives, tea, meat, milk, eggs and honey.

(2) Meat production estimate is taken from "the Meat Supply and Demand Trends in Turkey" by Orhan Düzgüneş and Turan Güneş, Robert College, 1965.

(3) Seventeen eggs is accepted as 1 kilogram in the calculations.

(4) Citrus production is converted into kilogram according to the conversion factors accepted by the State Institute of Statistics.

TABLE 6

AGRICULTURAL CROPS PRODUCTION (1948-1966)
(In thousand tons)

Years	Cereals	Pulses	Industrial Crops	Oil Seeds	Total Field Crops	Grapes	Fruits[2]	Nuts	Citrus	Olives	Total Fruit Production	Grand Total[3]
1948	9,042	378	1,515	337	11,272	1,331	438	116	57	211	2,153	13,425
1949	5,349	315	1,645	367	7,676	1,751	558	186	59	241	2,795	10,471
1950	7,764	395	1,877	341	10,377	1,399	533	99	41	265	2,337	12,714
1951	10,679	427	3,988[1]	507	15,601	1,386	520	179	88	227	2,400	18,001
1952	12,242	492	4,527	535	17,796	1,634	512	163	108	394	2,811	20,607
1953	14,344	520	4,838	486	20,188	2,000	670	149	104	254	3,177	23,365
1954	9,624	436	4,687	475	15,222	2,248	735	240	161	532	3,916	19,138
1955	12,433	487	5,433	539	18,892	1,895	537	167	198	200	2,997	21,889
1956	11,818	487	5,471	514	18,290	2,606	807	292	177	539	4,421	22,713
1957	14,598	532	6,432	471	22,033	2,010	697	184	290	226	3,407	25,540
1958	15,077	574	7,227	547	23,425	2,992	829	277	283	482	4,863	28,288
1959	13,996	597	8,863	602	24,058	3,225	1,011	260	260	402	5,158	29,216
1960	15,216	640	9,578	552	25,986	2,775	795	185	286	427	4,468	30,454
1961	12,636	592	7,966	570	21,764	3,189	1,169	275	289	689	5,611	27,375
1962	14,618	586	8,081	588	23,873	3,382	1,138	272	296	290	5,378	29,251
1963	17,400	608	8,977	622	27,607	2,693	1,155	232	384	619	5,083	32,690
1964	14,388	583	10,872	792	26,635	2,790	1,242	344	325	694	5,395	32,030
1965	14,670	589	9,416	793	25,468	3,350	1,211	204	425	394	5,584	31,052
1966	16,411	591	10,487	903	28,392	3,100	1,234	331	460	841	5,966	34,358

SOURCE: Calculated from the data provided by the State Institute of Statistics.

1/ Starting in 1951 includes melon and watermelon production.

2/ Includes tea production.

3/ Vegetables not included.

TABLE 7

INDICES OF AGRICULTURAL CROP PRODUCTION (1948-1966)
1948=100

Years	Cereals	Pulses	Industrial Crops	Oil Seeds	Total Field Crops	Grapes	Fruit	Nuts	Citrus	Olives	Total Garden Crops	Grand Total
1948	100	100	100	100	100	100	100	100	100	100	100	100
1949	59	83	77	109	68	104	127	160	103	114	130	78
1950	86	104	124	101	92	105	122	85	73	126	109	93
1951	118	113	263	150	138	111	119	154	154	108	111	139
1952	135	130	299	159	158	121	117	141	189	187	131	154
1953	159	138	319	144	179	125	153	128	182	120	148	174
1954	106	115	309	141	135	129	168	207	281	252	182	143
1955	138	129	359	160	168	132	123	144	345	95	139	163
1956	131	129	391	153	162	136	184	252	309	255	205	169
1957	161	141	425	140	195	139	159	159	506	107	158	190
1958	167	152	477	162	208	133	189	239	494	228	226	211
1959	155	158	585	179	213	144	231	224	454	191	240	218
1960	168	169	468	164	231	141	182	159	500	202	208	227
1961	140	157	526	169	193	140	262	237	506	327	260	204
1962	162	155	533	174	212	144	251	234	517	137	249	218
1963	192	161	592	185	245	148	253	200	671	293	234	244
1964	159	154	718	235	236	149	273	297	567	329	248	239
1965	162	156	622	235	226	149	263	176	742	187	257	231
1966	181	156	692	268	252	155	259	285	804	399	272	256

SOURCE: Calculated from the data provided by the State Institute of Statistics.

TABLE 8

CEREALS PRODUCTION AND YIELD (1948-1966)

Year	Production (In thousand tons)					Yield (Kilogram per hectare)				
	Wheat	Barley	Corn	Rice	Cereals Total 1/	Wheat	Barley	Corn	Rice	Cereals Total
1948	4,867.1	2,167.4	695.7	59.7	9,042.3	1,086	1,186	1,300	2,327	1,120
1949	2,516.5	1,246.5	724.5	57.7	5,348.7	628	709	1,206	2,187	711
1950	3,871.9	2,047.0	628.0	51.4	7,763.8	864	1,076	1,058	2,128	942
1951	6,600.0	2,700.0	850.0	65.0	10,678.0	1,169	1,301	1,364	2,145	1,213
1952	6,447.0	3,189.0	837.0	95.0	12,242.0	1,194	1,379	1,304	1,939	1,241
1953	8,000.0	3,640.0	108.7	108.7	14,343.9	1,248	1,494	1,224	2,174	1,295
1954	4,900.0	2,400.0	914.0	110.0	9,624.2	765	960	1,269	2,366	854
1955	6,900.0	2,985.0	855.0	61.0	12,433.4	977	1,131	1,211	2,125	1,029
1956	6,400.0	2,900.0	858.0	92.0	11,817.8	872	1,110	1,190	2,190	955
1957	8,300.0	3,650.0	750.0	115.0	14,598.1	1,159	1,387	1,057	1,642	1,195
1958	8,550.0	3,600.0	900.0	119.0	15,077.0	1,147	1,333	1,304	2,016	1,201
1959	7,852.0	3,300.0	1,000.0	92.0	13,996.0	1,042	1,200	1,428	2,044	1,103
1960	8,450.0	3,700.0	1,090.0	110.0	15,215.5	1,097	1,304	1,568	2,588	1,175
1961	7,000.0	2,948.0	1,017.0	140.0	12,635.8	907	1,058	1,442	2,372	982
1962	8,450.0	3,500.0	800.0	165.0	14,618.0	1,083	1,250	1,199	2,037	1,127
1963	10,000.0	4,288.0	990.0	130.0	17,400.4	1,273	1,504	1,477	2,363	1,336
1964	8,300.0	3,200.0	1,000.0	100.0	14,388.0	1,054	1,163	1,470	2,857	1,113
1965	8,500.0	3,300.0	945.0	130.0	14,670.0	1,076	1,191	1,454	2,600	1,132
1966	9,600.0	3,800.0	1,000.0	150.0	16,411.2	1,208	1,402	1,527	2,308	1,308

SOURCE: State Institute of Statistics

1/ Includes rye, oats, spelts, millet, canary seed and mixed grain products.

TABLE 9

INDICES OF CEREALS AND PULSES PRODUCTION
(1948-1966)

1948=100

Years	Wheat	Barley	Maize	Rice	Total 1/
1948	100	100	100	100	100
1949	52	58	104	97	59
1950	80	94	90	86	86
1951	115	125	122	109	118
1952	132	147	120	159	135
1953	164	168	109	182	159
1954	101	111	131	184	106
1955	142	138	123	102	138
1956	131	134	123	154	131
1957	171	168	108	193	161
1958	176	166	129	199	167
1959	161	152	144	154	155
1960	174	171	157	184	168
1961	144	136	146	234	140
1962	174	161	115	276	162
1963	205	198	142	218	192
1964	171	148	144	167	159
1965	175	152	136	218	162
1966	197	175	144	251	181

SOURCE: Calculated from the data provided by the State Institute of Statistics.

1/ Includes also rye, oats, spelts, millet, canary seed, mixed grain products.

TABLE 10

INDUSTRIAL CROPS PRODUCTION AND YIELD (1948-1966)

Year	Production (in thousand tons)					Yield (kilogram per hectare)			
	Tobacco	Potatoes	Sugar Beets	Cotton(lint)	Total 1/	Tobacco	Potatoes	Sugar Beets	Cotton(lint)
1948	83.1	454.4	726.5	58.2	1,514.6	783	6,909	14,806	195
1949	100.1	414.5	817.7	104.2	1,644.5	786	6,165	15,967	341
1950	93.3	605.2	855.1	118.4	1,876.9	727	8,022	16,781	264
1951	88.7	676.0	1,363.0	150.0	3,987.9	730	7,906	26,831	234
1952	92.2	873.0	1,068.9	165.0	4,527.3	674	8,559	22,260	244
1953	117.8	1,000.0	1,170.0	139.0	4,838.3	740	9,542	22,243	230
1954	102.0	1,000.0	1,200.0	142.0	4,686.7	645	9,174	16,844	244
1955	120.0	1,116.0	1,736.0	157.0	5,432.6	693	10,238	17,814	251
1956	116.6	1,100.0	1,791.2	165.0	5,470.9	662	10,000	16,926	259
1957	123.0	1,200.0	2,206.4	135.0	6,431.7	725	10,084	15,331	216
1958	115.3	1,472.0	2,337.6	180.0	7,226.8	734	10,744	16,689	285
1959	129.4	1,500.0	3,468.9	195.0	8,887.8	731	10,135	20,990	312
1960	139.4	1,400.0	3,384.6	175.0	9,577.9	734	8,750	21,608	282
1961	101.4	1,405.0	2,877.1	212.0	7,965.9	721	9,558	22,073	326
1962	89.8	1,489.9	2,730.9	245.0	8,081.7	601	10,869	21,719	371
1963	132.2	1,600.0	3,280.7	257.5	8,976.9	560	11,428	24,376	410
1964	193.7	1,700.0	4,705.8	326.0	10,872.3	711	11,724	25,198	479
1965	124.0	1,680.0	3,421.4	325.0	9,415.9	558	11,586	21,689	474
1966	167.7	1,750.0	4,116.0	373.2	10,486.6	588	11,667	26,983	524

SOURCE: State Institute of Statistics.

1/ Includes hemp fiber, opium gum, anise, flax fiber, onion, garlic, melon, watermelon and other industrial crops production.

TABLE 11
INDICES OF INDUSTRIAL CROPS PRODUCTION (1948-1966)
1948=100

Year	Tobacco	Potatoes	Sugar Beets	Cotton (lint)	Total 1/
1948	100	100	100	100	100
1949	120	91	113	179	77
1950	112	133	118	203	124
1951	107	149	188	258	263
1952	110	192	147	284	299
1953	142	220	161	239	319
1954	123	220	165	244	309
1955	144	246	239	270	359
1956	140	242	247	284	361
1957	148	264	304	232	425
1958	139	324	322	309	477
1959	156	330	477	335	585
1960	168	308	604	302	468
1961	122	309	396	364	526
1962	108	328	376	421	533
1963	159	352	452	442	592
1964	233	374	648	560	718
1965	149	370	471	558	622
1966	202	385	567	651	692

SOURCE: Calculated from the data provided by the State Institute of Statistics.

1/ Includes hemp fiber, opium gum, anise, flax fiber, onion, garlic, melon, watermelon and other industrial crops.

TABLE 12
HAZELNUT PRODUCTION AND INDEX (1948-1966)
(unshelled)

Year	Production 1,000 tons	Index 1948=100	Year	Production 1,000 tons	Index 1948=100
1948	50.6	100	1958	132.2	261
1949	92.3	183	1959	104.7	207
1950	26.1	184	1960	58.5	116
1951	93.2	154	1961	76.0	150
1952	77.9	91	1962	122.4	242
1953	46.1	243	1963	88.4	175
1954	123.1	104	1964	195.2	386
1955	52.6	299	1965	62.0	123
1956	151.0	145	1966	190.0	376
1957	73.4	145			

SOURCE: Calculated from the data provided by the State Institute of Statistics.

TABLE 13

TRACTORS AND AREA CULTIVATED BY TRACTORS, AGRICULTURAL CREDIT, CHEMICAL FERTILIZER

	Number of Tractors		Area Cultivated by Tractors		Agricultural Credits		Chemical Fertilizer[7]			
Year	Number[1]	Index[2] 1948=100	Fallow%[3] Included	Fallow%[3] Not included	(1000 TL.)[5]	Index 1948=100[6]	Production (tons)	Import (tons)	Total Supply	Kologram per hectare
1948	1,756	100	0.9	1.4	271,901	100	8,113	4,110	12,223	1.3
1949	9,170	522	5.2	7.7	346,302	127	11,324	15,533	26,857	3.0
1950	16,585	944	8.6	12.6	433,320	159	15, 95	26,208	42,103	4.3
1951	24,000	1,367	11.8	17.0	809,878	298	21,589	20,981	42,570	4.0
1952	31,415	1,789	13.6	20.0	1,200,226	441	24,554	42,765	67,320	5.7
1953	35,600	2,027	14.2	20.5	1,009,247	371	26,517	56,023	82,062	6.2
1954	37,743	2,149	14.4	21.4	1,036,658	381	44,309	37,753	82,062	6.2
1955	40,282	2,294	14.4	21.3	1,163,652	428	88,637	49,489	138,126	9.7
1956	43,727	2,490	14.6	22.5	1,378,464	507	30,034	51,998	82,032	5.6
1957	44,144	2,514	14.9	23.0	1,455,670	535	38,078	42,836	81,916	5.7
1958	42,527	2,422	14.0	21.6	1,397,278	514	28,512	41,842	70,354	4.8
1959	41,896	2,386	13.7	20.9	1,623,935	597	61,346	114,996	176,342	11.7
1960	42,136	2,400	13.6	20.7	1,426,758	525	64,622	41,361	105,983	6.9
1961	42,505	2,421	13.8	21.1	1,475,953	543	48,874	169,545	218,419	14.4
1962	43,747	2,492	14.2	21.6	2,049,176	753	162,858	187,521	350,379	23.1
1963	50,844	2,895	15.9	25.0	2,250,111	828	325,773	82,106	407,879	26.7
1964	51,781	2,949	16.3	25.2	2,840,418	1,045	313,000	108,072	421,072	27.4
1965	54,668	3,113	17.2	26.9	2,796,185	1,028	379,068	416,759	795,827	52.0
1966	-	-	-	-	4,568,679	1,680	379,000	604,480	983,480	-

SOURCE: State Institute of Statistics.

1/ The Summary of Agricultural Statistics, Publication No. 506, p. 5, Ankara 1966.

2/ Calculated from the data provided by the same publication. (Yearly work capacity of each tractor calculated as 75 hectares.)

3/ Ibid.

4/ Ibid.

5/ Agricultural Bank

6/ Ibid.

7/ Ministry of Agriculture.

TABLE 14

DISTRIBUTION OF CEREAL SEEDS, FRUIT-PLANTS, VINE-STOCKS
(1948-1966)

Year	Cereal Seeds (tons)	Cereal Seeds Index 1950=100	Fruit-Plants (In thousands)	Fruit-Plants Index 1948=100	Vine-Stocks (In thousands)	Vine-Stocks Index 1948=100
1948	-	-	573	100	3,815	100
1949	-	-	746	130	3,644	96
1950	35,000	100	1,198	210	3,131	82
1951	18,352	52	1,200	210	2,945	77
1952	3,812	90	1,389	242	2,722	71
1953	79,092	226	1,343	234	2,527	66
1954	234,195	669	1,895	331	3,421	97
1955	143,829	411	2,229	389	3,353	88
1956	130,846	374	2,246	392	3,071	80
1957	82,082	235	2,400	418	3,525	92
1958	70,887	203	2,255	394	3,267	86
1959	121,088	345	2,434	420	3,338	87
1960	33,687	96	2,390	417	3,315	87
1961	48,410	138	2,075	362	2,069	54
1962	48,145	138	2,293	400	2,621	69
1963	91,233	261	2,157	376	2,410	63
1964	95,869	274	2,883	503	2,875	75
1965	123,562	353	3,162	552	3,868	101
1966	185,621	530	3,859	673	4,216	111

SOURCE: Ministry of Agriculture

TABLE 15

CLEANED AND CHEMICALLY TREATED CEREAL SEEDS,
LAND DISTRIBUTION AND PUBLIC AGRICULTURAL INVESTMENTS

Year	Cleaned and Chemically Treated Cereal Seeds[1] Quantity (tons)	Percent of Total Cereal Seeds	Plant Protection Pesticides[2] Quantity (tons)	Index 1952=100	Land Distribution[3] 1000 Decare	Index 1948=100	Public Agricultural Investments[4] Million TL	Index 1948=100
1948	91,954	6.8	-	-	239	100	82	100
1949	73,669	5.3	-	-	389	163	105	128
1950	121,000	8.3	-	-	820	344	136	166
1951	160,000	10.7	-	-	1,032	432	195	238
1952	177,000	11.4	2,589	100	1,661	695	312	380
1953	209,000	13.1	5,298	205	2,098	878	221	270
1954	190,793	11.6	4,490	173	2,424	1,014	211	257
1955	221,549	13.0	4,261	165	1,809	757	248	302
1956	247,453	14.1	6,477	250	1,446	605	307	374
1957	258,378	14.4	8,346	322	1,529	640	376	459
1958	211,169	11.4	10,659	412	1,483	621	571	696
1959	261,435	13.8	18,529	716	1,259	527	650	793
1960	284,000	14.6	14,690	567	1,527	639	554	676
1961	224,000	11.3	12,607	487	60	25	732	893
1962	275,000	13.7	25,066	968	18	8	963	1,174
1963	324,802	15.8	26,206	1,012	11	5	1,327	1,618
1964	354,564	17.0	36,636	1,415	5	2	1,601	1,952
1965	453,500	21.6	35,709	1,379	101	42	1,855	2,262
1966	536,095	25.4	37,822	1,460	162	68	-	-

SOURCE:

1/ Ministry of Agriculture

2/ Ibid.

3/ General Directorate of Soil and Water

4/ State Planning Organization

AGRICULTURAL DEVELOPMENT STUDIES OF THE DEVELOPMENT ASSISTANCE COMMITTEE OF THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (O. E. C. D.)

BY

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For many years, OECD (formerly OEEC) has been concerned with the problems of agricultural development in its member countries. It has regularly examined the agricultural trends in members so as to achieve closer consistency in governmental policies. It has encouraged increased trade in agricultural products, has organized a number of mutually beneficial activities in fields such as seed certification, standardization of nomenclatures, packaging and marketing and has provided technical assistance for agriculture in its less developed member countries in southern Europe. It has been particularly concerned with the difficult problems of agricultural adjustment - notably, adjustments in incomes and employment in this sector - under conditions of economic growth.

It may be some consolation to developing countries to know that in struggling with problems of lagging agricultural development, they experience the same problems as our own developed members. Thus a recent OECD study[1] states:

> "The process of economic growth is complex and creates problems of adjustment in all sectors of the economy but especially so in agriculture. Agriculture is usually the oldest sector in the economy, characterized by a distinctive pattern of life and organization: life in attachment to land; in small units combining property, management and labor; engaging all or most of the family members in

1. "Agriculture and Economic Growth", OECD, Paris, 1965.

agricultural pursuits; and relatively isolated from the urban foci of modern economic growth. All these characteristics make for obstacles to an easy transfer of properly trained and educated labor to other growing employment sectors; to an adjustment of production to changing demand; to changes in scale and structure of farm units; and to movement of capital out of agriculture. At the same time, unlike many obsolescent older sectors, agriculture has benefited from vigorous technological innovations, particularly in the developed countries since World War II. There is thus a distinctive contrast between the technologically feasible agricultural production processes and the persistent pattern of production and life among large groups of small scale farmers responding but slowly to pressure of low incomes."

Only over recent years, however, has the organization become deeply concerned with the wider issues of world agricultural development, notably as a result of the growing world food problem, which is closely related with production policies of our members as well as to their trade and external aid policies. In the first place, OECD is contributing data and projections on agricultural trade in member countries with FAO's Indicative World Plan, which is designed to provide an improved picture of levels and trends of output so as to assist national agricultural planning. In the second place, the aid-providing members of OECD, grouped in the Development Assistance Committee, have called for a larger and more effective international effort, to assist the developing nations to solve their critical agricultural and food problems more rapidly (DAC Washington Resolution of July 1966). DAC is not itself an aid-providing body, but it is the place where aid-giving members, who are providing about 9 percent of the flow of funds to developing countries through bilateral and multilateral channels, meet together to work out, as far as possible, common approaches.

It is about this latter development that I shall speak. In asking ourselves what could be done to speed agricultural development, we in the DAC have inevitably been addressing ourselves to the same questions as the governments of developing countries. Fundamentally, we have been concerned with two closely related issues

- how to accelerate longer term growth in food supplies for less developed countries (both in total and per capita)
- how to make up interim deficit through external aid in food or in other appropriate forms.

The reasons for concern with these issues are: first, the fact that food production in developing countries as a whole has barely kept pace with the rapid rate of population growth: second, that as a result the developing countries have switched from being net food exporters in earlier decades to becoming food importers in the 1960's and that even the more optimistic projections suggest that the strain on their foreign exchange availabilities from this source will become much heavier in the future; and third, that it is now appreciated that the whole process of growth and development should have as its cornerstone the raising of incomes and living standards of the mass of the population who are occupied and will for some decades at least continue to be occupied on the land.

GENERAL POLICY CONSIDERATIONS

It is of great significance that a major change in sentiment at governmental level, to which this meeting is a witness, has occurred in recent years in assessing the priority which should be accorded to agriculture in the development process. The reasons vary - food shortages, inflationary pressure arising from food supply inelasticities, lagging agricultural exports, and so on. But there may unfortunately be a large gap between declared policy and actual implementation. If basic economic policy (with respect to prices and taxes, for example) disfavour the producer, other measures to stimulate output are not likely to succeed.

Undoubtedly, one of the major lessons, perhaps the major lesson, to be learned is that, as Pakistani experience above all has shown, farmers are fully responsive to adequate and demonstrable price and income opportunities. The first requirement, therefore, is a clearly defined national policy, not one merely of the departments responsible for agriculture, which contains the appropriate combination of incentive measures.

This becomes all the more essential when we consider the inadequacy of the institutional and administrative apparatus dealing with agricultural problems in many countries. This may take the form, on the one hand, of a lack of certain essential services — an extension net work, for example, or a sufficiently diffused credit system; but it may also take the even more intractable form of a proliferation of agencies concerned with aspects of agricultural development at the national, regional and local level. In this way,

the small supply of skilled and dedicated administrators may be overburdened with administrative work caused by overlapping and sometimes conflicting responsibilities. The temptation is great, sometimes with the best of intentions, to set up a new body or agency in order to by-pass an existing system which is considered inefficient or outmoded. Sometimes this may be necessary as a last resort or where an entirely new function is created, as for example, in a major land settlement project. But more often than not, it merely compounds the problem of the scarcity of good agricultural administrators, especially where the new agency is too close an imitation of similar institutions existing in developed countries.

Nowhere is the shortage of capable agricultural staffs more apparent than at the field level. Using conventional methods of administration, training and extension, indeed, it is difficult to see how the vast deficit of qualified local staffs can ever be made up in quite a number of countries. The basic need is for a radical change in the attitude towards the agricultural service as a profession, and, closely linked to this, an upgrading of the status of agricultural training institutions. It should be a matter of first priority to ensure that, at the least, the existing institutions are fully used and that young students are directed to them away from professions which make a marginal contribution to national development. Since a good deal of technical training is also provided under assistance programs, it is also incumbent upon developed countries to ensure that they have adequate specialized training capacity to meet the demands of developing country nationals. Beyond this, there is scope for much experiment with short cuts to meet the middle level skill gap, the use for example, of rapidly trained monitors (acting under adequate supervision and with provision for refresher courses) such as have been set up in Iran and Pakistan or of traveling teams to work with local monitors such as have been created in parts of Africa and Latin America.

PROBLEMS OF APPROACH

The problems of choice of approach (tactics rather than strategy) in agricultural policy are particularly difficult ones, given the atomistic nature of the sector, its tens and hundreds of thousands of separate points of decision and its special human and social dimensions. These factors are compounded by a lack of knowledge both of basic data necessary for policy decisions and of the interrelationships of factors affecting change. I was interested to hear the insistence of the Iranian

delegate on the frustrations caused by the lack of basic statistical data.

Even in the absence of precise quantitative knowledge, however, we can all learn a good deal from past experience. One of the most salutary lessons has probably been that the attempt to multiply and spread the effect of innovations through projects of the "demonstration" type needs to be approached with the greatest caution. We have learned, and we are still learning, that pilot projects which stand in isolation from surrounding farms may even have a negative effect on development in setting up fresh resistances to change. The interlinking of demonstration, dissemination of advice and farm inputs is a far more complex process than we had realized.

Some of these pitfalls can be avoided if projects are mounted on a sufficient scale to become themselves self-sustaining. This usually involves the selection of an area or region in which all the necessary inputs are provided simultaneously, with the corollary that other areas receive less than their "fair" share of such inputs. This is a difficult political decision to take: but there is no question that our techniques are now adequate to mount such "limited area" approaches successfully, given careful advance planning. There are enough authentic success stories using this approach to encourage greater attention to it by governments.

We have also learned that cooperative institutions of farmers require for their success not only a desire to cooperate but also a stiffening of competent professionals to ensure that farmers reap tangible and identifiable benefits. This again calls for a expanded training and educational effort which must be timed to ensure that cooperative institutions are firmly established from the outset and continue when the initial enthusiasm has worn off.

The cement for innovation, accelerated change and cooperative action may well be the supply of an adequate volume of low cost farm credit. Here again, we have seen the wider acceptance of the notion of selective credit schemes, which concentrate both on financing and technical advice on specific national goals, whether in the use of inputs such as fertilizer or the production of specific outputs such as livestock. We might also note the increasingly important role of regional development banks, notably in Latin America and more recently in Southeast Asia, in supplementing national sources of credit.

The principle of selective action, which permits a greater degree of integration of the various factors needed to induce growth and change, is thus gaining ground. But we should still remain pragmatic about this. Any opportunities for widely diffused action in certain fields as, for example in educational and training reform, should still be taken; and in certain circumstances it may be desirable to take a risk in the injection of a fairly limited number of inputs in order to produce at least some initial stimulus. This point has been put succinctly in a recent paper by Dr. Moseman, who has warned us not to get lost in a "maze of thinking that everything must be done concurrently."

POINTS OF DAC FOCUS

Our own discussions in DAC have led us to the conclusion that there are three factors, the supply of fertilzers, the further development of adaptive research for agriculture and the human resource (technical training and education)problems, on which attention should be especially focussed. This selection is determined partly by the scale and complexity of the effort which is needed in these fields and partly by our position as a group of aid-providing nations. This is not, of course, an exclusive list, but it is one which provides the core of national and international action to raise agricultural productivity. And all of these items are especially worth considering for cooperative action at the regional level among a number of developing countries.

Fertilizers - The Development Center of the OECD, which is a semi-autonomous research and training institute, has recently completed a study on the "Supply and Demand Prospects for Chemical Fertilizers in Developing Countries." One newspaper has referred to the "devastating arithmetic" which it contains. Let me refer briefly to its findings:

(i) Increased agricultural and food output will need to rely more heavily in the future on increasing yields per hectare as against taking new land into cultivation and under nearly all conditions this must involve much increased fertilizer consumption.

(ii) World consumption of fertilizer has been rising at around 11 to 12 percent a year in the 1960's; developing countries'

consumption has been rising even faster - at about 15 percent a year. Even if this rate continues, their share of world consumption will still only amount to one-third by 1968; their rates of fertilizer application will at that rate remain well below developed country averages.

(iii) Continuation of this increase assumes that farmers' demand, already very strong in many countries, will remain effective i. e. that the development of credit, agricultural research results and market incentives can be accelerated. We should be moving from a phase of limited, scattered fertilizer application into one of more generalized and intensive application in which fertilizer distribution and extension services will have to become more effective.

(iv) Production capacity can be found to meet this demand and the role of developing countries both as consumers and as producers of fertilizers is being increasingly recognized. The study points out that "nearly one-fourth of all new capacity under construction is located in the developing world" and that "plant locations at or near the source of raw materials are becoming increasingly attractive. "

(v) However, even with an assumed substantial increase in productive capacity in developing countries, they will become increasingly major importers of fertilizers - especially if the nutrient mix includes a higher proportion of phosphates and potash.

(vi) Both the increased investments in developing countries and their greater import requirements will raise major problems of foreign exchange availabilities for these countries. This is where the "devastating arithmetic" becomes apparent. External capital requirements for investment are estimated at about $650 million per annum during the 1970s; but import needs will call for foreign exchange expenditures of ever $4 billion by 1980, covering both fertilizers and raw materials needed for fertilizer production. The combined total of around $5 billion would amount to about 8 percent of total export earning of developing countries by 1980, and about half of present total public and private capital flows.

(vii) While production of fertilizers in developing countries is currently more expensive that their import, the foreign exchange savings from such products can be considerable; and, in any case, import of fertilizers is considerably less costly than grain imports assuming that fertilizer use is reasonably effective. A rough calculation for India, for example, shows that the wheat price C.I.F. Indian ports, which stands at about 80 dollars per ton could fall to about 24 dollars per ton before wheat imports would break even with fertilizer imports in foreign exchange terms.

These calculations, even if they are taken only as rough orders of magnitude, raise a number of very important issues. On the external financing side, the magnitude of requirements has to be seen against the present limited and rather static flow of public and private capital into developing countries and, for some of them, actual or potential difficulties in servicing their external debt obligations. Undoubtedly resource will have to be had to private sources of financing, preferably in the form of long-term investments rather than simply the use of short and medium-term supplier credits. While there are signs that aid-financed fertilizer supplies are increasing significantly, it seems highly unlikely that this expansion can be expected to cope with more than a modest part of total foreign exchange needs. If private investments are to be relied upon, then it is clear that the investment climate needs to be sufficiently atractive, and this raises major policy problems for developing countries not only in terms of the treatment of foreign investment generally but, equally important, the role of the private sector in fertilizer distribution and price determination. In this field, as in others, it should not be forgotten that private firms can be as important as suppliers of know-how as they can as suppliers of capital.

We are following up this report in further discussions with interested official agencies and with the fertilizer associations so as to see how its practical implications can be met. We are interested in ideas which have been put forward for special guarantees for investments in fertilizer and other agricultural inputs and in the means of more closely associating public and private initiatives in this whole field. Further, we are examining with our members how far fertilizer aid can be linked with food aid so that their participation in an international effort to meet the food problem can be based more closely upon their respective capacities to supply one or the other. This question assumes additional importance in view of the new GATT

Kennedy Round agreements on food aid and current UN proposals to establish a multilateral food aid fund.

Research - I do not need to stress in this audience the key role of adaptive research for new varieties and new methods in the effort to modernize agriculture. The struggle to improve the quality of inputs is a never-ending one and we can make only very limited and intermittent progress in expanding output if we rely upon the reordering of existing varieties and techniques. Moreover, since the building up to research capacity and the obtaining of useful results is inevitably a long-term operation, we must think now about the improvement of research systems if we are to achieve results in the future.

Our concern has been essentially with the organization and articulation of agricultural research institutions. We naturally turn in this case to the 20 year experience of the Rockefeller and Ford Fondations in the breeding and selection of new wheat, rice and corn varieties as well as to the specialized experience of a number of European institutes which have been working for decades in plant breeding, disease and pest control and so on. It is true also that there are already established in a number of developing countries networks of research stations which operate within the national territory or parts of it and which cover selected products or specific problems.

But it is our feeling that a wider international coordination and interchange of research results holds promise of potential gains which have only just begun to be tapped. This could work on a number of levels; world centers, such as the International Rice Research Institute in the Philippines, can concentrate on broad basic and applied research in crop and animal production, develop new types and varieties, disease and insect control measures and techniques for effective utilization of fertilizers and other cultural practices. They would have an essential function also as training centers for professional scientists to work at the regional and natioanl levels. Regional centers can test materials and approaches developed at world centers and adapt the results to suit local methods and conditions, likewise providing a training base for countries within the region. In no way would such centers replace or reduce the importance of national research systems; on the contrary, they would strengthen such systems and add an element of leadership and prestige which would enhance the standing of national agricultural programs.

It would be an impossible task for us in OECD and one of doubtful utility, to attempt to establish a complete world inventory of needs in this field. But we are now examining, with the various national and international agencies and with the foundations, what specific opportunities there may be for promoting regional, or possibly world research centers, dealing with particular groups of products or problems. This is not necessarily a matter of establishing new centers. As far as possible, it would be desirable to build on existing centers, reforming or broadening the range of their activities - and in any case, on the basis of a careful survey of functions, long-term staffing needs and costs, and the desired linkage with national systems.

Human rescources and technical assistance - European and North American experience has fully confirmed the strong correlation between "intellectual investments" in agriculture and the levels and rates of progress in agricultural productivity. Of all the missing factors for achieving agricultural expansion in developing countries, it is probable that lack of skilled personnel, at both the higher and the middle levels, is the one most difficult to deal with. And it can be demonstrated, as has been done for example, in the excellent work of the Shell Company on the transformation of rural communities in Borgo Mozzano (Italy) and elsewhere, that the returns from carefully planned and supervised technical assistance are many times the cost of providing such services. There is no question that opinion is now swinging back towards favouring a greater proportion of human resource investments in the capital/technical assistance mix for agricultural development. Unfortunately, the supply of good personnel is almost everywhere difficult, and it takes time to develop capacity to train new personnel. A number of our members (e. g. France, the United Kingdom and the United States) have recently taken measures to recruit additional personnel on a longer-time basis and to sponsor arrangements with their own national institutions to provide such personnel.

The fields of fertilizer supply, adaptive research and the pooling of skilled agricultural staffs are all eminently suitable for a co-operative effort among the countries represented here. From what I have said, you will see that I hope principally to learn from these discussions and, if necessary, to indicate to our member countries what they can to do help.

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THE DEVELOPMENT OF AGRICULTURAL RESEARCH AND EDUCATION

BY

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The essential development problems of agricultural research and education are much the same in all countries, whether they have only recently started to evolve modern systems of agriculture, or whether they have already progressed some distance along the road towards the maximum utilization of the agricultural environment. How to solve them, however, is greatly affected by the particular circumstances of each country. There is no "best" model, universally applicable to all countries.

In this paper I am recording my own views and experiences, which are not necessarily those of the British Government, or of any of its ministries or agencies, or of the Faculty of Agriculture of the University of Reading.

THE DEVELOPMENT OF AGRICULTURAL RESEARCH

The objects of agricultural research are to provide information which farmers can use to produce more output, and to make more profit, per unit area of land, and, where new land is available, to increase the area of land which is profitably farmed. The development of agricultural research presents three facets: 1) deciding what research to do, 2) doing it, and 3) ensuring that the results are applied.

Deciding What Research To Do

Two questions arise here: a) how the research priorities are decided, and b) who decides them.

How the research priorities are decided - The first task here is to decide what factors are limiting yields, profits and the area of land under cultivation. In all countries, yields are less than they could be for technical reasons (climate, soils, genetic potential of plants and animals, diseases, pests and weeds, agricultural methods) but in many they are limited also by economic, institutional and social factors which oppose change in agriculture. It is no good breeding a cotton which responds better to fertilizer, and so yields more than the present varieties, if the price is too low, the market too inefficient or corrupt, or the supply of consumer goods too small, too uninteresting or too costly to spur the farmer and his wife to the extra effort and expense needed to grow and harvest the new variety.

We all know about these non-technical limitations, but we have no clear understanding of how they work or even, in some cases, of how to detect them and measure objectively the constraints they impose on the farm enterprise. It is clear that they do not work in the same way in all countries. Why for instance, has the Rockefeller Program in the Agricultural Sciences been so outstandingly successful in Mexico, but less so in Colombia and Chile? Why has the agriculture of Kenya forged ahead so rapidly in recent years, while that of neighbouring countries has not? Why are there still large areas of backward farming even in the so-called advanced countries? We do not know, and we must find out. In collaboration with the Rockefeller Foundation we are arranging an International Seminar, to be held at Reading in September 1968, on change in agriculture and the factors which promote and oppose it. At this Seminar agricultural and social scientists will be brought together to analyse past successes and failures in agricultural development, in the hope of producing mutual understanding and a series of guide-lines for the study of the relation of agriculture to social change.

Where necessary, therefore, agricultural research programs must include research into these matters. Of them, only agricultural economics has hitherto been generally regarded as a legitimate part of agricultural research, which has been preponderantly based on the objective and quantitative natural sciences which got into the field first under such men as Davy, Lawes, Liebig and Pasteur. However as the

social sciences come to grips with the real world, and learn how to define and measure quantitatively the concepts with which they deal, they must come into the party too.

Their results must also affect decisions about priorities in that part of the program which is based on the natural sciences. They will indicate areas in which technical research is not likely to lead quickly to change, and others in which resistance to change is likely to be smaller.

I do not propose here to discuss technical limitations in detail, since that will have been done elsewhere in this Conference, but I do wish to suggest that preconceived ideas should always be rigorously tested, and that the special features of each country be taken into account. For example, in a recent exercise on agricultural research in Ethiopia, it became evident that the first need of all was to know more about the spatial distribution of climate, soils, and agricultural systems and potential - in other words to conduct an agro-ecological survey. This proposal was criticised and indeed rejected, apparently because work of this sort was not important in the home country of the critic, who seemed to think that the mixture which had served to cure all agricultural ills there was a universal panacea, applicable without distinction to all times and places.

When the factors limiting yield, profit and area have been identified, and placed in order of priority, the next task is to decide how to attack them, and to estimate what the attack will cost and what it will yield. This is a management problem in comparative cost-benefit analysis, though it is of a somewhat novel type, since in many areas the benefits are enormously greater than the cost, if the results are effectively used. It may cost less than $250,000 to produce a new crop variety which will yield several million dollars worth of extra crop per year with little or no increase in production costs. We need to develop the techniques of management planning for agricultural research so that we can replace vague optimism by something more precise.

In all countries, including the most advanced, the main weight of agricultural research must be on projects which will yield direct and foreseeable benefits, or permit other research to realise such benefits. This sort of research has recently been described in Britain as "mission-oriented." In addition, it is usually desirable to stimulate a certain amount of research of a more "speculative"

kind in order to develop particular areas in which more knowledge, and a greater number of trained and experienced people, are needed for agricultural purposes. (The overworked distinction between "pure" or "fundamental" and "applied" research generally produces arguments about words rather than useful results. A piece of thoroughly "pure" work may often be deliberately undertaken in order to solve a specific practical problem, and an applied study, like Pasteur's work on fermentation, may well throw up results which have such general application that they are truly "fundamental.")

Who is to decide the research priorities? - Many people are interested in the research priorities-farmers, agricultural advisors and administrators, economists, politicians, scientists (academic and otherwise), business men. Many, though not all, of their interests are legitimate, and they are certainly all different. Some of them, like the farmers and the tax-man from the Ministry of Finance, want immediate results; some want research grants; some want particular benefits for their supporters or constituents; some want to go to international gatherings like this one; some want power and authority; some want opportunities for profitable investment; some may even want to fill empty stomachs and make farm people more prosperous. In this welter of interests, the most important elements are technical and scientific competence, and after them foresight and continuity. Like agriculture, agricultural research is a long-term business, aimed at continually-developing goals. It requires a professional cadre which takes a long time to build, and it requires long-term investments in buildings and land. The machinery for reaching decisions must therefore be preponderantly influenced by the staff of permanent organizations who can relate short-term tactical decisions to a background of stable long-term strategic policy, and who will still be around when the cows come home, so that they can if necessary answer for their mistakes as well as take credit for their successes. The ephemeral politician, the minister who may have to take up a new assignment at any time, or even the permanent civil servant who may move from one ministry to another at short notice, cannot be solely entrusted with decisions whose consequences will affect action thirty and more years hence.

In many countries (including Britain and the Sudan) agricultural research is not the responsibility of the Ministry of Agriculture. This is an extreme position, and it is moderated by the peculiarly British tradition in which informal consultation overcomes all sorts of seeming administrative absurdities. In Mexico a virtually autonomous Office of Special Studies, in which the Rockefeller Foundation

provided continuity, directed the research program. In other cases universities provide an important element of continuity and independent judgment. Evidently there are many different ways of doing the job. In every successful case, however, there is some sort of Council, Office or Advisory Board for agricultural research, in which all legitimate interests have a voice, which can take the long-term decisions, has the financial and organizational means to carry them through, and wins authority and respect, both nationally and internationally, by its works.

Doing the Research

Two questions arise here: a) who does the research and b) how is it to be organized and tested?

Who does the research? - Research is done by people, and the first need here therefore is for trained and experienced men. In many countries, the domestic supply of trained men is not yet large enough to meet all the needs, and it is necessary to import skill and experience from other countries. This leads to many difficulties, but they can be overcome provided the newcomers have been properly prepared both technically and morally for their work, and are led and directed so that they and their families not only adapt themselves to their new environment, but identify themselves positively with the aims and aspirations of the society in which they have come to live. They must also be prepared and able to stay there long enough to make a significant contribution. The man who comes for one or two years, to widen his experience, is seldom worth his cost. Even at the best, foreign skill and experience are extremely expensive and are becoming more so. It is essential to train local people and build up an indigenous professional cadre.

A locally born scientist must be appropriately qualified for his work, like any other. At present this often means that he attains his first degree in his home country (and to the content of those degrees I return below) and then goes abroad (preferably after a period of service at home) for research training. In principle, this is a good thing, and it should continue, for some graduates at least, so long as the home country is not itself a leading international center of thought and action in agricultural science. This presents a problem for the local universities, since it means that their best graduates leave them to go abroad instead of helping as graduate or postdoctoral students to build up indigenous research schools. There

is no simple answer to this problem until the local universities have research schools strong enough to attract students from other countries to redress the balance. The brain-drain is no new phenomenom; even Leonardo da Vinci spent his last years in France; but the international agencies and foundations could well be encouraged to allocate funds in order to offset it, and the local universities should use the advantages of their special situations to develop research schools which are of international interest.

The man who goes to a more advanced country for graduate work runs another risk. He may be set to work on a highly specialized problem which has no obvious application in his home country. This trains his mind and teaches him method and technique, but it may well leave him isolated and dissatisfied when he returns home and finds that neither the funds nor the equipment are available to enable him to continue work in the only field in which he has experience and confidence. We who train students from such countries have a very heavy responsibility to select wisely the problems we set them, and their home authorities should ensure that the projects on which their young men are put to work are relevant to the needs of the country.

Even if this is done the new Ph. D. may well come back, his apprenticeship completed, into a research organization without any developed professional structure; he may indeed have to assume senior responsibilities himself very early in his career. This deprives him of a very important element in a young scientist's training - a period of successful and more or less independent work in an established real-life organization, in which he can develop his confidence and independent abilities within an existing and stable program, guided by more experienced colleagues. In this phase he learns how to choose priorities in his work and break down more complex problems into more manageable pieces, and so acquires the experience, judgment and scientific taste, as well as administrative experience, which will fit him to be a leader in his turn.

How is the research to be organized? - Good research is a highly individual business. It depends essentially on the ideas, drive, enthusiasm and initiative of individuals. Yet these individuals and their independent qualities have to be brought together to serve national ends in a common program. This is the dilemma of all research organization; the art is to combine individual initiative with common action without destroying either. There is only one way in which it can be done - by a grass roots system of consultation

in which every man is encouraged to help as best he can to form the common program, knows what his objects are and what his part in the effort is, and gets credit for his share in it. Not all directors, and not all less senior workers, are paragons, and the extreme individualist at either level may have to be told that his best contribution is more likely to be made elsewhere, but where communication is easy and responsibility is delegated, the two opposites rub along together well enough. The responsibility for communication and leadership is of course primarily on the senior man: he is paid to select and get on with his juniors and if instead he consistently quarrels with them it is he who must go. It is also his task to preserve continuity and stability by ensuring funds for the work and protecting his staff from capricious external pressures. Research must be organized on the basis of agreed annual programs for which specific funds are provided; and once the program is agreed on no one must be allowed to rock the boat.

From the national point of view, there are advantages in dispersing research in several sorts of institutions ranging from the specialized government research station at one extreme to the nominally independent university department at the other, provided only that at all levels the work done represents value for money. Where the balance between state-controlled and more independent research lies in any one country will depend on the amount and distribution of scientific strength: there is no unique correct answer. The national program must have sufficient strength, and that means sufficient money, to give a lead; and once that is assured there are very powerful arguments for drawing in, by means of research grants where necessary, all possible resources from the private and particularly the academic sectors. Specialist advisory committees which include competent senior non-official people may be invaluable.

To get the work started is not enough: there must be means for assessing the results and for stopping it if necessary. The specialist advisory committees can help in this. Particular institutions which are supported by government should be visited and reported on at regular intervals by groups which include as many senior non-official scientists as possible. Each such institution should have its own board of governors to advise and support its director, and to help him and his staff to formulate their programs of work. In these ways the national program and the financial decisions through which it is implemented come to rest on a broad basis of professional understanding and support.

Further comments on agricultural research in the universities appear below.

Ensuring That the Results are Applied

Agricultural research is for use, not for ostentation. If its results are not used, money is wasted. It is the duty of the national research organization, as well as of the individual research scientists, to see to it that the results are put to work. If a project has been correctly selected in the first place, this should be easy, unless the industry, for the reasons set out above, is incapable of accepting change.

Usually the official agricultural service includes an extension branch whose task it is to take the research results to the farmer. In individual states in the United States extension and some of the more applied and practical parts of the research program are both controlled by the state university; and this certainly ensures that results are taken out to the farmer speedily, often by the research men who have produced them. In Britain we are at the opposite extreme: official research and extension are separate, and both are largely separate from the university system. Nevertheless it moves: numerous personal contacts and the sensible location of laboratories help us to bridge the gap. At many of the more applied research stations a member of the appropriate branch of the extension service is stationed to act as a liaison officer. The same method has been used in Northern Nigeria to link teaching and research in the university with the extension service outside it. These links work in both directions: they lead to a two-way traffic - problems and suggestions from field to research and specialist workers; results and guidance from research workers and specialists to the field. Research workers have a particularly important role in the refresher training of extension workers.

In many countries commercial firms provide even more guidance to farmers than do the official services. Whenever this is so, it seems essential to find means of associating the commercial and the official effort more closely, particularly when the commercial firm is also actively engaged in research.

The results of research must also be carried to the educational institutions: this is dealt with below. In general the large and formal periodic conference is less effective as a means of conveying research results to the extension and education services than frequent personal contacts at professional and technical levels.

THE DEVELOPMENT OF EDUCATION INSTITUTIONS

Institutional education serves agriculture at four different levels - in the primary and secondary schools, in specialist post-secondary vocational training institutions, in universities, and in farmer training centers. Most of this education is provided or at least strongly influenced by governments. A very great deal has been written about each of these levels. Here I seek only to define the philosophy and objects of education at each level, and to make some comments on the methods of instruction that follow from the philosophy. In general, agricultural education will succeed only as agriculture succeeds: careers in the industry or in the service of the industry will be attractive only if the industry is prosperous. If agriculture itself is not advancing, it is inevitable that agricultural students will have white-collar ambitions and hold practical work in contempt: the critic must ask himself whether he personally would wish to devote his life to the practical work of the industry, or to send his sons into it, and if not why not. An Iron Age technology cannot hope to attract lively youngsters who happen to have been born into the Space Age.

Agriculture in the General School System

All citizens, and particularly those who grow up in towns, must be informed about the sources of their food and of biological raw materials, about the agriculture of their own country, and about the main problems of agricultural policy. To be so informed, they require a general background of information on biological, geographical and physical science subjects. Instruction in these subjects should therefore include agricultural examples from the earliest stages. In secondary schools in towns, applied and human biology and civics should carry this further. Country secondary schools should offer science-based courses in the principles of agriculture, exemplified by observations, measurements and simple experiments in the laboratory and particularly in the field, on climate, soils and farm crops and animals. The school garden or farm should be an open-air laboratory for these studies, and not merely the scene of unpleasant labor calculated to reinforce any desire the students may already have to get as far away from the industry as they can.

Specialist Post-Secondary Training (intermediate training)

This training is intended for the young man or woman who wishes to manage a fairly large farm, or to enter official or private employ-

ment in agriculture at a level below that of a graduate. It could also, in some circumstances, be useful in the training of primary school teachers. Its object is to convey an informed understanding of the processes of farm production, of current and possible future advances in agricultural technology, and of the methods by which the farm business is run. It is based on science and business management and aimed at current practice.

The intermediate sector is likely, in many developing countries, to be the largest sector of the agricultural education system. It will produce the bulk of the staff of the official services, including those who are in closest contact with the farmers. It must therefore, contain a science base sufficiently strong to ensure that the student (helped by refresher courses from time to time) is able to welcome and understand innovations through the whole of the forty or more years of his or her working life.

The instruction must contain a good deal of practical work, particularly in the field. Once again field experiments are important as means of illustrating scientific ideas and methods. Students in these institutions will usually have chosen to enter them and can therefore be expected to be interested in the methods of commercial production, provided these are more modern and more successful than the traditional methods.

It is particularly important, especially in societies in which women have substantial responsibility for food production, that a sufficient proportion of students at this level should be women. The Western concept of the male extension worker bringing his message to a male farmer may fail completely when food production is women's work, as it is in some African societies. Moreover women have a very special role in rural social development, and often in economic development too - for example in the marketing and distribution of food. Plainly there must be women agricultural officers for this work, and wherever possible they should be trained alongside the men.

University Education and Training in Agriculture

The object of university education and training in agriculture is to produce men and women who not only understand the scientific and economic bases of farming, and can understand and accept innovations, but can also develop innovations themselves as research workers, direct the introduction or innovations as administrators, and train

their successors as teachers. They are high-grade and costly products. Their training is based on the sciences (particularly general biology, anatomy, morphology, genetics, biochemistry, environmental studies and plant and animal physiology), and on economics and engineering; and it must be such as to give them an understanding of experimental method and some training in logical argument and in making decisions. A university syllabus in agriculture is not intended merely to teach the student about the best current practice in crop and animal production in the country concerned; it has to teach him the common applied scientific basis of successful agricultural practice in all countries. The local practice should be one only of a number of examples used (in comparative studies) to illustrate the application of those general ideas. Such a course enables the student to adapt himself readily to different conditions, and it provides the best possible training for research on agricultural systems and practice.

At the same time the university, if it is worthy of the name, must provide intellectual leadership for the community. It does this by educating and training the future intellectual leaders, and by advancing knowledge through pure and applied research, not only in agriculture and agricultural science, but in many other fields also. In my view a purely technological agricultural university, in which all activities revolve round farm affairs, is less well adapted to educate and train, and to advance knowledge and to provide leadership, than a university in which a wider range of interests act and react on each other. Any separation of agriculture from other faculties may be particularly dangerous in a country whose academic and research strength is not great, since it is bound to disperse scarce resources and lose the positive gains of cooperation and collaboration.

In all true universities, the academic freedoms include the right of each academic to pursue freely the search for new knowledge, wherever it may lead. At the same time universities cannot neglect national needs. In agriculture, their research should form part of a common national effort broadly aimed at practical goals. Clearly there are possibilities of conflict here between individual freedom and social needs, but the risk must be taken. The universities, for their part, must explicitly accept their social obligations and so earn the trust and support of the community. In appointing staff to agricultural faculties they should seek men and women of distinction whose research interests take account of social needs, and most of whom devote a large part of their research time to 'mission-oriented' research - so long

as it is good research. The prestige of 'fundamental' or 'speculative' research too easily draws university research workers in agriculture away from the practical objectives which they should constantly have in view. Government and university authorities must consciously seek to guide them along appropriate paths by involving them in the national planning of research and by the judicious use of research funds. The individual research worker in a university must be free to choose his research as he wishes, but his head of department, or the national research authority, must be equally free to decide whether or not to pay for it.

These relations are delicate, they grow slowly and they must be tended with care, particularly where an agricultural faculty forms part of a Ministry of Agriculture. They are of the utmost importance, since they determine the intellectual initiative and liveliness of a faculty of agriculture, and hence the quality of its teaching and of its graduates.

A university has a dual role in another field. On the one hand, a university exists to serve the national community that supports it. On the other, it has obligations to mankind as a whole. A university must strive to become an international institution. It forms part of a world community of learning and action which has grown in strength through a historical period of great and accelerating change. As communications improve and the world shrinks, the links within this community become ever stronger. A university faculty of agriculture, like any other, must be able to develop these links by correspondence, visits and publications, by arranging significant international gatherings, and by attracting students and research workers from other lands to work in its laboratories and at its field stations. In new faculties in countries where university research is not highly developed this is particularly important, since it is the only way in which the need to build up strong academic staff and research schools can be harmonized with the need to send many of the best graduates abroad to broaden their experience and put them in touch with the leaders of research in their fields of interest. The exchange aspects of schemes for international cooperation are consequently of the highest importance.

While I should be the last to belittle the importance of the university level of agricultural education, experience suggests that some countries have expanded this sector beyond their capacity to support it. Graduates are produced for whom there are no jobs, and this leads to disillusionment and to the 'brain drain': the well qualified

young scientist is unwilling or unable to work in his own country either because there is no job for him there or because it is too poorly paid. The development of universities must be related to effective manpower needs in the future, and not solely to the numbers of qualified high school graduates who wish to enter them.

The Institutional Training of Farmers and Farm Workers

The higher levels of education have a delayed effect on the industry. A university faculty of agriculture founded now will not significantly affect the industry for ten years. The urgent task is to educate the farmers themselves. In many countries the day-to-day work of the extension service is powerfully aided by institutional training of farmers and farm workers and often of their wives also. There are innumerable ways of doing this - all combinations of long and short courses, residential and non-residential institutions, part-time and full-time instruction - are successful in different countries. Where however most farmers are poor, little-educated, or even illiterate, the important thing is not so much to train the farmer, as to convince him that he can be trained. For this purpose a residential course of no more than one or two weeks, built around visual and spoken demonstration and practical instruction in a small group of related skills, has been found in many countries to have a powerful effect in breaking the ice and creating a demand for more education. This requires a network of farm institutes, or training centers, in the country-side, provided with accommodation, feeding and some recreational facilities, and staffed by practically-minded local people, who speak the language and have mastered the skills they have to teach, and who know how to teach without relying on the written word. Where the industry is on the move, such centers can have more immediate impact on change in agriculture than any other level of agricultural education, and consequently they may often deserve higher priority in development programs than the expansion of existing facilities at other levels.

Agricultural Extension and Agricultural Change

At all levels, those who teach and so far as possible those who are taught should be aware of the nature of change in agriculture in their country, of the factors which promote or impede it, and of its relation to general economic and social advance. This is the philosophy of agricultural extension without which its methodology and practice (education, psychology, teaching method, organization

technical content and so on) may not be fully effective. Particularly in countries where the industry is only now starting to advance, or where its advance has not yet begun, extension work requires far more than skill in communication and good material to communicate. In this fuller sense agricultural extension should form part of the curriculum of all courses at the intermediate and university levels, so that the graduates can play a conscious part in transforming agriculture. Agricultural education in the past has been largely science - and technology-oriented. In seeking to change agriculture, particularly in countries where it provides the livelihood of most of the people, we are seeking to change the lives of large numbers of men and women and even the character of whole nations. These changes cannot be left to take their own course: they must be understood and consciously planned so that they can happen speedily, efficiently and with the minimum of social and human damage. Throughout the developing world the swollen slum cities with their disease, poverty, hunger and social disintegration testify to our failure to do these things in the war on hunger, we must do them and do them properly, yet in this we are hampered by almost complete ignorance of the social relations of agricultural change. I hope that the International Seminar on Change in Agriculture, to which I have already referred, will bring together some at least of the essential information on these subjects and that its published proceedings will serve as a manual of agricultural change during the thirty critical years that lie ahead.

THE RELATION BETWEEN RESEARCH AND EDUCATIONAL INSTITUTIONS

The educational institutions make, or should make, significant contributions to research. They also produce the future research workers as well as the people who will apply the results of the research to the farming industry. A significant proportion of these people are employed in the public service, and both the research and the educational institutions are largely or entirely paid for by governments, which are consequently bound to be closely interested in getting value, in increased farm output, for the money they invest. For all these reasons, it is essential that proper machinery be devised to link together the programs of the research and educational institutions, and to relate their work to the country's needs. There are many different ways of doing this, including the highly organized system of the United States and the much looser British system. In many countries, the main feature is some sort of central council for

agricultural research, to which I have already referred. In other countries, however, and particularly in those in which agriculture is the principal industry, this may not be enough, since it may not sufficiently associate the research and educational effort with general economic and agricultural policy. An apparently simple solution is to place all aspects of agricultural research, education and extension under the control of a Ministry of Agriculture, which has to form agricultural policy as part of general national policy and is therefore best able to determine priorities. Many countries have found however that research, whose nature it is to innovate and to change things, does not fit well in a Ministry which exists to carry out tasks given to it by legislation, and which tends to preserve the status quo; and in others it has not proved easy to allocate one part of the educational system to the Ministry of Agriculture while leaving the rest in the care of a Ministry of Education. There is no ideal or universal solution; each country has to work out its own, in accordance with its resources and needs, in such a way as to give research and education the freedom they need to experiement and innovate, while determining their objectives, size and scope in accordance with national interests.

Whatever form of organization is adopted, the most effective way of associating research and educational institutions is to bring them together physically. Perhaps the best solution is to establish research institutes and universities close to each other, after the style of Wageningen in Holland, and then to establish formal or informal local links between them. A university can give very powerful help in this process. In Northern Nigeria, for example, Ahmadu Bello University was established next to the headquarters station of the official research service, which then become part of the university, though of course its annual program (which is paid for by government) is approved by a board on which the ministry is very strongly represented. At Reading we have as neighbours, within a 25 mile radius, a considerable number of official (or officially sponsored) and commercial research institutions in the fields of food and agriculture, as well as the regional headquarters of the National Agricultural Advisory Sevice. Our Faculty of Agriculture has collaborated with most of these institutions for many years, to our great benefit in both research and teaching. As a result we are very well placed to help overseas institutions, for which we can provide, through our Overseas Service Unit, a direct yet unofficial link with large parts of the British research effort in food and agriculture. One result of this has been that the Ministry of Overseas Development is exploring the possibility of moving certain

of its largest laboratories in these fields (the Tropical Products Institute, the Anti-Locust Research Center, and the Overseas Land Resources Unit and possibly other parts of the Directorate of Overseas Surveys) to Reading, and associating them closely with the university. Needless to say, we shall welcome this if it proves possible; it is bound to increase enormously our capacity to help our colleagues in sister universities and in research institutions overseas.

REGIONAL RESEARCH PROGRAMS

There are six central questions here: 1) what is a region, and what is regionalization 2) what sort of research can best be done regionally, 3) who formulates and directs the regional program, 4) who pays for it, 5) who does the work and where, and 6) how are the results used? I propose to comment on these questions briefly. Experience of regionalization in agricultural research is so limited that generalizations are unsafe. I am dealing solely with research, but some of the considerations are relevant to education also.

What is a region and what is "regionalization"? - A region in this context must consist of a group of sovereign states, more or less near one another, with common agricultural problems and preferably a common language, which are prepared to work together for long enough - and that is for many years - to permit some form of co-operation between them in agricultural research and education to pay off. If any of these conditions fails, "regionalization" may fail and considerable investments may be lost. It is seldom, moreover, that a group of sovereign states consists of truly equal partners; usually one or two are more equal than the others, and so the regionalization may appear to give these more fortunate or favoured ones a degree of leadership that may sooner or later come to be resented.

"Regionalization" may have many forms. The Inter American Food Crops Program of the Rockefeller Foundation appears to have developed at the technical level, without any formal agreement between governments. It is essentially a system of cooperation in planning programs and pooling results. At the other extreme, a central "super-national" research organization may be set up, by agreement between governments, with a director and headquarters laboratories. Such a scheme has always encountered territorial jealousies and rivalries, particularly in times of change. Yet inividual scientists are usually glad to cooperate across national frontiers; this is inherent in the nature of science.

What sort of work can best be done regionally? - It has often been assumed that regional organizations are suitable to tackle common problems, or more fundamental studies, which need equipment or human resources too expensive or too rare for any one territory to deploy on its own. This starts off on the wrong foot, since by definition such a regional organization is at least one peck ahead of its territorial counterparts, and sooner or later this will be resented. Central organizations can however be very valuable in providing continuity across national frontiers (for example in mapping in climatology, geology, soils, and vegetation, in disease control and quarantine, and in maintaining central plant and animal collections) and in providing a point of exchange, contact and discussion on common problems-for the territorial organizations. From these common services and exchanges research may come to be shared between territorial organizations in an orderly way.

I have concluded that the role of a central organization in executing research is less important than its role as a focal point for cooperation, mutual guidance, coordination of action and sharing results.

Who formulates and directs the regional program? - From this it followed that except in some special fields, I am doubtful of the value of centralized research or educational institutions serving more than one sovereign state. I believe however that there are very great prospects for cooperative organizations which bring together the national efforts of neighbouring countries. In such an organization, the program would be formed cooperatively and executed largely in laboratories and at experimental stations in the individual countries. The regional organization would have staff of its own, particularly in specialized subjects, but they would not all be concentrated at a headquarters station. Instead they would be distributed at territorial or regional stations in the member countries. The execution of the program would be supervised by a director and a small staff whose location would be determined largely by ease of communications.

Who pays? - Plainly the greater part of the cost would be borne largely by the cooperating governments; this is the importance of long-term stability and agreements. Some guarantee of stability can be provided by a neutral external organization which provides finance and some key staff; and it is plainly an advantage if such an organization is evidently free from political ties or pressures so that no undesirable strings can be attached to its aid. This external finance

can also confer an element of insulation against local pressures, though plainly this requires skill and tact. The Rockefeller Foundation has helped in this way during the past decade to build cooperation between the countries of the Americas in food crop research, and the Cotton Research Corporation has done the same for cotton research in a number of tropical areas for over 40 years.

Who does the work and where? - Ideally the work is best done by indigenous scientists of the countries of the region, mostly working in their own countries. Many difficulties (not least of language), can arise in mixed teams of scientists of different nationalities, at least in the earlier stages; but as international collaboration becomes an accepted reality, it may well be fostered if some of the younger and more mobile workers spend part of their career in other countries. If the international cooperation is buttressed by a systematic training scheme, it will often prove most efficient to conduct part of a man's training in a foreign country. One of the disadvantages of central regional stations in regions which are short of skilled people is that national efforts may be weakened if some of the best people are withdrawn from their own countries to work in regional centers.

While a truly international scientific service is a worthy ideal which can do much to promote international understanding, I believe that regional organizations can work best only when the national organizations are strong enough to throw up the problems which can best be solved regionally, and to apply the solutions to the conditions of their own countries. I conclude therefore that, in general, regional scientific potential must not be developed at the expense of national strength, and this is one of my strongest reasons for preferring a cooperative type of regional organization to a "super-national" type.

How are the results to be used? - The results of such cooperative regional projects must be communicated to national research organizations, translated where necessary into local terms and then passed on to the extension and education services, and so to farmers, in individual countries. All this reinforces the view that (except in some very special fields or in very special circumstances, for example the nations are too small to have viable research organizations of their own, as in parts of the West Indies) the first task is to build the national organizations, since without them the regional organization cannot be effectively used. Regional organization of any sort must draw much of its strength from the grass-roots in the individual countries. Cut off from this support it is all too likely to fail.

I believe that parallel considerations apply to educational institutions. Experience shows too plainly the divisive tendencies in regional universities; sovereign states want their own academic institutions. Thus it is often wasteful in strict cost-benefit terms, but a formal analysis will leave out of account the importance to a nation of the independent intellectual leadership and service which a good university, properly staffed and equipped, can provide. Whether we like them or not the facts are plain. We live in an age in which nationalization is growing; formerly unitary states tend to divide, rather than to come freely together. Across the rising barriers academic cooperation, particularly in research, post-graduate work and specialist undergraduate teaching, has an important part to play in preserving international ideals against the tides of change, as well as in making better use of scarce resources, but the tides are running strongly and cannot be denied. Once again, therefore, the practical answer seems to be to encourage cooperation in appropriate fields but to recognize that this is most likely to grow between independent equals rather than as an international substitute for national institutions.

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THE DEVELOPMENT OF AGRICULTURAL RESEARCH AND EDUCATIONAL INSTITUTIONS AND PROGRAMS

BY

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The growing concern about deficient world food supplies, dramatized by two years of short monsoons in South Asia, and emphasized by depletion of U.S. and world stocks of food grains, has placed international agricultural development in a new perspective. It is now generally recognized that 1) world food needs must be met largely by increased production in the developing nations, 2) most of the increase must be in food grains, and 3) the greater production must come from more intensive cultivation of present arable lands. This will require substantial change in agricultural production practices, with greater emphasis on the more effective use of improved crop varieties, fertilizers, pesticides, machine and irrigation water.

It has been amply demonstrated that the proper combinations of such new inputs can boost yields of the major food crops three to four fold. Our purpose is to consider the types of institutions and programs that will facilitate the orderly development and use of new knowledge and materials to accelerate agricultural growth.

We have had substantial experience during the past two decades in "institution building" in cooperative agricultural development programs. But many of these projects have been concerned with multiple-purpose community development, with joint attention to agriculture, health, sanitation, road construction, etc. Considerable emphasis has been on organizing extension services to improve communications with rural people. Some attention has been given also to the strengthening of

individual rural universities or colleges of agriculture. But little effort has been made to establish integrated agricultural research and education systems for the orderly and continuous infusion of innovations to improve production.

Our mutual neglect of the development of indigenous agricultural research and educational institutions to promote production stems from 1) the "extension bias" or assumption that advances from developed nations could be transferred directly, 2) the emphasis on industrial development, and 3) the heavy reliance, almost from the beginning, on surplus agricultural commodities from the U.S. to meet deficiencies in the developing countries. This bond of interdependence— for markets on the part of the surplus producing nations, and for supplies on the part of the receiving nations— has been particularly significant in retarding cooperative efforts to build agricultural production capabilities in the developing countries.

Farming methods in the agriculturally less developed nations are characterized by relatively low investment, low risk, and low productivity. We would not expect change from these traditional practices to occur rapidly under usual circumstances. But with today's worldwide pressure for increased food supplies, from a rapidly growing population, every effort must be made not only to accelerate increased agricultural production but also to provide for steady improvements over a sustained period. This will require new emphasis on science and technology, with special attention to 1) the systematic introduction of new materials and practices from agriculturally advanced nations, with "adaptive research" to modify and fit such potential innovations to local conditions, and 2) the building of indigenous capability in research and education to insure the perpetuation of further productive innovations.

ADAPTING INTRODUCED AGRICULTURAL TECHNOLOGY

Much of our early cooperative technical assistance was based on the premise that technology from agriculturally advanced countries could be transferred directly to the developing nations. The experience in establishing production of hybrid corn in Europe during the Marshall Plan period of 1948-51 created a general assumption that similar direct transfer could be made to other parts of the world. We learned, after a decade of experience, that not only hybrid corn but other improved crop varieties and production practices from temperature zone agriculture usually do not fit the tropical environments of most developing countries.

There is a growing realization on the part of qualified agriculturists that the transfer of agricultural technology must be orderly process of introducing, evaluating, and modifying the new inputs. Frequently only relatively minor adjustments in production practices will bring out the full potential of a new variety or other input which on initial observation may not have appeared to be outstanding.

An example is the experience in introducing the highly productive "Mexican wheats" into India and Pakistan in the past several years. These varieties, with their short, stiff straw and capability to utilize high levels of nitrogen fertilizer to produce yields that are double to four-fold those of the varieties commonly grown in the Near East and South Asia, did not perform as well in some of the first trials in India and Pakistan as was expected on the basis of their records in Mexico. It was necessary to acquaint those responsible for conducting the test demonstrations with some of the special characteristics or requirements of the introduced varieties. The short statured wheats are dwarf also in the seeding stage. This affects their ability to emerge when planted too deeply, so a relatively uniform and moderate depth of planting is required. The short stature also limits their competition with weeds and so special weed control measures may be necessary. The varieties respond to high levels of fertilizer, up to one hundred pounds or more of nitrogen per acre, in contrast with the usual applcations of 35 pounds or less. The early maturity of the varieties requires adjustment of the irrigation regimes or the timing and amounts of application of water. They tend to "shatter" or lose their seed if allowed to stand in the fields after they are ripe, so timely harvesting is important.

The introduction of "new seeds" or of fertilizers can result in disappointment if we do not give proper attention to interdisciplinary adaptive research and testing to insure selection of potentially adaptable varieties; to suitable planting methods; to effective disease, weed and pest control practices; and to soil fertility and water management. This involves an "institutionalized science" approach, both from the donor or resource end— to insure the maximum potential application, and in the cooperating developing country— to insure effective initial evaluation, modification, verification, and distribution of the new material or practice.

BUILDING NEW TECHNOLOGY RESOURCES FOR AGRICULTURAL DEVELOPMENT

The Rockfeller Foundation Program in Agriculture, initiated in cooperation with the government of Mexico in 1943, was one of the first efforts to utilize research to improve materials and practices for increased production of the basic food crops, suited specifically to cropping conditions of the host country. The systematic effort for the introduction, evaluation, adaptation or modification through research, and distribution of new materials and production practices was the basic ingredient in the spectacular increase in wheat production in Mexico. Production had been inadequate for domestic needs from the time the crop was introduced into the country by the Spaniards in about 1520, and in 1943 when the cooperative program was launched, Mexico was importing about one-half of her national requirements. In 1956 Mexico for the first time achieved self-sufficiency in wheat and the steady increase in production related closely to the infusion of new technology from the cooperative research program.

The cooperative program in Mexico concentrated on adaptive research to provide modern technology for improving production of wheat, corn, beans and other crops under the farming conditions in Mexico. The similar cooperation extended to Colombia, Chile, and India from 1950 to 1956 also had the primary objective of fitting innovations to the environments and needs of the host country. The benefits from these "national" programs have been made available to other countries through the usual procedures of exchange of materials and visits of technical personnel.

Regional and International Programs for Corn Improvement

The initial organized effort to utilize the new research resource from Mexico in a regional program was the Central American Corn Improvement Project, initiated by the Foundation in 1954 in cooperation with the Central American republics of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. Jamaica and the Dominican Republic have been included in more recent years.

A northern Andean regional cooperative corn improvement program, with headquarters in Colombia and with participation of research organizations of Ecuador, Venezuela and Peru, was established in the late 1950's. An inter-Asian corn improvement program, based upon the cooperative work that was initiated in India in 1957, is just getting under

way with headquarters in Thailand and cooperation with national agencies of India, Pakistan, Nepal, Thailand, the Philippines, and Malaysia.

No regional effort has been organized in Africa, but Rockefeller Foundation support for corn research in Kenya, Ethiopia, the United Arab Republic and Nigeria, together with the project supported by the U.S. Agency for International Development on improvement of the major cereal crops of Africa, with special emphasis on corn and sorghum, furnishes a nucleus for such regional collaboration. The U.S. Department of Agriculture is conducting the AID-financed project.

In 1966 the International Maize and Wheat Improvement Center was established in Mexico by the government of Mexico and the Rockefeller Foundation. This center will concentrate on basic and applied research to develop prime materials with maximum potential for corn and wheat growing regions of the world. For example, six "germ plasm complexes" have been assembled from the more than 250 races of maize collected in Latin America. These complexes or genetic composites have been widely distributed through the regional maize improvement programs, and in Africa, and it is evident that they will be extremely useful in breeding programs to develop superior varieties for lowland tropical areas of the world.

The international dimension of research for corn improvement illustrates the evolution of patterns of technical cooperation in which the "donor" collaborator is making a specific effort to design resources for maximum potential fit to the needs of the developing nation.

Regional and International Programs for Rice Improvement

A resource of agricultural science and technology of special significance with respect to impact on world food production potentials is the International Rice Research Institute at Los Banos, adjacent to the College of Agriculture of the University of the Philippines. The Institute was established after a careful evaluation of the needs and opportunities for developing and applying new technology to improve rice production in the rice bowl of Asia. Following an intensive study of problems and prospects in the region in 1955-56 the Rockefeller Foundation furnished support to strengthen existing programs and institutions in Asia through training awards, fellowships, and grants for equipment and facilities. It soon became apparent that a more concerted effort was necessary and in 1960 the Rockefeller Foundation,

Ford Foundation and government of the Philippines collaborated in organizing the International Rice Research Institute. Within two years the Institute's laboratory facilities were constructed, more than 200 acres of experimental fields were laid out, and a staff of 20 senior scientists was employed to direct research on all aspects of rice production and use. The Institute provides leadership for in-service training, sponsors conferences on selected research problems, and has an outstanding information and documentation center.

The Institute's initial program concentrated on the evaluation of available advances in improved varieties, cultural practices, and in pest and weed control methods. The variety Taichung Native 1, which had been bred and selected in Taiwan, proved to be widely adapted not only in the Philippines and other Asian rice bowl countries but also in India and Pakistan. This short-strawed, lodging resistant, nitrogen responsive Oryza indica variety has produced yields of more than 8,000 kilograms per hectare, or essentially double to four-fold those of local rice varieties. This high yield performance has been a major factor in impressing not only farmers but also government leaders in Asian countries of the potentials of new production technology in meeting food requirements.

The continuing crop breeding program at the IRRI has produced the selection IR-8 and other varieties, together with other new production technology that is being applied in the Philippines through an intensive program supported by the Agency for International Development, in Pakistan through a cooperative program initiated in 1966 with Ford Foundation support, and in India with cooperative help from the Rockefeller Foundation and AID. The Institute also is collaborating directly with other rice bowl nations to make improved materials and production practices available.

The new technology for improving rice production that is flowing from the IRRI should be channeled to rice growing areas of Africa and Latin America through regional centers or programs that would facilitate rapid evaluation, adaptation, and use. The Ford and Rockefeller Foundations and the Agency for International Development are exploring the organization of such regional programs.

Regional and International Programs for Wheat Improvement

The international cooperation in crop improvement that is perhaps of greatest interest to the CENTO countries is the program from which

the "Mexican wheats" have emerged. The semi-dwarf varieties Sonora 63, Sonora 64, Lerma Rojo 64A, Pitic, Penjamo 62 and other selections with short, stiff straw that can utilize high levels of nitrogen fertilizer application to produce exceptional yields are non-sensitive to day length so are suited for growing over a wide range of latitudes.

These wheats have not only furnished the new technology base for the nearly four-fold increase in yields per hectare in Mexico but they are also supplying a major new input thrust for increased wheat production in India, Pakistan, Turkey and elsewhere in the Near East, South Asia, and Africa. About eighty thousand tons of seed of these highly productive varieties have been introduced into this region from Mexico in the past year, including 18,000 tons purchased by the government of India in August 1966, and 19,600 tons purchased by the government of Turkey and 40,000 tons by the government of Pakistan in May 1967.

The present group of "Mexican wheats" that are making such an important worldwide impact are the product of more than 15 years of international biological engineering beginning with the cooperative wheat improvement program of the Rockefeller Foundation and the government of Mexico that was initiated in 1943 as an intensive adaptive research effort. The stem rust disease was the principal handicap to wheat production in Mexico at that time and the rust resistant varieties and hybrid selections introduced from the United States and Kenya provided an initial stop-gap for increasing and stabilizing yields. Then, selections from crosses of these introduced varieties with local wheats further increased yields since the new selections were more specifically adapted to local growing conditions.

A heavy infestation of the virulent form or race 15B of stem rust in 1951 caused heavy damage to the selections carrying resistance from the U.S. germ plasm but the varieties with the Kenya source of resistance withstood the disease. In 1953, however, stem rust race 139 caused heavy losses to varieties with Kenya parentage. The continuing breeding and selection program in Mexico, utilizing germ plasm or genetic stocks from a worldwide collection of wheats, made it possible to supply farmers with a constant flow of new disease resistant varieties and hold losses to a minimum.

The short-statured, high yielding, widely adapted Mexican wheats that are performing so well in Pakistan, Turkey and elsewhere

inherited those characteristics largely from the variety "Norin" which was introduced into the U.S. from Japan by the U.S. Department of Agriculture in 1947. Norin was a parent of the variety Gaines, bred and selected for growing in the Pacific Northwest region of the United States, where it has produced yields of more than 200 bushels per acre. Gaines is a temperate zone counterpart of the high yielding Mexican wheats, with mutual Norin parentage.

The Mexican wheats are insensitive to day length and in international trials have been among the top yielders within latitudes from 36° south of the equator to 50° north. They have produced 7 tons per hectare (over 100 bushels per acre) on irrigated farms, but perform well also under rainfed conditions. They are capable of yielding well on soils of low fertility as well as under exceptionally high soil fertility levels.

With the variety Gaines and related selections for temperate zone conditions and the Mexican wheats for tropical regions we now have varieties and production practices for wheat, as in the case of rice, with the potential — through adaptive research — for doubling yields under a wide range of farming conditions around the world.

OTHER REGIONAL RESEARCH PROJECTS FOR INTERNATIONAL AGRICULTURAL DEVELOPMENT

The regional and international research centers that have been established for improvement of maize, rice and wheat have evolved from the Rockefeller Foundation program in agriculture that was established nearly 25 years ago. More recently initiated regional research projects, supported by the U.S. Agency for International Development and other organizations, broaden the base of new technology resources for accelerating increases in world food production.

A central research program was initiated in AID in 1962 and most of the projects in agriculture and rural development are designed for adaptation and modification of advanced U.S. agricultural technology to suit conditions in the cooperating developing countries. These projects are problem-oriented and regional in scope, each involving cooperation of a number of countries. The research for our foreign aid program is conducted through contracts with other organizations with staff and experience in the special fields or disciplines.

The Agricultural Research Service is conducting research on the improvement of major cereal crops in Africa, with special initial emphasis on corn and sorghum. The cooperating U.S. scientists are located in Uganda and Kenya, under agreement with the East African Agriculture and Forestry Research Organization (EAAFRO), and in Nigeria, under agreement with the Scientific, Technical, and Research Commission (STRC), which coordinates research activities in West Africa. As indicated earlier, rapid progress has been made in developing improved hybrids and production practices that are being accepted promptly by African farmers.

Another AID-supported regional project conducted by the USDA Agricultural Research Service which has particular significance for CENTO countries is on the improvement of grain legume production in the Near East and South Asia. Very little systematic effort had been made prior to initiation of this project in 1963 to improve production of the pulse crops, including lentils, chickpeas, cowpeas, beans and mungbeans. The pulses are an important source of high quality protein food in many Asian and African countries. The project headquarters is in Tehran, Iran, where the Ministry of Agriculture, Plan Organization, Pahlavi University and Karaj Agricultural College are cooperating. In 1965 the project was extended to India, with cooperation of the Indian Council of Agricultural Research and the Indian Agricultural Research Institute.

After only three years of research it is evident that production can be increased substantially through selection of higher yielding varieties with resistance to a number of destructive diseases, through control of insect pests and improved soil fertility and cultural practices.

Other regional research projects supported by AID, on the adaptation of the sterility method for the control of the tsetse fly in Africa, on the fertility status of soils in Latin America, on the improvement of practices for control of weeds in Latin America, on the improvement of protein content and quality of maize, wheat and sorghum, and in a wide range of other problem areas that limit agricultural production, are helping to build new resources for more effective technical cooperation.

The experience of the past decade, and especially of the past five years, in regional and international research in agriculture has not only furnished valuable new technology but has also given us experience in establishing patterns of collaboration that are mutually satisfactory and productive.

The international and regional centers and programs are multi-purpose endeavors which provide for:

1. combining research in the several scientific disciplines to overcome the various factors that inhibit production,

2. training programs for research scientists, and for extension personnel who must become increasingly knowledgeable about interrelated production practices,

3. regional studies to obtain rapid evaluation of the potentials of new materials or practices under various environments,

4. regional conferences of technical personnel to facilitate exchange of knowledge, and

5. library and documentation facilities to expedite the dissemination of information.

We should keep in mind that the planned production of new crop improvement technology for use in international agricultural development is a relatively recent departure. The pattern of these resource bases, at the international and regional levels, is still emerging. The regional research projects supported by the U.S. Agency for International Development together with the international research centers established by the private foundations furnish the components for more effective international systems. The Ford and Rockefeller Foundations, the U.S. Agency for International Development, and the Development Assistance Committee of the OECD are studying needs and opportunities for the further strenthening of these international resources.

There are challenging opportunities for greater regional collaboration, not only among the CENTO countries but also more extensively where the linkage with other research resources can speed up the adaptation of new technology. The research on wheat production and on improvement of grain legumes could be expanded and integrated into more effective regional efforts. Mutual problems in soil fertility and water management, in production of forage and feed crops for livestock production, in the improved production of oilseeds, and on such non-agronomic factors as storage, transportation, marketing and credit might well receive joint attention. The selection of specific opportunities for regional cooperation is, of course, a matter for the appropriate representatives of the countries concerned.

NATIONAL SYSTEMS OF AGRICULTURAL SCIENCE AND TECHNOLOGY

The international centers or programs furnish a valuable linkage or channel between the technology of agriculturally advanced nations and the developing, food deficit countries. It is essential, however, that we recognize this source of new technology as a supplement to— and not a substitute for— strong national systems of agricultural research, education and extension. The Rockefeller Foundation has placed special emphasis in recent years on the international centers, but, as stated by Dr. J. G. Harrar, President of the Foundation:

> "The international research institute is designed to fill a gap, to aid and reinforce rather than supplant existing institutions and agencies dealing with similar problems, by sharply focusing on one or a very few obvious problems of international importance. Such an institute is able to develop thrust which otherwise might not be generated as quickly. It also has the advantage of being in a position to carry on fundamental research, the results of which may have universal application."

Every major developing nation should have a solid institutional base of research and education for agricultural development. The training of individual specialists in the various disciplines related to agriculture is important. The building of individual agricultural colleges or universities and experiment stations also is important. But these human and institutional resources must be integrated into a national system of research, education and extension designed to foster change in agriculture if these investments are to be meaningful.

The building of improved agricultural research and educational systems in the developing nations will require substantial change in concepts, in training, and in program orientation. These nationwide systems of research should include central facilities and services, together with regional and local adaptive research and verification programs. The education and training should emphasize practical or in-service experience focused on the significant inhibitors in domestic agriculture. It is essential that extension workers not only know how to farm or grow a crop but also appreciate the importance of integrating new production inputs into "packages of practices" including improved varieties, soil fertility and water management practices, weed and pest control methods, and other specific requirements for various farming areas.

The training cannot, of course, be limited to the technician level since conceptual leadership in identifying problem areas susceptible to research and in planning relevant investigations is developed through the training at the M. Sc. and Ph. D. degree levels.

The form of the national institutional structure for agricultural research and education will depend upon the existing organizations and the nature of changes required to improve their effectiveness. The experience of the U. S. and some other countries may be of interest in defining approaches and identifying some of the factors or elements involved.

STRENGTHENING THE INSTITUTIONAL BASE FOR NEW TECHNOLOGY IN THE CENTO COUNTRIES

There is a new urgency in the development of national adequacy in agricultural research and education programs in the CENTO countries. The rapid and massive introduction of the highly productive wheat varieties from Mexico, and the new rice varieties and production practices from the IRRI, offer the positive rewards of substantially higher yields of these crops. Pakistan hopes to achieve self-sufficiency in wheat production in the next few years. In Turkey, where the wheat production revolution was initiated more recently, the aspirations and expectations are similar. However, the new crop varieties and the intensified cultivation practices present new potential hazards of losses from diseases and pests which can be overcome only through a continuing strong adaptive research program.

The achievement of self-sufficiency in wheat production in Mexico was based largely on introduced and adapted new technology. The maintenance of adequacy of domestic wheat production, in spite of a substantial increase in population, stemmed from the continuing vigorous indigenous research program to combat losses from stem rust, as well as from leaf and stripe rust and other diseases. The capability of the cooperative program in Mexico to contribute new technology and scientific leadership for wheat improvement in other developing nations reflects the attention given to the building of staff and institutional capability in Mexico.

We are concerned with dynamic biological systems in which the evolution of virulent new forms of diseases or pests can be anticipated when we introduce new crop plant hosts into new environments.

The experience in the U.S. with crop disease epidemics furnishes some evidence of the magnitude of this problem. The new virulent race 15B of stem rust was first observed in farmers' fields of the U.S. in 1950. In 1951 it not only caused heavy damage to wheat in Mexico but began the build-up to the epidemic proportions that caused losses of 65 and 75 percent of the U.S. durum wheat crop in 1953 and in 1954. A series of new disease forms caused losses in the U.S. oat crop that ranged from 15 to 30 percent annually during the decade beginning in 1945, coincident with the introduction of new varieties with exotic germ plasm.

We cannot, of course, anticipate the nature or extent of possible destructive forces that will be encountered in more intensive crop production. And with urgent worldwide demands for more food grains it is essential to provide for maximum safeguards against losses, through effective plant disease and pest surveys, research in plant pathology and entomology to insure prompt identification of new forms of diseases and insects, and plant breeding and genetic research to develop resistant varieties. This institutionalized science approach is necessary to safeguard current advances but will also furnish the important new technology resource for the continued growth in the agriculture sector that must be achieved for total economic development.

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TOTAL SYSTEMS PLANNING FOR A FERTILIZER INDUSTRY

BY

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INTRODUCTION

In the last few years there has been renewed and increased emphasis throughout the world on the problem of providing food for an ever-expanding population. Many experts have predicted that much of the world faces almost certain famine unless major positive steps are taken.

Two major solutions have been offered. One is the long-range proposition of reducing the rate of population increase, particularly in countries least able to support larger populations. It is unanimously agreed, however, that this long-range solution cannot avert major human suffering and in some cases mass starvation in the short run.

The second solution is to increase food production sharply, using existing natural resources. It has been proven by many countries that with proper impetus, planning, and implementation of plans, the short-range solution of increasing food production can be effective. Measurable results can be seen within a year or two and major results within five years.

In all food production plans a major stepping stone has been that of increased use of fertilizer as an important input factor. Increased fertilizer use, of course, has been used in conjunction with improved varieties of seeds, improved irrigation, improved management systems, together with the other inputs.

The major purpose of this particular CENTO conference is to explore the status of present and future planning for ways and means to arrive at the short-range solution to produce more food and thus eliminate human misery. The purpose of this panel is to discuss a single item-fertilizer.

WORLDWIDE SUPPLY-DEMAND SITUATION FOR FERTILIZERS

Recent studies by FAO, TVA, and others point toward a probable requirement for and possible use of 65 million tons of plant nutrient by 1970. The rate of increase in fertilizer consumption during the past three or four years suggests that the expected requirements may well be reached if adequate amounts of materials are available when and where farmers need them.

On the other side of the supply-demand equation there are two significant points. First, known supplies of basic raw materials for producing sufficient fertilizer materials are adequate to satisfy the requirements through 1970 and beyond. Already plans have been made on a worldwide basis to mine more than enough phosphate rock and potash from known producing fields. Hydrocarbons for production of nitrogen are available on a practically unlimited scale, far beyond any probable use in production of nitrogen through the next few decades. Although sulfur has been in short supply, there appears to be a trend toward a loosening of this supply. Higher sulfur prices have brought into play much sulfur production which heretofore, because of low prices, had not been economically feasible.

The second point concerns world plant capacities to produce finished fertilizer products. Recent unpublished studies at TVA indicate that there have already been announcements of new plant capacity which will increase total world capacity for nitrogen to more than 60 million metric tons by 1970-71, with 36 million metric tons of P_2O_5 and 28 million metric tons of K_2O. Of course, from these total capacity figures must be subtracted the amounts which will be used for industrial purposes and other nonfertilizer uses together with capacities of some plants which will cease operations because of obsolescence. Overall, these other uses cannot be expected to exceed 15-20 percent of total capacity. It is not clear as to the precise amounts which will be in production by 1970. It is clear, however, that by 1970 there should be sufficient world capacity to produce fertilizers to satisfy the total probable requirements.

PLANNING FOR PRODUCTION FACILITIES

You recognize as well as I that this brief summary of the world supply-demand situation does not tell the whole story. It does not point out that many nations will have excess productive capacities while others will have little or no productive capacity by 1970. Individual nations must of necessity evaluate their own needs, resources, and capabilities to produce or otherwise fulfill their needs.

Need for National Production Facilities

Because its foreign exchange normally is limited, an individual nation cannot look at the total world supply-demand situation and be content. Foreign exchange positions of nations naturally vary; however, in most developing nations foreign exchange is in short supply. There are requirements for industrial equipment and know-how which generally must be imported. Unless the nation is especially rich in some available raw material, exports normally do not equal in value the need for imports of these finished industrial products and facilities.

For example, in the fertilizer industry rock phosphate can be purchased in the producing country at a cost of perhaps $25 per ton of P_2O_5. The finished fertilizer product may cost as much as $140 per ton of P_2O_5. Natural gas, a basic raw material for production of nitrogen fertilizer, may normally be purchased at a cost equivalent to $6 - $10 per ton of nitrogen produced therefrom. Anhydrous ammonia may be imported at less than $60 per ton of nitrogen. The finished nitrogen fertilizer may cost more than $200 per ton of nitrogen. Thus, if only to eliminate excessive drain on foreign exchange, individual nations must assess their own position with respect to an overall supply-demand situation for fertilizer materials.

Assessing National Requirements for N, P, and K

In approaching this national planning for fertilizer requirements, the first job is to assess needs and probable uses of fertilizer. Needs must be assessed not only in terms of total amounts of N, P, and K required, but also in terms of uses by crops and by areas of the country. Further assessment must be made of the specific types of fertilizer—whether solid or liquid, straight materials or mixtures. And, if mixtures, what grades or ratios will be required.

This detailed evaluation of the needs and probable uses serves as the objective for the remainder of the production planning cycle. Until this evaluation is completed it would appear to be useless to attempt the remainder of the planning cycle.

Evaluation of Resources

A second portion of the planning function is to evaluate resources within the country. First, there should be a complete review of the production facilities already in operation or under construction. This review should include not only the current or proposed product mix of the plants but also any alternative product mixes in terms of N, P, and K and types of fertilizers which might be useful in satisfying overall requirements.

If, as is usually the case in developing countries, there remain additional requirements for fertilizer, the next job is to assess the availability and relative economics of the natural resources which might be useful in additional production facilities. In such an analysis of resources, possible importation of various portions of raw materials or intermediates should be considered. Quite often certain materials, although available within the country at an exorbitantly high production cost, can be imported at cost levels low enough to overcome the overall limitations of foreign exchange availability.

Analysis of Alternative Production Configurations

When the requirements of finished product and total resources have been evaluated, the next job is to determine the alternative production and distribution configurations that will lead to the most efficient use of resources for production of total needs. This overall study might be considered by economists as a mathematical minimization problem — minimizing total cost of producing and distributing a given amount of final finished product to a given geographic area.

This "minimization approach" has been followed in Turkey. We have been fortunate in being able to work with the State Planning Organization, Azote Sanayii, Donatim, Etibank, the Turkish Department of Agriculture, and many other agencies in making such an overall detailed planning approach.

From the literature available it would appear that the same approach, with minor modifications, is used in Iran and Pakistan. It

is evident from review of many published articles that much individual planning has been accomplished by all CENTO nations. Each nation recognizes the importance of fertilizer to their people and is taking steps to establish fertilizer industries which will help produce adequate amounts of food.

Possibility for CENTO Fertilizer Planning Work Group

The importance of planning within individual nations cannot be over-emphasized. At the same time, however, no nation can afford to overlook the possibilities for cooperation with neighboring states. Since no one country may have the "ideal" combination of resources for a fertilizer industry, it is possible that continuing joint reviews by CENTO nations could lead to attainment of individual national objectives with less total expenditure of resources.

Foreign exchange limitations would seem to make it particularly appropriate to consider such an approach. For example, could Turkey trade steel or copper to Iran for natural gas, and thus reduce its foreign exchange outlay for imported naphtha — an alternative source of hydrocarbon for ammonia? Pakistan undoubtedly will need sulfur for its fertilizer production. The world trade press reports that Iran may have an exportable surplus of sulfur. Could this be traded to Pakistan for tea and sugar which Iran needs — to the benefit of both nations?

These examples are only illustrations, not proposals. They do, however, suggest further consideration of the possibilities for pooling or exchange of raw material resources as one way to minimize fertilizer production and distribution costs in each nation. Pursuit of such possibilities would be a logical function of a continuing joint fertilizer planning committee.

PLANNING FOR DISTRIBUTION AND MARKETING

In the foregoing discussion, emphasis has been almost entirely on proper allocation of resources for production functions. At several isolated spots bare mention has been made of production and distribution. In most of my work with U.S. industry and with USAID and its contacts, primary emphasis has been on production facilities. Only minor work is normally devoted to planning increased distribution facilities necessary if fertilizer is to be used to produce food. If materials are not available there certainly will be no requirements

for increased distribution facilities and the many services incidental thereto. Thus it is only natural that initial planning should be for production facilities. However, as a fertilizer economist for the past 20 years with TVA, I have often been dismayed at the relative amount of emphasis which has been given to production costs versus total distribution costs. The U.S. fertilizer industry has apparently spent a major portion of its research time in developing low-cost production. Little time and even less concentrated study have been given to the all-important phase of moving fertilizer from the production point to the farmer and ensuring that the farmer knows and respects its value.

Relative Costs of Production Vs. Distribution

Any close study of production and distribution economics will indicate that costs other than production costs are far more important in determining total costs to the farmer and thus cost to the nation. For instance, in the U.S. it is well known that ammonia is in some cases being produced at a total cost of less than $30 per ton. By the time this same ammonia is delivered to the farmer's field and applied, the cost usually exceeds $100 per ton. It might appear that middleman profits are excessive. To all close observers of distribution costs, however, it soon becomes clear that this large margin between cost applied on the farm and production costs is quite necessary because of actual transportation, distribution, and other marketing costs which are incurred. Recent studies at TVA and by others indicate that these marketing costs for ammonia may well exceed $30 per ton in the retail locations alone, and with no profit as such.

We do not intend to undertake a discussion of the absolute level of marketing costs in comparison to production costs. The point is that additional planning must take place over and above the planning for bare production facilities. Perhaps as many economies can be effected by proper planning on distribution and marketing as in planning production facilities. Conversely, if the distribution and marketing system is not developed, production facilities cannot be successful. If fertilizer can be produced but cannot be sold, it has no value and the production facility will fail.

What, in addition to production facilities, is required for a successful total production and distribution system?

Let me first make it clear that the following discussion on the needed facilities and services is by no means complete, nor are there specific criteria which have been standardized to determine

the absolute level of facilities or services required. Far too little study has been made of the needs and relevant costs which must be borne if these facilities and services are to be provided at a level adequate to maintain proper distribution and marketing of increased amounts of fertilizers. It is further an implied contention that it might be mutually advantageous to CENTO nations to have a continuing review of planning for these specific areas as well as others which will arise with respect to an ever-expanding total fertilizer industry.

Requirements for Distribution and Marketing Systems — General

In looking at these additional planning areas, let us start at the farm. Unless the farmer can be assured of relatively high and stable prices for his product, he has no reason to use fertilizer.

I well remember the year 1936, when I was growing up on a small farm in Tennessee. That year, during the middle of the depression, we were unable to sell our wheat. Granaries were full and there simply was no market for wheat. We did not apply fertilizer on wheat that fall; in fact, we did not raise wheat that fall.

Farmer Credit Requirements

Another area of service requiring attention is that of farmer credit. Several recent estimates have been made that credit will be required for as much as 80 percent of the total fertilizer used. This credit is required for more than 60 days' duration; it is required generally on crop terms. Even within an area as developed as the U. S., a large majority of fertilizer is sold on credit terms extending throughout the production cycle of the crop.

Credit within itself is an intricate subject. As you may have found, it is difficult to establish a system of credit that ensures both adequate use of fertilizer and repayment for that fertilizer. Credit systems throughout the world have had and will continue to have problems. In spite of this, however, there is a need for this service if the total fertilizer production and distribution system is to be successful in helping ensure adequate increases in food production.

Education

We must also recognize that in the early stages of any new element of national development, there are likely to be crevices in public know-

ledge and attitude that must be bridged by education. This places a heavy burden on a nation's educational system, mass media, and social organizations. The requirements for an expanded educational system are applicable in all areas, not just in developing nations. Rapid technological changes are taking place in the fertilizer industry, changes in types of material, changes in quantities available, changes in fertilizer price ratios. Thus, it is inevitable that a knowledge gap will exist and that an expanded educational system will be required.

To the best of our knowledge, no one has clearly delineated the specific types and areas of educational activities which must be carried on if the total production and distribution system of fertilizers is to be successful. Perhaps this delineation has not been made because types of distribution systems have varied so widely between countries and even within countries. The educational needs, of course, will vary with types of farming and stages within the development of the total farming concept.

We do not propose that the following discussion on education is complete. We are not even certain that all steps may be necessary on a universal basis. We merely set forth for the panel's consideration several specific areas which have been useful at least almost universally. These areas are delineated in terms of needs for additional educational activities.

First, in any country where new fertilizer materials are to be used on new types of crops, there is the farmer's need for additional information on how best to apply the fertilizer in order to maximize his profits and at the same time assist in the national objective of increasing food and fiber production. Usually, many different approaches are required if such an educational effort is to be successful. It is difficult to "reach" all farmers. It is sometimes even more difficult to convince them that their customs and habits of farming can be improved. In areas where mass media such as newspapers, radio, and television are highly developed, concerted approaches through these mass media have been highly effective. In areas where extension services have been organized, mass meetings of farmers have been effective. Demonstrations in which proper fertilization, together with other improved farming practices, is carried on or exhibited to neighboring farmers have also been effective. Generally, however, no one method has proven sufficient to accomplish the end result. Only by a massive coordination of educational personnel and a useful combination of educational media has the job of convincing farmers been successful.

There is also the requirement for additional educational efforts and activities designed for the teachers of farmers. By teachers here we intend to imply not only college professors but the whole segment of extension workers, experiment station workers, and all others who might be involved in agricultural education. Farmers worldwide appear to follow the suggestions and advice of their own sons and neighbors who have gained more formal education and thus have assumed the vitally important functions of assisting in planning and advising on better ways of doing things. Sometimes they follow this advice slowly, to be sure. But such personnel must be trained if they are to be successful.

The last segment we will discuss in relation to need for additional education is one which many times is forgotten, or at least not emphasized. This segment includes those people who handle and sell the fertilizer, including the retail dealer.

The retail dealer is the last man who has close contact with the farmer before the farmer actually applied his fertilizer. He normally is one with whom the farmer discusses his present and future farming plans. Quite belatedly in the U. S. we have found the value of giving educational training to this individual. We have found that the retail dealer essentially is more than a salesman. One of his major functions is assisting the farmer in proper selection and use of fertilizer as well as the other input items which are purchased.

For many years little effort was made in our country to teach this retail dealer the many things which he needed to know about soil fertility and fertilizer use. Only in the past ten years have we seen the beginnings of a formal educational program for this vital link in dissemination of information. This program includes formal schools and short-term training sessions established for retail dealers. This activity must be increased throughout the world if fertilizer use expansion is successful.

Fertilizer Laws

I am quite unaware of the status of fertilizer laws in the CENTO nations. I am aware, however, of major problems with fertilizer laws within the United States. In early days of the fertilizer industry when very little fertilizer was used, it did not seem important to public officials or to the industry to have laws to regulate the sale of fertilizer. Fertilizer consisted of very simple materials, such as

nitrate of soda, ordinary superphosphate, and imported potash.

With the coming of new, highly improved and sometimes highly complex materials, it soon became evident that some system of regulation was required. This system was required first to protect farmers— to ensure the farmers that they were obtaining the specific type and quantity of fertilizer plant nutrient for which they were paying. It soon became evident to the reputable fertilizer industry that these laws were helpful to them also.

The National Plant Food Institute in the U. S. is putting forth major effort to get all states to pass a uniform fertilizer law. It is claimed, and with good reason, that such a uniform law would reduce overall costs of the industry and in turn reduce the cost of fertilizers to farmers. It would ensure easy flow of manufactured fertilizer materials across state boundaries; thus, a plant in one state could manufacture and sell one particular type and grade of fertilizer in many states and not be forced to change his manufacturing procedure, his bagging procedure, and other distribution procedures for different batches of fertilizer going to different states.

In this respect, would it be mutually advantageous to the CENTO nations to discuss the possibility of uniformity of their fertilizer laws? Would not such an approach in this area also reduce overall production and distribution costs and thus in the long run result in lower costs to the farmers?

Distribution and Marketing Facilities

Last, but perhaps most important of the items discussed today is cost of distribution and marketing facilities. It has been found in the U. S. and other areas that total investment in fixed facilities to fulfill the distribution and marketing functions may equal or even exceed the investment in production facilities. A producer of fertilizer may think the investment cost of $40 million for a nitrogen plant is high. If he is expected to distribute this fertilizer, however, he soon finds that an additional $40 million investment may well be required to cover the costs of fixed facilities within the total distribution and marketing channel.

The high cost of distribution and marketing facilities is not a phenomenon connected only with the free enterprise system. It is common to the fertilizer industry of the world. The requirement for

large expenditures in this area springs from the many functions which must be performed if fertilizer is to be successfully produced and distributed.

To be economically successful, a fertilizer plant must operate twelve months a year. Farmers use fertilizer in one or two periods of the year; thus, there are requirements for large amounts of storage facilities to hold the fertilizer produced in the off season until such time as it is needed by farmers.

The very nature of farming, with its high degree of uncertainty resulting from the vagaries of weather, also results in need for large fixed investment in the distribution and marketing system. It is impossible to predict which area of the country will have a drought and therefore require smaller amounts of fertilizer. It is impossible to predict which week of the year good weather will come and thus lead to increased immediate need for fertilizer within a specific area. So, large regional warehouses must be established closer to the end-use area than the large, centralized production point.

To the best of our knowledge, there is no one optimum configuration for a distribution and marketing system for all countries. There is no one optimum configuration even within any one single country. It has been found worldwide that distribution and marketing facilities must be fitted to the requirements of the particular type of farms within an area. It is apparent that each type of farm has different requirements with respect to types of fertilizers, quantities of fertilizers, and the many services which must be offered along with the fertilizer materials.

It is also apparent from study of the distribution and marketing facilities around the world that as farming conditions change and as the fertilizers themselves change, the configuration of the distribution and marketing facilities must change. A continuing review of the current total system of production and distribution must be made. If the distribution and marketing systems are to be most efficient, changes must be planned as new conditions arise within both the farming community and the community of the fertilizer production industry.

Forward Planning

It is quite obvious from a study of the planning efforts of CENTO nations that fertilizer plays a major part in the agricultural development plans for the future. Fertilizer is one of the major input factors which must be made available if future food requirements are to be met.

Foreign exchange costs for finished fertilizer on the scale of use which is planned would be exorbitant. It is obvious that plans have been made on an individual national basis for production facilities which will decrease requirements for foreign exchange costs. It is not obvious, from published information at least, that an equal amount of planning has been accomplished on the distribution and marketing phase.

Even in the area of production plannning, there may be possibilities for effecting long-range economies for all nations of this panel by a continuing coordinated approach. There would appear to be possibilities of making a greater use of the least costly natural resources of the three nations combined. Such planning might well result in a situation where economies of each of the three nations will be improved with no detriment to any nation.

There would also appear to be many areas concerned with distribution and marketing wherein joint planning and/or exchange of views could be mutually beneficial. In this area of distribution and marketing no one system has been found to be optimum throughout the world. Many combinations of systems have been useful. This is an area which has been approached worldwide on a trial-and-error basis. Many of the trials have been successful for short periods of time but have lost their economic advantage and sufficiency as conditions changed. In such a situation—replete with changes on both the supply side and the demand side—would a continuing review and discussion of successes and plans be of assistance to all the nations connected with CENTO?

It is clear to all, I believe, that a tremendous job must be accomplished if the total fertilizer requirements are to be met in the coming decade. It is clear to all that this job must be accomplished if extreme human misery is to be averted. This total systems planning and accomplishment will cost large amounts of resources, both in terms of money and natural raw materials. Many possible systems which might be attempted in doing this job more economically and more efficiently might well lead to tremendous benefits to all concerned. The cost of such undertakings may be high, but the benefits undoubtedly are much higher.

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IMPROVING IRRIGATION AGRICULTURE IN IRAN, PAKISTAN, AND TURKEY

BY

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Irrigation agriculture in the mid-eastern countries has been one of my major interests during the past 20 years. During this period I have seen irrigated agriculture become a central interest of many of the governments in this region and the basis of the rising expectations that science and its application can produce solutions to the traditional problems of poverty, hunger, and disease among rapidly increasing populations.

The nations of Iran, Pakistan, and Turkey are due special commendation for the courageous and vigorous manner in which they are developing programs, acquiring information, and instituting practices to impr ve water supplies, distribution systems, farm irrigation practices, and the art of crop production on expanding of land.

Two of the faculty of Utah State University have participated in the third, fourth, fifth, and sixth Near East-South Asia Regional Irrigation Practices Seminar. These are D. F. Peterson, Dean of the College of Engineering, and A. A. Bishop, Head of the Department of Agricultural and Irrigation Engineering. They have advised with me in shaping my remarks here, and they send their greeting

to their friends in the countries represented here at this conference. The Proceedings of these conferences* have also been helpful.

After examining the Proceedings of these and other seminars and conferences held in the Middle East, I conclude that there is no facet of irrigation agriculture that is not receiving attention and about which the countries' technical leaders are not knowledgeable. Unfortunately many of these programs of research, education, and construction are of recent origin. Based on the experience of my own country they could hardly be expected to produce major dividends for many more years. But this is an era of impatience. Our peoples are gaining a vision of a better world and will not wait for the slow transitions of the past.

Fortunately truth is universal and much of our knowledge can be transferred from country to country. With appropriate modifications, practices can be adapted to a wide range of circumstances. These modifications require a modest amount of adaptive research to reduce principles to acceptable practice, but the time and costs involved are far less than that required for the original innovations. In the face of the opportunities for using available knowledge and the urgent demands of our peoples, we must do better in the future than we have in the past. While the total crop production for the 15 year period from 1948 to 1963 is estimated to have increased by a factor of 1.85 for Iran**, 1.35 for Pakistan; and 2.10 for Turkey, the gains were largely offset by population increases. Furthermore, these increases have been attributed to be the result of a 50 to 70 percent increase in the area of crops, with only one-third to one-half of the increases from increased yields and changes in crop patterns.

Since previous discussions have demonstrated a broad knowledge of principles and technology associated with irrigated agriculture, one of our major inquiries should revolve around how the application of

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* 3rd Regional Irrigation Practices Leadership Seminar, NESA Region February 15-26, 1960. Lahore, Pakistan

4th Irrigation Practices Seminar. Regional NESA Leadership Seminar, April 16-28, 1962. Ankara, Turkey

5th Irrigation Practices Seminar NESA Region, March 2-14, 1964. New Delhi, India

6th Irrigation Practices Seminar, NESA Region, March 19-30, 1966. Amman, Jordan

** Changes in Agriculture in 26 Developing Nations. Foreign Agr. Report No. 27. EAS Dept. Agr. Economic Research Service, 1965.

this knowledge and future capital investments can be most effective in attaining the increases in production that appear within reach.

Similarities Among Countries

If we examine the various resources and the input factors associated with the development of improved irrigation agriculture in the countries of Iran, Pakistan and Turkey, we find some strong differences, but even more remarkable are the many broad similarities. In each of the countries irrigation agriculture provides the primary hope for major increases in the production of food and fiber. In all countries the costs of irrigation development are high.

These costs are only partially repaid by the farmers. With society in general making a large investment in irrigation projects, the people have a right to demand that every effort be made to obtain high crop yields, and thereby return maximum benefits from the public investment. The public expectation for immediate returns from its investment is likely to be disappointed because of the distrust with which the average farmer views innovations in farming methods. He has lived so close to starvation that his strong inclinations are to cling to the traditional practices that have enabled him to survive in preference to venturing into the unknown.

1. Water supply is a major limiting factor in irrigation development in Iran and Pakistan, but Turkey has a current surplus of water, with scarcities in the more arid areas.

2. The farms are generally small and the management skills of most farm operators are low.

3. In the three countries there is a rapidly growing emphasis on the use of ground water for irrigation through the drilling of wells.

4. There is a general lack of credit at acceptable rates, particularly for long term on-farm capital improvements.

5. Salt accumulation in soil presents a general problem. The problem is most wide-spread in Pakistan, but is very acute in many areas in Iran and some in Turkey.

Each of the countries has recently accelerated programs for acquiring needed basic information for the planning of irrigation projects. Among the expanding developments are the establishment of networks of meteorological stations; increasing the number of streams and river gauging stations; expanded land classification programs; enlarged studies of ground waters and the performance of pumped tube wells; chemical laboratories have also been established to assist farmers in the adoption of practices that will maximize crop yields under irrigation.

Some Major Differences

Differences between countries are more in the magnitude of special problems than in distinct differences in the nature of the problems themsleves.

Pakistan has the largest integrated water distribution system with longer and larger canals. Pakistan has the most limited water supply in relation to the area being irrigated, and related to these situations, Pakistan has the more extensive and acute problem of soil salinity.

Turkey has a greater proportion of its land area with sufficient rainfall to permit non-irrigated crop production. Turkey is, therefore, able to concern itself with whether current investments can bring greatest returns through irrigation projects or through improved production under natural rainfall.

Turkey and Iran have plans to substantially increase irrigated areas. Pakistan seeks more water to increase crop production and leach salts from presently irrigated lands.

All three countries are increasing the use of ground water for irrigation. Urgent needs necessitate that Pakistan consider pumping some water of low quality and mixing with canal waters. Iran has a special problem in integrating the drilling of wells and the pumping of water with the established rights of an estimated 40,000 ghanats currently tapping relatively shallow ground waters.

Pump well development has been promoted somewhat by government subsidy, but especially in Pakistan private development of wells has expanded rapidly in recent years.

Programs to Improve Water Use and Crop Yields Under Irrigation

This discussion is not intended to detract from the many excellent programs of acquiring needed information, of planning and constructing water distribution systems, and of direct aid to farmers. My inquiry is concerned with why these activities have not resulted in greater increase in crop yields and farm income than has occurred, and how such improvements can be promoted.

Use of Ground Waters

The recent emphasis on utilization of ground water has furnished an excellent opportunity for private investment. In Pakistan pump wells could produce an estimated 49.5 million acre feet per year. Government programs have installed 3,500 tube wells. During the same period, private enterprise has established 30,000 wells and an additional 30,000 are expected in the next 3 or 4 years. This major activity by the private sector of the economy is one of the most exciting developments in recent years.

A similar interest in pump wells exists in Iran. There are 100 drilling machines now in the country that are capable of drilling 1,000 deep wells per year. Turkey has a large potential for wells, but currently lacks equipment and experienced manpower. *

The development of wells for irrigation is an excellent example of how under favorable conditions the private sector will go ahead with major investments in agricultural production. Careful consideration should be given to how well development under the private sector can be further encouraged. Since surface water projects are usually constructed with a substantial subsidy from public funds, some public investment to promote well drilling is justified. Such help should consist first of technical assistance in exploration of underground water resources and evaluation of well performance potentials in promising areas. Second, public assistance should assist in providing quality well drilling equipment and specifications for drilling, pump equipment, and operation and maintenance. Where possible, electric power lines should be located for ready access to wells. Public sharing in costs of well drilling, pipe, and pumping equipment may or may not be needed.

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* Prospects for Turkish Agriculture. A report by study team to the Ministry of Agriculture, Ankara, Turkey. December, 1966.

In the past a too common failure has been to visualize and plan an irrigation project as a construction achievement, rather than as an integrated part of an agricultural production scheme. Too frequently careful cost-benefit analyses have not been made, or if so, the project plans have not anticipated or provided for the considerable costs of bringing individual farms to a high rate of production. Hopefully, the errors of the past in planning irrigation projects are past. But the persistent gap between engineering and construction skills in making a water storage and distribution system and the use of water in an integrated program that will attain high crop yields is still very wide and difficult to cross.

Project Management to Meet Farm Needs for Water

Project management to meet farmer needs is often inadequate. Water applications must be spaced properly for individual soils and crops. Too often a project is planned with irrigation turns spaced too widely for the attainment of high yields of most crops. Numerous experiments have shown that if the integrated moisture stress in the plant root zone goes much over one atmosphere, yields will be depressed. Sandy soils or shallow rooted crops may necessitate irrigation more than twice as frequently as a combination of deep loam soils and deep-rooted crops. In some cases dishonest water managers seek special gifts for prompt delivery of water. Delivery of water on demand is very difficult for projects with many small irregularly shaped farms served by small ditches. Careful planning and execution of delivery schedules is mandatory for project success. Decisive and vigorous government action must be taken to insure that every possible effort be made to deliver water to individual farms on a schedule that will meet the demands for high crop yields.

Water charges should be planned to achieve desired goals. In some instances the systems chosen have thwarted incentives to produce. Flat charges per hectare irrigated encourage greater and less efficient uses of water than charges based on actual water used. A uniform charge for a required quantity of water per hectare needed for good crop yields combined with a much higher charge for larger amounts is often used. This penalizes the extravagant use of water, yet encourages use of adequate quantities to attain good crop yields and to control salinity.

Tax requirements are often based on crop yields rather than on the potential of resources to yield. A tax based on yields often destroys

incentives for good farming, since the farmer sees some of the rewards from his extra efforts being syphoned away.

Land leveling, reorganization of farm water distribution systems, choice and use of an irrigation practice adapted to water supply, soil, crop, and skill and financial resources of the farmer are essential to efficient use of water resources and maximum returns from labor and other production inputs.

Land Leveling

Probably in most instances surface irrigation methods with land leveling will be generally selected for the three countries. Land leveling is obviously needed for the uneven soils in or near the mountainous areas so common in Iran and Turkey. But the benefits may be no less striking on the broad flood plains so common in Pakistan. Minor undulations that are hardly perceptible on slightly sloping soils may result in water ponding and eneven distribution that can significantly reduce yields.

Drainage

New project areas require careful study to anticipate drainage needs. Such needs are usually readily observed in the older irrigated areas. The answers are, however, more difficult for established projects because rarely can drainage be solved on an individual farm basis. I understand studies are under way as to how drainage systems can be planned, installed, and managed in irrigated areas with small farms. This is a pressing problem deserving careful study.

Farm Planning and Management for High Yields

One obvious fact is that the average farm situation in these countries does not attract the managerial skills and capital needed to integrate the many production factors into an effective system. Irrigation farming requires the highest managerial skills and the largest proportion of labor of any farm system. This is because water management requires special facilities and extra labor, and crops are sensitive to both the quantities of water and the timing. Furthermore, irrigation modifies the microclimate of the farm so that suitable crop varieties, insect damage, and plant diseases may be greatly changed. Also, the fertilizer needs are modified.

In numerous irrigation-crop management experiments in western United States a traditional combination of inputs gave among the highest yields when compared with increased amounts of such inputs as water or fertilizer evaluated separately. For example, with irrigation practices held constant, increased fertilizer or new crop varieties gave only slight benefits. Similarly, with traditional low rates of fertilizer and with older or unimproved crop varieties, more frequent irrigations often have not increased yield. When, however, combinations of crop varieties suitable for high yields, increased rates of fertilizer application and more frequent water applications have been used together, yields have been doubled or trebled. But as crop yields have increased other factors needed consideration. These have included the possibility of more plants per hectare, better timing of planting, tillage, and harvesting operations; the need for more careful insect control, and the appearance of new diseases that required special attention.

Although simple in principle, the actual practice of reassessing the entire crop production program on a farm is difficult to adopt by the average farmer who has learned the art of agriculture from his father, and who feels deeply that his long continued attachment to an individual plot of land provides insights that cannot be attained through formal education or science.

One of the most convincing programs to encourage changes in farming has been test-demonstration plots. These should be located on private farms, but carefully managed to insure success. There is a natural distrust of results secured on government operated farms. Too often the farmer comments that he too could farm better if he had the backing of the government's money.

To the farmer converted to the advantages of improved integrated crop production practices, the development of a farm plan seems a logical and necessary step. Land leveling or sprinkler irrigation appear as desirable to insure the efficient uniform application of water to the land. Planned changes in cropping and production practices to take full advantage of the soil, water, equipment, labor, and managerial skills available on the farm are needed.

These farm assistance programs will require a sweeping change in the assignments of government employed agricultural scientists and technologists. Inducements and regulations should be imposed to have these men located in rural areas, to devote their time to working directly with the farmers on the farms.

Public Investment on Presently Irrigated Land vs. New Projects

Production of food and fiber in any country depends as much on the yield per hectare as on the number of hectares cultivated or irrigated. Since irrigation project development is very costly, and since present crop yields in the three countries are generally low, immediate attention should concentrate on the question as to whether public investment cannot bring greater benefits by concentrating on increasing yields on presently irrigated lands in preference to investing in projects to irrigate additional lands. The technical knowledge and required inputs are available. The limiting ingredient seems to be the incentive of individual farmers to produce products for sale rather than merely to supply the needs of his family. An essential base for incentives is the availability of desired goods that will motivate efforts to acquire needed capital for exchange. Without such incentives, the farmer is content to continue on a subsistence level.

Concentration on increased production on lands now irrigated offers several advantages: (1) a distinctly greater benefit-cost ratio from public investment; (2) more immediate increases in crop production from investments; (3) the development of public policies, practices, and management skills that will insure greater returns and higher benefit-cost ratios from future irrigation projects.

RECOMMENDATIONS

1. Place first priority on increasing yields on presently irrigated land in preference to developing new projects to irrigate additional land.

2. Provide technical assistance to aid in increasing crop yields as follows:

    a. Provide technical and financial assistance in farm improvement, including improved irrigation water distribution and land leveling, drainage where needed, and land reclamation from salinity. Plans and farm programs should provide for a balanced group of production inputs that will insure high crop yields.

    b. Intensify applied research and extension aid for farmers, including test-demonstration plots in farmers' fields.

c. Organize and supervise water distribution so that scheduled water deliveries would assure high crop yields.

d. Intensive testing of new crop varieties, importing seed of best adapted varieties and establishing a program for production, certification and distribution of good seeds.

e. Provide fertilizers at minimum cost.

3. Provide incentives for farmers to produce more crops within the capabilities of available resources. Some appropriate incentives to consider include:

a. Devise water charges to achieve goals appropriate to the local situation. Flat charges per hectare encourage greater water use and usually low efficiency in irrigation practices. Charges on the basis of water used encourages good irrigation practices and farm methods such as land leveling. However, if the charges are excessively high they may discourage use of adequate quantities of water.

b. Farm credit should be increased at modest interest rates. Credit provision could be based on an agreement requiring the adoption and execution of production practices that will insure increased yields.

c. Taxes and water charges should be adjusted to provide incentives for producing high yields. A change from charges based on yields to those based on capability of resources is recommended.

4. The governments of Iran, Pakistan and Turkey can promote increased crop production under irrigation agriculture through programs that will encourage private capital in development of underground water by removing all unessential restrictions and giving technical assistance and financial aid in well construction and equipment acquisition.

5. That a regional research center be established to investigate and determine alternative methods for approaching the common problems which are delaying implementation of improved irrigation practices and procedures. The possibility of introducing sprinkler irrigation may also be studied and if found feasible should be introduced.

6. Prior to planning future irrigation projects, countries should be aware of the advantages of large as well as small size project implementation. This evaluation should result in a balance of implementation priorities.

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APPENDIX I

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