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THE ACTIVITIES OF GOVERNMENTAL AND OTHER AGENCIES IN ENCOURAGING TECHNICAL DEVELOPMENT

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IF I am to be helpful in opening a discussion on this subject, I must first pare the broad subject assigned me to such proportions as will enable me to speak with the confidence born of my own experience and observations.

Although I have spent my life in agencies dedicated to the encouragement of technical developments, I realize that today there are so many activities of this character that I cannot lay claim to know more than a few. I must therefore confine my remarks to some activities of certain governmental and non-governmental agencies. Regretfully, I must omit 'other agencies', including voluntary organizations such as missionary societies and philanthropic foundations, although I hold in high esteem their widespread activities.

Even within the narrower limits of my experience I must speak of activities in the field of agriculture. But I interpret the term 'encouraging technical development' as embracing all those activities open to governmental and non-governmental authority which taken together are indispensable to increasing productivity.

I stress the concept of *all* activities because my early training and the greater part of my experience having been in the natural sciences as applied to agriculture, I have come to a keen appreciation of the importance of social, economic, and political aspects of the activities essential to the encouragement of technical developments.

Were I speaking to soil scientists, crop specialists, animal husbandmen, foresters, fishermen, or nutritionists, my remarks would be directed largely to those activities which in my own experience have contributed enormously to increased agricultural productivity in many countries, and which are capable of comparable contribution in others. I have witnessed and taken part in notable advances made during the last half-century, and I have been impressed by what science and technology have done. I have learned that seemingly insurmountable problems can be surmounted. I have seen the expansion

of the frontiers of agriculture, and the successful settlement of areas that previously were forbidding indeed.

Travel in various parts of the world during recent years has convinced me of the striking similarity of physical and biological problems confronting people generally. Not only are these problems fundamentally alike in their technical aspects, they may also be attacked successfully, I believe, by essentially the same scientific and technological methods that have already proved effective in many places. It is this similarity of problems and the promise and potential of known techniques that make possible successful technical assistance. A competent man in any discipline can leave his own country and find realizable opportunity within his competence in a distant environment.

But there are differences to be observed, as striking as the similarities. The differences are most apparent among people, their cultures, their economic, social, and political statuses. Noting these differences, and recognizing their bearing upon activities aimed at technical developments, one comes to appreciate the interrelationship of factors which call for integrated activities designed to cover a much wider field than can be embraced by the purely technical approach. One recalls the numerous agencies in one's own country that have contributed to the advancement of agriculture, the almost concurrent progress of governmental activities in the support of education, research, extension, statistical and regulatory services, credit facilities, and other important areas of interest. One sees, also, similar support in non-governmental circles, as in farm organizations, co-operatives, scientific institutions, industrial firms, and commercial bodies. This leads one to sense more keenly the lack of such things in countries less advanced in agriculture.

It is in this connexion that, on this occasion, in speaking to agricultural economists, I shall lay more emphasis upon economic, social, and political activities for encouraging technical developments than upon the technical activities themselves.

Larger output does not automatically produce larger consumption or increased welfare of farmers. In fact, large increases in output which markets are not ready to take can cause reduced farm prices and incomes, damaging producers without real benefit to consumers. In turn, reduced farm income, or the fear of it, may inhibit the adoption of technical developments which are likely to be costly and to return their costs only over a relatively long period, not only in agriculture but throughout the economy.

Therefore, if governments are to use their powers—as they are—

to increase productivity per unit and the physical volume of production, the technical physical measures must be accompanied by those economic and social measures which provide for receiving the increased volume of production in the markets, and for accomplishing the adjustments in the rest of the economy, and in the related economies of other countries, which permit consumption to keep pace with the expanding volume of production.

Anyone can see that factories making ploughs and fertilizers are an essential part of agricultural development. But so are factories which make consumer goods and provide jobs for many non-farmers, and wages to spend on food. A general balanced rise in productivity and real wages is essential. Moreover, unless rising real wages are distributed in some effective proportion to the stomachs to be filled and the backs to be clothed, they do not contribute fully to increasing consumption, and therefore to increasing production, of such agricultural goods as foods and fibres.

Even the focus of this symposium on the adequacy, from the point of view of technical development, of contemporary institutional systems, recognizes that there is in the world a vast body of technical knowledge which, if applied uniformly or universally—as it is not at present—would result in increased productivity at least in many areas now disadvantaged. But to what extent do contemporary institutional systems encourage, or inhibit, the application of this technical knowledge?

This question emphasizes economic and social, and I may even say political engineering rather than physical, technological engineering. The chief needs, upon which wider application of technical knowledge awaits, are improvements in the organization and administration of the institutions and services through which encouragement is given to productivity, and to the distribution and consumption of the product.

How have governments come to take such an interest in all this? The individual producer has always had the most compelling interest in increasing his productivity. Simply, it enables him to eat better or to eat as well with less effort. In the universal specialization and exchange of production, the whole community lives better if individual productivity rises, and the product can be distributed. This is why the organized community—that is, government—has intervened in these matters for a very long time. The efforts today are rather broader—we hear of five-year plans—but a rude beginning was the medicine-man's announcement that the tribal god required fertility rites at planting time. We come up the scale through legal

patent monopolies, tariff protection of infant industries, great agricultural research and extension systems, and now see widely-embracing national five-year plans.

There is a natural growth in this planned action by governments. Some technical means of increasing his productivity can be devised and applied by a single farmer, whatever his neighbours may be doing, but he can apply others only, or better, if he and his neighbours co-operate. Likewise, some of the larger efforts which governments undertake can be successful, or will be more effective, only if governments join hands.

For reasons as simple as this, the Food and Agriculture Organization came to be created as an agency through which governments can consult each other about problems and policies; and plan jointly and carry out co-operatively measures to increase the productivity of their farms, fisheries, and forests—not forgetting all necessary accompanying measures to improve the distribution of the product so that it can contribute to human welfare.

If the process of increased productivity and improved distribution occurred evenly everywhere, there would nevertheless be advantages in this mutual aid. But the process has been very uneven. This is one reason why it would be difficult to say simply 'yes' or 'no' to the adequacy of contemporary institutional systems in this connexion. There exist in various countries very different institutional systems and levels of technological application. Some are primitive, dark-age, medieval, or at least antiquated. We can even look at the institutional systems of the countries called most advanced and see some needs for improving their adequacy in this regard.

The results of such disparities existing side by side can be unpleasant, if not disastrous—not simply to some of us, but to all of us. More than ever before, the people who suffer the results of low productivity and poor distribution—poverty, ill health, ignorance, hunger—can see that not all others endure these things. They are impatient to catch up. They press their governments for action. In the close, modern interdependent world, frustration of such impatience makes uneasy neighbours. This in turn motivates friendly governments of more advanced countries to assist their neighbours.

So, within the countries most directly concerned, we find a ferment of internal effort to raise productivity and improve distribution rapidly—a search for capital, a reaching out to learn and teach the technologies, a willingness to change even traditionally embedded institutions and to create new ones as rapidly as possible. We also

find friendly governments through bilateral arrangements making grants and loans of capital and sending missions of advisers not only in the physical technologies, but also in connexion with such institutional arrangements as land reform, farm credit, co-operative organizations, and research, extension, and education. In the relations between home and colonial governments, we see this process broadened and on a much more enlightened base—no longer the old 'colonialism'. We see it also between governments fully and even fiercely sovereign. In part it is a heart-warming humanitarianism, and in part it is enlightened self-interest. Productive neighbours are better customers, better suppliers, better neighbours.

Finally, we find inter-governmental institutions organized to assist in mutual or co-operative help for self-help. F.A.O. is one example, among its circle of sister agencies in the United Nations family. The word 'mutual' here has two meanings. First, in helping each other, no country is without its special skills and the so-called 'under-developed' can offer a good deal. Second, developments in agriculture, health, education, transport, communication, industrialization, investment, general administration, labour welfare, must march along together; they are mutually supporting.

These three lines of expanding effort should not be thought of as duplicating or competing. In India, Ceylon, Pakistan—and elsewhere—one may find, for example, the local official department using its own funds and powers, working with an F.A.O. irrigation expert and a U.S. Point Four tube-well-drilling expert, to develop an area of new farming land.

National plans are voluminous, complicated, and impressive in their total effort. For example, in the first three years of her five-year plan, to March 1954, India's Central and State Governments spent the equivalent of about 1,858 million U.S. dollars.¹ Of this, about \$226,000,000 was devoted to agriculture and community development, \$632,000,000 to irrigation and power, \$470,000,000 to transport and communications, \$71,800,000 to industry, \$417,000,000 to social services including rehabilitation of displaced persons, and \$42,500,000 to other purposes; and Ceylon has just announced a six-year plan for economic development, including agriculture, involving \$400,000,000 in capital outlay, of which it is hoped to obtain \$80,000,000 in foreign aid.²

In 1954 the Organization for European Economic Cooperation

¹ Government of India Planning Commission, *Five Year Plan Progress Report for 1953-54*, Sept. 1954, pages 10 and 11.

² *New York Times*, 6 Apr. 1955.

issued a report¹ on economic conditions in the overseas territories of the O.E.E.C. members, that is, the territories of the United Kingdom, France, Belgium, Portugal, the Netherlands, and Italy. 'In almost all the territories', the O.E.E.C. reported, 'development is stimulated, co-ordinated and in part financed in accordance with specific plans. . . All these programmes set more or less definite objectives for investment, financial resources, production and foreign trade.'

A report by the Secretary of State for the Colonies to the Parliament of the United Kingdom² in January 1955 indicated plans totalling £526,595,000, of which local and loan resources combined would finance £438,557,000.

The United States no doubt comes to mind as an example of assistance in economic development extended to other, and fully independent, governments.

A recent report by the Hoover Commission³ in the United States shows that the United States in the fiscal years 1946 through 1954 has expended over 23 thousand million dollars in grants and over 11 thousand million dollars in loans or credits for economic and other purposes, excluding military aid. Some 4 thousand million budgeted for 1955 could be added, but a prospective unexpended balance of nearly 8 thousand million dollars could be excluded. So it could be estimated that U.S. taxpayers have expended or loaned in ten years nearly 31 thousand million dollars, to improve the economies of other countries, and much of this for the purpose of increasing productivity of foreign producers. In addition, the United States participates extensively in the multilateral technical assistance programmes of agencies such as F.A.O.

F.A.O. may serve as an example of the inter-governmental institution in this respect. The Member States which compose the Organization joined 'to promote the common welfare by furthering separate and collective action . . . for the purposes of raising levels of nutrition and standards of living . . . securing improvements in the efficiency of the production and distribution of all food and agricultural products, bettering the conditions of rural populations. . . .'

The Organization's functions are to collect, analyse, and disseminate information on these subjects. It may promote and recommend national and international action with respect to research, improve-

¹ Organization for European Economic Cooperation, *Economic Conditions in the Overseas Territories*, Paris, 1954: page 9.

² *Report on the Administration and Use of the Funds Provided under the Colonial Development and Welfare Acts*, London, Jan. 1955, H.M.S.O.: Table 1, page 24.

³ *New York Herald Tribune* (Paris edition), 4 June 1955.

ment of education and administration and spread of public knowledge, conservation of resources, adoption of improved practices in production, processing, marketing, and distribution, provision of agricultural credit, and international commodity arrangements. It may also furnish such technical advisory assistance as governments may request.

In 1955 F.A.O. rounds out its first decade. The membership has grown from 42 to 71 governments. Our regular programme funds, contributed by members on a percentage scale, have grown less rapidly, from \$5,000,000 annually to \$6,000,000—offset, of course, by declining purchasing power.

However, since 1951, these regular funds have been supplemented by from 5 to 6 million dollars annually, through the pool totalling some \$20,000,000 annually, earmarked solely for an expanded cooperative, global programme of direct technical advisory assistance for economic development in under-developed countries. These funds are contributed in national currencies to a programme operated through the United Nations family of organizations. In the ten years, the F.A.O. staff has grown to nearly one thousand persons of whom about one-third are technical officers in agriculture, economics, fisheries, forestry, nutrition, or the information and administrative services. In addition, the Expanded Technical Assistance Programme funds enable us to keep between 250 and 350 technical advisers in the field, assisting some sixty countries to plan and develop productivity and the improvement of processing, marketing, distribution, and nutrition, and particularly to train their own people to carry forward better the established projects. We have drawn these experts from fifty countries. More than 800 fellowships have been granted to further this important purpose. The whole of this special advisory assistance aspect of our work, however, rests upon a continuing fundamental programme with which it is increasingly integrated.

My review of this point has largely applied to the less well developed countries of the world. So much of F.A.O. activity is concerned with helping them improve and modernize their activities that we naturally are inclined to think of them first. For this audience, I hardly need to mention the enormous developments which have occurred simultaneously in the more highly developed countries. Practically every one of them has developed and applied, out of pre-war and war-time experience, powerful and effective methods of planning and programming its agricultural development, although in recent years the improvement of conditions has permitted sub-

stantial relaxation of direct intervention in the collection and distribution of farm products, the rationing of consumption, and in direct price controls. In a greater or lesser degree, practically every highly developed country still draws up advance goals or forward programmes more or less formal in character for its future agricultural production, and supports agricultural prices or incomes through one device or another. Further, in some countries such as Cuba (sugar), in the United States (basic crops), and France (wine) direct measures to limit or reduce output have been taken when supplies increased beyond current demands at the prices established by governmental policies. In addition to these national measures, there has been a gradual increase of special international action to reduce the fluctuation in commodity prices and exports through such devices as the International Wheat Agreement, the International Sugar Agreement, and the proposed International Olive Oil Agreement. The development of such agreements, however, has been much slower than was expected some years ago.

National supports to farm income and farm prices have been one of the factors which have helped maintain stable levels of demand in the decade since the war. These supports, together with other measures for maintaining stable industrial activity and employment, have provided 'built-in stabilizers' which have helped to prevent any of the economic recessions which started since the war from growing into a downward spiral and creating great world-wide economic depressions such as those of 1920-1 and 1929-33.

F.A.O.'s activities to aid the more fully developed countries have naturally differed from its services to under-developed countries. Here, our main economic function has been to provide a World Forum where agricultural problems could be discussed and debated, and common lines of national policies agreed upon; to supply a world-wide statistical and economic intelligence service which would give all countries adequate, dependable, and unbiased information on the situation and prospects, and to provide means for examination and discussion of current commodity problems. On the technical side F.A.O. has assembled and published information on the latest scientific developments in each agricultural field, and has helped all countries, advanced as well as less highly developed, to keep in touch with scientific advances affecting agriculture, no matter where they occurred. The improvement of technical activities, especially in the more highly developed countries, has been assisted by the establishment of regional technical committees or commissions in such fields as crop production, livestock production, forestry,

fisheries, and forage crops. Through the recurring meetings of these bodies, experts from each major region are able to discuss among themselves the most recent advances in particular fields of agricultural science, in some cases to plan co-operative experiments, and in general to speed up the adoption of new methods and improved practices regardless of where they have been first developed.

I should not like to attempt close evaluation of what has been accomplished by all this effort, but it has visibly yielded a good deal of fruit, and the results are probably cumulative.

What of the hopes of closing the great gaps between the areas of lowest and those of highest productivity, effective distribution, and ample consumption?

Given the present strong urges to increase and improve, and the observation of history, the only possible answer is that a relative success eventually will be achieved. I qualify this with 'relative' and 'eventually'. We are not talking about Paradise tomorrow.

What rate of progress may be expected? One can only answer that it will be discouragingly slow to people in a hurry. But by reason of what has already been learned, development can be more rapid in the under-developed areas than it otherwise would be, both in the technologies themselves, and in the planning and organization of efforts to speed up the process.

One does well to remember that in the so-called advanced countries, the developments leading to relatively high productivity and relatively good distribution commonly enjoyed by consumers, have not been achieved without mistakes. Nor have we made all our mistakes yet. The way has been learned by slow, partial, and often painful steps from the tribal seed-planting fertility rite to the present complex organization of planned stimulative effort. Partial planning will remain our soundest approach, rather than attempting immutable all-embracing plans. We are neither wise enough, nor can we plan and work ahead fast enough as situations change, to attempt the all-embracing blueprint. But while having to go through much the same steps of learning, governments now undertaking expansion of their schemes can go faster by having the benefit of accumulated experience, and the very great willingness to assist, of their neighbours.

I am very sure that in inter-governmental effort we have yet a great deal to learn. One thing we are learning is the nature of the main needs if this vast, desperate, hopeful effort of so many people to lift themselves by their own boot-straps is to be successful. It requires better organization of efforts on all levels and lines of activities.

For instance, under-developed countries having large hidden unemployment, or under-employment, and under-utilization of natural resources could do a great deal for their own technical development by a better organization of these under-employed resources by improving their agrarian structures, by community development schemes, co-operative organizations, and the provision of incentives.

The experience of F.A.O. as an international institution, in helping countries to meet these needs, may be illustrative of many of the problems and of what can be accomplished. Organization of effort begins with the understanding of situations and possibilities, the defining of objectives, and the shaping of general policy. In all this, I believe that F.A.O. makes a contribution. The Conference, the Council, and regional and technical meetings, bring together responsible governmental department heads and their technicians. In their discussions one can see the growth of a broader understanding, the tendency to correct some unwise courses, a concern for the reform of the agrarian structure, and a continuing stimulation to greater effort.

We are increasingly useful, too, as an institution through which member governments obtain statistics and economic intelligence. The data are gathered and compiled by countries, by regions, and on the global basis. One of the needs in a great many countries is for much more dependable information of this kind.

While I am in the field of common institutional services in acquiring and exchanging data, I should not neglect our technical information services. For one example, our lists of plant breeders, together with catalogues of genetic stocks of important crops, now enable breeders to work with each other and to obtain genetic stocks within a much broader framework than ever before.

Viewed broadly, distribution must take in both the local marketing services and facilities, and the perplexing questions of relations between farm buying power and industrial production and urban buying power, and must include questions of international trade as well.

In under-developed countries, the facilities are mostly lacking for rural credit, grading of farm products, selling by grade, local and terminal storage facilities, and warehouse certificates which can serve as collateral for loans on stored products. On these more local ends of the distribution system, F.A.O. has both made technical studies and given direct advisory assistance. For example, a marketing expert helped Libya formulate grading and quality control legislation,

and grading, packing, and treatment facilities for citrus fruit exports, developing outlets which increased income to farmers.

But marketing facilities alone do not solve the problem, as accumulating surpluses have shown in North America where such facilities are highly developed. By and large, buying power for farm produce is created by factory produce. And because the intervening distribution costs are relatively inflexible, prices of farm products tend to fall even faster than declining production and buying power of urban communities.

Countries have dealt with this problem by two divergent courses. On one side they have treated the symptoms of inadequate demand and falling prices with direct support of farm prices. Various devices for this are now almost world-wide for most standard crops. On the other side they have tried to adjust their programmes to provide a balanced development of agriculture and industry, so that effective demand should expand with production.

On the second line, the idea of developing national programmes aimed at maintaining a better balance between supply and demand is easier to state than to practise. In general, earlier F.A.O. Conferences simply agreed on the desirability of expanding production as fast as possible. Emerging food surpluses and growing experience opened the way to more specific consideration. The 1953 Conference discussed international co-operation for disposing of these surpluses. Measures were recommended to member States to expand consumption. These included improved marketing arrangements, and nutritional programmes for special population groups, together with selective expansion of the products most needed to improve quality. The emphasis was thus upon redirection rather than restriction of production, and upon selective expansion of consumption as well as production. Full success would have been too much to expect, and the United States, for example, has had to resort to reductions in production to prevent further excess accumulations. But some progress has been made in readjustments, and the United States has made great efforts to dispose of the existing surpluses in line with the principles agreed upon and in consultation with the countries affected.

In addition, a basis has been laid for readjusting national programmes to make them as consistent with each other as possible. Regional consultations are being held in the Far East, the Near East, and Latin America. The agricultural countries of the more industrialized European and North American regions, through meetings of the Commodity Policies Committee, the F.A.O. Council and Conference, and to some extent through meetings of the U.N.

Regional Economic Commissions, consider the same issues of relating their programmes to those of neighbouring countries in the region, and to the world picture as a whole.

The problem of balancing supply and demand cannot be solved solely in the field of agriculture. Since expenditure for food and clothing rises less elastically than for other components of family budgets, other parts of the economy have to expand even faster than agriculture if a balance is to be maintained. In the less fully developed countries especially, some advance programming of governmental investment and some co-ordination of private with public investment is needed if misallocation of resources is not to create problems. Understanding of these problems has grown through discussions in F.A.O. meetings, and the staff has given a good deal of attention to their study.

As the early history of North America shows, development investment funds are needed from outside. That continent had rich resources and a light population, but many of the present underdeveloped countries have enormous populations and the resources appear relatively less rich or not so easily developed. They can put little into financing their own development. F.A.O. has no funds and no authority to provide capital. But with the keen concern of member States, F.A.O. has pioneered the study of international financing. A better understanding of the problem has contributed to a willingness to deal with it. F.A.O. has co-operated with the International Bank in appraising agricultural projects, and would expect to co-operate closely with the proposed S.U.N.F.E.D.—the Special United Nations Fund for Economic Development. Since no institution for giving such training existed, F.A.O. has co-operated with the International Bank and with the United Nations in holding training centres for officials of countries engaged in formulating projects requiring outside capital. These centres, held in the Far East, Near East, Latin America, and the Mediterranean Basin, have given help in working out programmes for projects, appraising their technical and economic potentials, and presenting projects for financing.

Our most recent activity in this general field links the development financing concern of governments with the problem of agricultural surpluses. F.A.O., in agreement with India, made a pilot study¹ in that country to show how agricultural surpluses could be used to

¹ Food and Agriculture Organization, *Uses of Agricultural Surpluses to Finance Economic Development in Under-Developed Countries*, Commodity Policy Studies No. 6, Rome, June 1955.

provide part of the capital for financing development in the less fully developed countries.

Economic development, especially in agriculture, calls for a long view and for assurance of continuity of funds, even though they be at a modest level.

The development plans of countries depend strongly on outside assistance, both in capital and—as through F.A.O.—in the lending of expert advisers. The principal donor countries have left little doubt that, in principle, they hope to persevere in this effort. But they are mostly unable to commit themselves financially for more than a year ahead. Not all the currencies given are convertible. We may know only shortly before, or only actually in, a given financial year what our resources will be even for that year. Neither can we know, until countries present their requests, what scale or kind of help we should be prepared to give. The pressure must be toward enterprises which, if not of the most fundamental importance, can be realized within foreseeable resources. More stable funds would contribute to greater effectiveness of this system. What can be done even within the present uncertainties is, nevertheless, most impressive and heartening.

The need for stable government is obvious. Changes in policy, in taking up or abandoning programmes, in the personalities, powers, and funds of ministries, dampen the effectiveness of planning and carrying out enterprises of these kinds. Many of the governments now striving to raise the levels of their people's living are new governments; no less than fifteen of them have attained sovereignty since the war. They have everything to deal with at once. One must have the utmost sympathy and admiration for the people who are striving to man the upper responsible posts.

Beneath this level, there often does not yet exist a trained and stable civil service to carry on and encourage a balanced development. There are not enough people trained and experienced to man the laboratory, experimental farm, and economic research; not enough to man the teaching and extension work that is needed; not enough to man the co-operative organizations. The institutions themselves often need to be developed, at least from some rudimentary stage. Inadequate educational facilities may mean that the trainees for such institutions have first to be better prepared, and in larger numbers. Here seems to be a field in which effort should be organized from both ends. At the local end, co-operative community development utilizes the resources, perhaps latent, of man-power, intelligence, responsibility, and active participation in the local community toward the better technical utilization of its physical resources.

Governments can do, and are doing, a good deal to encourage this. Reforms in land tenure, in rural credit, in taxing systems, in rural education, in marketing and pricing systems, and other institutions of the agrarian structure, increase the incentive to use more technical means for increasing productivity. They facilitate the distribution of its product.

At the other end, the number of experienced people available to organize the necessary institutions and services, on an indigenous basis but with the benefit of watching others with like problems, is being increased. I have already referred to one way of doing this—the regional training centre. At the request of member governments, F.A.O. has organized such centres or seminars in extension organization and methods, supervised credit, home economics, rural co-operatives, rural welfare, statistics, marketing, and formulation and appraisal of development projects. Nor should I forget to mention the Fundamental Education Training Centres which U.N.E.S.C.O. has organized and in some of which we have participated.

Out of all this, I hope and believe, is coming a better organization of human effort through institutions which fit the various needs of different areas. Out of it should come, not too gradually to meet the deeply and impatiently felt needs of people, such a better application of technologies to natural resources that the sum of human welfare will grow, especially in those areas where its advance has been delayed too long.

ARTHUR JONES, *Ministry of Agriculture, Fisheries and Food, England*

I am glad Dr. Cardon stressed the bearing of economic, social, and political developments on technical progress. We are living much too near the events to understand the magnitude of the upheaval that has taken place in economic and political thinking during the last two decades. In fact I very much doubt if there has been anything like it since the light of Christianity burst upon pagan Rome. We in Great Britain claim with some justification that Keynes was the prophet of the new age, but beyond all question the State which has given a lead to the world in international executive action is Dr. Cardon's own country. It is therefore most appropriate that he should be our principal contributor this evening. With so wide a range to cover, he is the first to admit that he can only suggest rather than discuss the nature and bearing of the measures which governments and inter-governmental agencies take to foster research, experimentation, and advisory work among farmers. There is, however, great force in his point that the growth of technical knowledge is very often uneven,

thereby causing changes in supply without corresponding changes in demand. We therefore draw the conclusion that deliberately planned adjustments are required both in the national and the international spheres.

Dr. Cardon is concerned in much of his paper with the less well developed (or, as Dr. Aziz prefers, mal-developed) rather than the more highly developed countries. He is well aware of the many obstacles and difficulties in the way of technical advancement where institutions are new, capital deficient, and trained personnel inadequate. Progress under such conditions must be slow and gradual. On this question of assimilation of knowledge and pace of progress, we are all concerned with the obstacles and inhibitions to be found even in advanced countries, where institutions are highly developed, capital abundant, and technical advisers numerous. Most of us, for example, are conscious of the gap which exists between what the technical adviser knows can be achieved and actual performances on the farm, in crop yields or livestock production. One of the fundamental problems that face any government in 'planning and programming its agricultural development' is to judge how 'powerful and effective' are the methods, and how far they fall short in inducing farmers to make use of available technical knowledge and economic advice to reduce unit costs and adjust their enterprises to the needs of the markets.

The problem that we are up against in the United Kingdom, and which must face other governments which are relatively well served with both technicians and economists, is to assess the changes in productivity and output which may be due to technical progress on the one hand and to changes in demand and prices on the other. In my own country we have quite an elaborate system of guaranteed prices, production grants, consumer subsidies, &c., but the real problem is to achieve the right adjustment so as to ensure farmers reasonable remuneration and consumers a fair deal. Another question to which the answer is not at all certain, is whether support for agriculture, through governmental action in the form of subsidies and deficiency payments, has encouraged or inhibited technical progress. No doubt a large number of farmers have been encouraged to experiment and plan ahead by the assurance of relatively high prices; but others have relaxed their efforts because they were not spurred on by the necessity either to increase output or to reduce costs, in order to maintain their net incomes.

On the problem of surpluses to which Dr. Cardon referred, it is clear that if governments promote increased production, either by

guaranteeing prices or by encouraging technical improvements through advisory services, they may have to take measures to re-direct or restrict production unless they are prepared to put a heavy financial burden on the taxpayer in order to maintain farmers' prices irrespective of greater supplies, which inevitably depress the market. For example, our most embarrassing surplus—that is, in pigs and eggs—has been due more to the incentives of high guaranteed prices than to technical improvements.

Dr. Cardon has opened an enormous field for discussion when he interprets 'encouraging technical development' as 'embracing all those activities open to governmental and non-governmental authority which taken together are indispensable to increasing productivity'. In taking such a broad view he could not of course deal in detail with any particular activity except in the review he gave us of the work of F.A.O. Perhaps it would add to the interest and value of the discussion if I gave a brief description of the measures taken by my own government to encourage technical development and increase productivity. I shall confine my remarks briefly to the steps we have taken to foster technical improvements through research, education, and advisory work, which in the long run must be the right and wise way to promote efficiency and raise living standards.

The promotion of agricultural research in Great Britain is largely the responsibility of the Agricultural Research Council which maintains a continuous supervision of the projects undertaken, in the main, by independent research institutes which are grant-aided by the Ministry of Agriculture and the Scottish Department. Some of these institutes are widely known: for example, Rothamsted which is especially devoted to soil science; the Welsh Plant Breeding Station; the National Institute for Research in Dairying; and the East Malling and Long Ashton Stations which are primarily concerned with fruit. The Research Council also controls and directs research through its own institutes. In addition, of course, all the departments of agriculture at universities undertake a considerable volume of research.

The development and application of research work and the promotion of technical efficiency in farming and in horticulture are, as far as England and Wales are concerned, the responsibility of the Ministry of Agriculture which in the main operates through the National Agricultural Advisory Service and the Agricultural Land Service. Perhaps I should also mention that during the last war the Agricultural Improvement Council was established as an advisory body composed of scientists and practical farmers.

A chain of experimental husbandry farms has been established

under the N.A.A.S. for the purpose of testing the results of research work under varying conditions of soil and climate and applying these results to the diverse farming systems found in the country. These farms fill what has hitherto been a serious gap between the research worker and the farmer, and will be the means of incorporating new methods, new varieties, new techniques of all kinds more speedily in ordinary farming practice.

The provision of advice to the farmer is largely the responsibility of the N.A.A.S., established in 1946. This Service is organized on a provincial and county basis with a small number of senior officers at headquarters to direct and supervise the work. At the eight Provincial Centres there are science specialists in such subjects as entomology, soil chemistry, and bacteriology; husbandry specialists concerned with problems of livestock, milk production, farm machinery, and poultry; and horticultural specialists in glasshouse crops, fruit, and vegetables. These specialists have the task of keeping abreast of research and investigational work in their subjects and passing the latest knowledge to the county advisory staffs for transmission to farmers and growers by visits and in other ways. Mass-instruction *media* such as films, demonstrations, exhibits at shows, discussion groups, and farm walks, are widely employed. These county officers comprise both general advisory officers and others who specialize in such subjects as milk production, livestock husbandry, horticulture, poultry, and farm machinery. The counties are organized on a district basis and the spearhead of the county staff and the immediate point of contact for the farmer or grower is the District Advisory Officer who has between about 1,000 and 1,500 farmers within his area.

Education, which must play and always has played an essential part in the encouragement of technical development, centres round the universities in the training of personnel for the research centres and advisory or extension services. The training of young farmers and agricultural workers is the responsibility of the local education authorities through farm institutes which are grant-aided by the Ministry of Agriculture. These institutes have increased in number from seventeen to thirty-six in the last ten years and about 2,000 young men and women are trained in them every year. There has also been rapid expansion of the universities' agricultural departments, where about 1,600 students are taking degrees or post-graduate diplomas every year. In 1939 the Government provided a little over £600,000 for agricultural education and advisory work. Today that figure is between £3½ and £4 million a year.

Post-war interest in research is evident from the increased numbers

of scientific workers (from about 900 five years ago to 1,700 today); and the grant provided annually by the Ministry of Agriculture has increased from £200,000 in 1939 to nearly £2 million. Capital grants for the period 1951 to 1956 amount roughly to £4 million.

In very general terms that is the pattern of our research, educational, and advisory services. Possibly others will refer to agencies of a voluntary character. I will only mention organizations such as the Royal Agricultural Society of England, and local shows and discussion societies which have contributed much to the well-being of agriculture in the matter of crop rotations and livestock improvement. Neither is there time to refer to the work undertaken by agricultural economists and in particular to the techniques they have developed and the standards they have established, which are now being increasingly used by our technical officers as the one realistic and effective approach to farm advisory work. Another development which we cannot ignore is the interest taken by commercial organizations in both research and advisory work. Again, the scope, and in my opinion the duty, of our statutory marketing boards to encourage advisory work and possibly to provide field facilities in the way of personnel to that end, should be considered. In other words, farmers themselves through their organizations must surely shoulder more responsibility for their own advancement than has been the case up to now.

May I, in conclusion, raise one or two issues of a general character that arise from Dr. Cardon's address and which must be present in the minds of all concerned with this problem of increasing efficiency? There are a number of economic obstacles to the exploitation of new techniques which must be overcome if we are to make the progress desired. I have in mind the importance of capital and very often the difficulty of obtaining it; and the size of farms in relation to the increase of labour productivity. How, for example, can intensification go hand in hand with labour saving whether by mechanization, improved organization, or better work planning? In this connexion I must emphasize very strongly the need for the farm management economist to work hand in hand with the technologist. Our advisory approach, if it is to be really effective in all countries, must be based on a sound technical plan allied to a clear appreciation through systematic analysis of its economic implications. Again the approach to technical development must be twofold. Demonstrations, farm walks, discussion societies, &c., must be directed in the main to the farmer of average intelligence and education. On the other hand, for advice to be useful to the individual farmer, the adviser must assess

the farmer's general competence, education, and initiative. It is worse than useless to provide a plan for an individual, or for that matter a far country, if the standard of technical knowledge is not such that it could be reasonably carried out.

Another aspect of technical development is the problem of using trained personnel to the best advantage. In many countries the number of qualified extension workers is quite inadequate. In those circumstances how much can be done by men with little or no technical training provided always that they are instructed by fully trained advisers? This may be the solution in many countries if we are to accelerate the rate of improvement. In the same vein, can the advisory officer properly perform duties other than extension in the commonly accepted sense—enforcement duties, for example?

What rate of progress can we aim at in the case of under-developed countries? There are many obstacles such as illiteracy, and traditional customs and beliefs, such as the 'cattle complex' in Africa where a man's social position is measured by the size of his herd and, I thought until Sunday last, the number of wives he had. This custom as you know has resulted in overstocking and soil erosion. These are some of the issues which appear to me fundamental. Finally, I am in complete sympathy with Dr. Cardón's views on the future of planning. It is so pitifully easy to criticize present orientations; so painfully difficult to devise procedures which are bound to succeed in a changing world. We can but search out a way forward, uninhibited by ideologies, unafraid of innovations. None the less we shall probably find that the secret of planning, like that of politics, is compromise.

A. H. STENSGÅRD, *Sveriges Lantbruksförbund, Stockholm, Sweden*

I have no direct comments to make on Dr. Cardon's paper, other than to express my appreciation, and my hope that his views may be a little too pessimistic. For the most part, I wish to consider non-governmental agencies, which have only been touched on in the opening paper, and I shall restrict my remarks mainly to the Nordic countries of western Europe. I find it also appropriate to restrict myself to agencies which aim primarily at the encouragement of agricultural development.

As Dr. Cardon has observed, the individual producer has always had the most compelling interest in increasing his productivity, and can best do so by co-operating with other producers. Co-operation in certain forms has occurred for a very long time. Nowadays it

usually appears in the form of associations which have been founded to provide various special benefits for their members.

For present purposes, we may group those agencies as follows:

1. Agencies designed to increase the knowledge and skill of the farmer. These are usually associations for technical improvement by means of educational, investigational, and advisory services (e.g. agricultural societies of regional character).
2. Organizations for the acquisition of the material and financial assets which are necessary for technical development.
3. Organizations for the marketing of products; which organizations are designed to increase the level and stability of farm incomes.
4. National agricultural organizations, whose aim is generally to protect the interests of the farmers in the community, especially in matters concerning agricultural policy, and to encourage agricultural improvements and co-operation amongst farmers.

When speaking about governmental and non-governmental activities we must remember, however, that it is often impossible completely to separate the two. We are mainly concerned with collaboration between the State and the individual farmers through intermediate organs within which the State and the farmers participate to varying extents both financially and politically.

The initiative in activities of this kind (for mutual exchange of experience and for advisory service) has been taken mainly by individuals of proven ability, even in cases where this activity is now primarily financed and directed by the State. Those agencies which are now directed mainly towards extension service in agriculture have developed in this way.

I agree with those who think that this activity should be financed and directed mainly by governmental authorities, because it is essential that an information and advisory service should be conducted impartially and should reach all farmers, including the small farmers. Only the State can provide adequate means to ensure this. The same applies to experimental work in the use of fertilizers, testing of machines and implements, &c.

However, there are certain disadvantages of purely governmental control. The farmer will be apt to solicit the aid of the State for everything that is to be done rather than attempt to solve his own problems. There is also a risk of losing the close contact and collaboration which is desirable. It is hardly possible to establish exact principles to determine the relations between the State and the

farmers. The experience of the Nordic countries, however, indicates the desirability of giving considerable authority to the farmers. This can be achieved if the responsible bodies retain their character as agricultural associations but are obliged to follow certain principles laid down by the State. In countries where the farmers have not already started agencies of their own for these purposes the matter should probably be judged differently. Other associations for the encouragement of technical change, such as animal and plant breeding associations and societies for co-operative ownership of machinery, can often obtain financial aid from the State, although their activities are conducted independently. In a country of small farms this has proved to be a valuable way of encouraging technical improvement. For example, the Swedish Seed Association, which has developed varieties and strains of great value not only to Sweden but also to other countries, is a farmers' association which was financed, at first, mainly by private means. It remains a farmers' association but its scientific activities are now financed mainly through State grants.

Co-operative commercial organizations have been mentioned in various connexions. This group includes those which provide farm supplies and finance capital, as well as those which sell the farmer's produce. In many cases the different activities are performed by the same enterprises (dual-purpose co-operatives); but in the Nordic countries the societies usually specialize. There, co-operation has expanded rapidly. In the dairy industry co-operatives command over ninety per cent. of the total market. They also handle from 50 to 75 per cent. of the trade in fertilizers and concentrates.

The co-operatives which supply farm requisites try to help farmers by acquiring supplies of reliable quality and at the lowest possible price. In so doing they combat dishonesty and profiteering and help to reduce costs generally. In the past the associations have seldom been pioneers in the production of new and better kinds of farm supplies and equipment. These have been purchased mostly from manufacturers. However, the great co-operative enterprises have now started manufacturing the commodities in question. Since they belong to the farmers themselves, they are well suited to advise the farmers on commodities and to service and repair farm machines.

For providing credit to farmers for the promotion of technical change, the co-operative credit societies are considered to be the most appropriate form of institution, as they have intimate knowledge of the borrower and can assess the likelihood of his making appropriate use of the credit. In Finland the organization of credit has been of great value for technical development, and not only

within agriculture. Through buying organizations, and a satisfactory credit organization, farmers can free themselves from financial dependence on private dealers which would compel them to sell their produce to particular dealers and to accept those dealers' prices.

I think it is of great importance that the credit associations should try, through members' investment and the funding of profits, to obtain sufficient of their own capital to provide security for the depositors. Gradually this makes it possible to collect savings in order to finance loans. In this manner the associations become self-financing and can also contribute to the development of other industries within the community. There are many instances where this has been achieved.

The marketing organizations help the farmers by trying to attain higher and more stable prices, and also through guaranteeing the sale of all his products which is no less important than the price. These advantages are achieved through integration of marketing activities, such as hauling, manufacturing (except grain), storing, and distribution to retailers and through shops owned by the co-operatives. Without doubt organization of this kind has reduced distribution costs in favour of both producer and consumer.

Through storing and close co-operation between local societies it is possible to provide regular supplies to the consumers independent of seasonal variations or local scarcities. Central organizations handle necessary exports and imports.

The effects on the producers of a secure market have been most marked. The milk supply for instance showed an unexpected and remarkable increase—amounting to 100 per cent. or more in some places. Obviously the security of the market provides the producers with an incentive for more effective utilization of resources and for technical improvements.

Mr. Davies has told us that in England the problem has been met by farmers agreeing to compulsory membership of an organization which takes away their individual freedom. We have not reached this point. Our aim is to include as many farmers as possible, but only on a voluntary basis. The compulsory aspect, at least in Sweden, has to be looked for on the political level, as political measures lay down certain general conditions for commerce. These are the same for all, and within this frame there is free competition. In the Nordic countries the private enterprises can work side by side with the co-operatives. Such unfair conditions as Dr. Aziz reported from Malaya cannot exist in Scandinavia.

Experiences similar to those spoken of here may have been met

with in other countries too. It has been questioned, however, whether co-operation can be of use in under-developed countries, and some unhappy experiences have been reported. However, failures have occurred almost everywhere. That does not prove that co-operation cannot work. Later on, when more experience is gained and better plans have been made, the experiment might go through successfully.

The present position of co-operation in Nordic countries is a result of more than fifty years of progressive development and accumulated experience. It is impossible to build similar organizations in under-developed countries in a short time. Even there the development must begin from the bottom.

It is not usually desirable to try to transfer a co-operative system from one country to another. It must be planned according to prevailing conditions, although experience from elsewhere may be of great help. If production is low, it is necessary to organize for an increase from the beginning of the enterprise. Once this increase is begun there are great chances that a simultaneous development of production and marketing will occur. Also, what have been considered as subsistence farms will probably show ability to produce for the market, or will be progressively converted into farms of more commercial type.

It is both easier and more desirable to erect a co-operative selling enterprise for agricultural products in regions of surplus than in the vicinity of big cities where the selling society may be of more value to consumers than to producers. It is wise to start with a limited project of a type that seems to afford the best possibilities for success in a favourable area. Nothing can give better incentive for future endeavour than a successful start.

For orderly development a co-operative system requires a central body for planning, education, and co-ordination. In Finland such a body (the Pellervo society) has been instrumental in building up the movement from the very beginning. In some other countries such bodies have been of equal importance in reconstruction and in raising the co-operative movement to its present position.

G. GAETANI-D'ARAGONA, *Agricultural Economic Observatory, Naples, Italy*

The preceding papers have raised an important point. In spite of the increased productivity of farm capital which results from technological change, it appears that the governments of many of the less fully developed countries are deterred by social and political

conditions from encouraging technological progress within their agricultural communities. These obstacles seem to be particularly formidable in those under-developed areas of the world which still have rapidly increasing populations. In these areas population pressure makes saving almost impossible and thus impedes large-scale industrialization and prevents the profitable utilization of the labour which would be displaced from agriculture by technical improvements.

As Mr. Elmhirst has already pointed out, not only does technical progress change the rural environment, but it also increases the need for governmental intervention in the control (not necessarily the reduction) of the growth of population in the under-developed, densely populated areas of the world. Population pressure and high rates of human fertility appear to be in basic conflict with technological progress. This conflict needs to be tackled by agricultural economists if the standard of living of the economically backward countries is to be raised appreciably. Can governments tackle this population problem without reducing the freedom of the individual to determine the size of his own family?

Proper apportioning of investments among different industrial and agricultural programmes can be very effective in reducing the population obstacle to technological change. Until now the interaction between economic progress and changes of population structure and fertility has been generally ignored. We can try, however, to formulate some basic propositions on this interaction.

Firstly, rural life, particularly if based on a subsistence family type of farming, is in most under-developed areas a relatively static way of living which is likely to perpetuate a high rate of human fertility. Industrial communities on the other hand are more conscious of the burden which a large family imposes in modern life. For example, motor-cars are often chosen rather than additional children.

Secondly, owing to the rigidity of the social values which prevail in rural communities of a subsistence family farm type, population varies with total income. Under these conditions, therefore, standards of living cannot be raised by investment.

On the basis of these propositions, we can establish the following principles for governmental action:

1. In the appraisal of alternative lines of investment, governmental action, aiming to maximize the social marginal productivity of the investment and to introduce technological change, should always take into consideration the occupational and population changes which are induced by different types of investment (industrial and

agricultural investment, for instance). Welfare equations can be used for the evaluation of the social marginal productivity of different investment programmes. But such equations should include a variable which measures the effects on occupation, and consequently on human fertility, of the various types of investment.

2. The occupation-fertility criteria can also be usefully employed to determine the comparative advantages of different programmes of agricultural development, and might be expected to reveal the folly, for example, of attempting to establish additional subsistence family farms where there is already heavy pressure of population on the land. Such a policy would thus be revealed as likely to induce a neo-Malthusian equilibrium, i.e. a State in which the level of population is determined by total income rather than, as in the original Malthusian theory, by the supply of food.

S. SINCLAIR, *University of Manitoba, Winnipeg, Canada*

This discussion raises a question which has received little attention at this Conference. Modern agriculture must have workers trained in modern agricultural techniques—agrologists, as we call them in Canada—if this industry is to keep pace with developments in the rest of the economy. Technical change depends upon invention and innovation resulting from research and experimentation by well-trained men. It also requires competent extension men to spread this new know-how among the farmers and speed its adoption. As the industry moves forward, its dependence on science in all forms is increasing. Consequently, the need for trained workers will increase. The question is: are we training enough workers to meet these needs?

In my travel to this Conference I asked about this. I was interested because in Canada we are experiencing a shortage of agrologists in research, education, and administration. The same situation seems to prevail in most of the countries I visited. The relative shortage is due to an increasing number of necessary posts without a parallel increase in student registrations in the agricultural courses at universities and colleges. This is happening when almost everywhere student registration is rising for every other profession.

The explanation for the relatively low registrations of agricultural students seems to lie in several factors. First is the question of salaries. It is a recognized fact that agricultural workers as a group are paid less than other professional groups. Some improvement has been experienced in recent years but a considerable gap still needs to be closed.

A second reason is that farm populations are declining, thus reduc-

ing the base from which candidates for agricultural training can be drawn. The declining farm population might not result in smaller numbers of agricultural students if it were not for the effect of another factor. In most of the countries I visited I found that the requirements for entrance into agriculture at a university or college, or before a student could graduate in agriculture, included farm experience or a farm background. I do not want to argue against such requirements, even though it is possible to do so. One can point to prejudices acquired by a youth on a farm that are hard to dispel and which may be a handicap to later work in professional agriculture. But I will argue that a farm background is not essential for all professional agricultural work. It deters competent young men resident in towns and cities from entering professional agriculture. The necessary supply of workers can be forthcoming only if recruitment for the profession is broadened to allow and encourage young men and young women from areas beyond the farm to take up agriculture as a profession.

R. MASPETIOL, *Paris, France*

I wish to draw attention to one aspect only of the change which has been going on for several years in State implementation of agricultural policies.

For a very long time, the peculiar position of agriculture within national economies has justified special solicitude on the part of public authorities; for farm conditions in many cases render the employment of labour and capital less profitable in agriculture than in many other industries. But this solicitude, which was expressed exclusively by protective fiscal or social statutes, had the major disadvantage of failing to provide sufficient encouragement to farmers to adapt themselves to new conditions. It tended almost to exempt them from progressive effort.

In the thirties the policy of many States started moving towards the organization of agricultural markets. But it is only since the end of the Second World War that a great change has come about by the adoption of plans for mechanization.

In the countries which apply the principles of a free economy the interests of the whole economy should reconcile themselves with the freedom of choice of several million independent farmers. Under these conditions planning must encourage farmers, through various incentives, to adopt the forms of technical progress which conform most nearly to the orientation which the public authorities count on being able to give to the development of agriculture—an orientation

which manifests itself in the objectives chosen by the political authorities. Important results have already been obtained in this direction in France, where the success of a plan of orientation depends essentially on the degree of security of prices and markets which can be given to producers. One of the major preoccupations of the public authorities is to ensure that development should continue at a similar rate in different regions. The more forward regions have a tendency to accelerate their efforts, while the less advanced regions stagnate or even move backwards. If measures were not taken to allow these latter to catch up, it might be difficult to maintain the unity of the country's agricultural policy. Many serious factors of social and political unrest would result from failure to do this. If the production of many goods can be increased, that of many others should be reduced. Considerations of quality should play an increasingly important role.

In conclusion, I should like to mention the prime importance of raising the cultural standards of the peasant masses in the present cycle of technical progress. This requires a considerable effort in the domain of agricultural propaganda and education. The management of the most modest farm now requires relatively wide knowledge and a mind capable of sustained attention and analysis. Technical progress requires and at the same time contributes to an increase in the intellectual and social value of the agricultural population.

CHANG CHING-TAI, *People's Republic of China*

Technical improvement in agriculture, in a broad sense, is a complicated and arduous process of conquering nature. It needs the encouragement and assistance of government as well as of research institutions. The Chinese people have a long history in agriculture and the peasants have accumulated rich experiences in farming through long years of practice. The outstanding characteristic of agricultural technical development in new China is the close alliance of scientific theories with farming practice. Agricultural scientists help the farmers to apply new discoveries and they also study the productive activities of the peasants at first hand. It is an important task for them to summarize farmers' experiences and put them on a scientific basis, so that they may be made available to the farming community in general in the form of technical guidance. We call this method, 'From the peasants and back to the peasants', and in applying it we can help not only to promote production but also continually to add new substance to scientific theories in agriculture. This is the

basic approach to technical development and, of course, it entails respect for the peasants' wisdom and ability.

The selection, cultivation, and popularization of better crop varieties has been one of our chief objects. Many peasants here discovered better seeds by selecting them from ears on the stalk, from individual plants and from threshing grounds. During the past few years, more than three hundred kinds of high quality wheat and more than ten improved cotton varieties have been found. By using them in place of local varieties we have achieved some 10 per cent. increase in yield. The main method of popularization is the exchange of seeds among the peasants under the guidance of agricultural institutions.

In addition to the selection of seeds, agricultural science institutions have also successfully cultivated a number of improved varieties of wheat, cotton, rice, and other crops on experimental farms. These new varieties have been widely tested by the farmers and have shown good results. For instance, the newly developed variety of cotton gives a yield from 10 to 20 per cent. greater than the native variety; and the proportion of ginned to unginned cotton rises from 1 to 3 per cent., while the length of fibre is increased by one whole grade.

What is the optimum number of plants of a certain crop per unit of land? Progress has been made towards the solution of this problem from both theoretical and practical points of view. For instance, the peasants have been accustomed to planting around three million plants of wheat on one hectare of land, allowing for some variation from place to place. According to the results of experimental planting by research organizations, it has been proved that the optimum number is some five million. Other things being equal this gives about 30 per cent. more yield. Our research agencies are helping the peasants to solve, step by step, the problems of close-planting other staple crops—such as cotton and rice—by carrying on trial plantations on the experimental farms. It is obvious that the method of rational close-planting should not be treated alone. Its application should be coupled with other factors, such as intensive cultivation and the use of adequate fertilizers, in order to obtain good results.

From the viewpoint of social development, the improvement of old-type farming implements and the wide use of modern implements mark the emergence of new productive forces. Owing to the use of modern implements in recent years, methods of cultivation have been much improved and the land better utilized. Experiments made in 1951 with eleven different crops in nine provinces proved that, other conditions being equal, the use of the new-type plough increased output on the average by nearly 17 per cent. and raised planting

efficiency by about 37 per cent. In places where new farm tools have not been used, the peasants often have to overcome the limitations imposed by old-type farm implements by deepening the furrows an extra 4 or 5 inches.

As a result of the development of producers' co-operatives, small pieces of land are gradually being combined into larger farms, thus creating favourable conditions for employing new-type implements, especially tractors. There are now eighty-nine tractor stations operating on an experimental basis. They help the producers' co-operatives to mechanize their farming and enable them to adopt comprehensive technical improvement. In so doing, the output has been raised by 20 per cent. This has encouraged the peasants to look upon modernized farming equipment and highly efficient farming methods as means to a prosperous and happy life.

The history of recent economic development throughout the world has shown that large-scale production is superior to small-scale production. This is true in agriculture as well as in industry. Therefore, the Government and agricultural science institutions began to establish large-scale State farms at a time when material conditions were difficult after the war. There are now ninety-seven completely mechanized State-operated farms covering a total of more than 180,000 ha. of land. The collective mode of production, mechanized farming, and the superiority of the advanced scientific techniques employed by these farms teach the peasants what collectivism means and lead them gradually towards it. The Wulitien State farm in the suburbs of Peking gave yields higher by 20 per cent. than the peasant farming with old techniques. Having seen this, the peasants nearby voluntarily organized producers' co-operatives and asked this State farm to help them by providing tractor services. The Hsinghuo Collective Farm, the first farm of its kind in New China, was organized with the direct assistance of the State-operated Huachuan Irrigated Farm. China has vast expanses of cultivable waste lands—more than the present cultivated land. This virgin soil needs to be reclaimed by planned mechanized farming. Most of the ninety-seven State farms were established for this purpose. All those in the north-east were started less than five years ago in uninhabited areas.

Flood and drought have long been a great menace to agriculture in China. In an effort to limit these natural disasters, the Government has put tremendous energies and resources into water conservancy. There are two aspects of the work. In the first place, the Government is directly undertaking the construction of modern large-scale water conservancy engineering works. The principle underlying these is to

achieve both long-term fundamental control and immediate control. Equal emphasis is given to the prevention of floods and the drainage of flood waters. The well known Huai River Project, the Kwantung Reservoir on the Yungting River, and the Chingkiang Detention Project, have already helped to safeguard agricultural production. The other aspect of water conservancy is the development of local irrigation works with governmental help. In 1954 the Government supplied the peasants with more than 110,000 water wheels on a loan basis. These small-scale works have resulted in an enlargement of the irrigated area by over 3 million ha. and a general improvement in irrigation in these areas. To encourage works of this kind as well as other technical improvements, the Government has provided large agricultural credits at very low interest rates (1.0 per cent. per month for short-term loans, 0.75 per cent. per month for the long-term loans, and 0.42 per cent. per month for farm implement loans). In some localities this governmental credit has constituted two-thirds of the total rural credits.

In addition, the Government and agricultural science organizations have helped in the prevention and control of plant diseases and pests, the development of animal husbandry, and the planting of protective forests. They have always listed the promotion of peasant co-operation as one of their important jobs.

Up to the present, about 60 per cent. of Chinese peasant households have joined mutual-aid teams and co-operatives, of which the producers' co-operatives have absorbed 14 per cent. of the peasant households in the country. The small farms being scattered are economically vulnerable. The peasants cannot individually afford to undertake any large-scale technical improvements. For example, the peasant farm cannot by itself use tractors; but modern mechanical farming is applicable when tens or hundreds of these small farms combine to create unified large farms, such as the producers' co-operatives. Ancient tools represent backward economies. This is true not only in industry but also in agriculture, and is the reason why the Chinese people have determined to put their every effort into national industrialization and, at the same time, to mechanize their farming step by step on the basis of agricultural co-operation. In this way we shall be able progressively to raise over-all social productivity, thereby bringing an ever-growing prosperity to the people, both materially and culturally.

Finally, but not least in importance is the need for a large number of trained personnel with special facilities to carry out technical development in agriculture. The Government has given great sup-

port to this work, materially and spiritually, by establishing research institutions, experimental farms, and agricultural schools. So far, 160 new agricultural research institutes, 2,007 demonstration farms, and 6,446 agro-technical stations have been built. There are 3,586 advanced research workers and about 50,000 agricultural technicians. For education, there are 26 colleges and universities of agriculture and 115 secondary farming technical schools. There were more college graduations in agriculture during the past five years than in the twenty years preceding.

As you know, we have made rapid progress during recent years, but even so our farming has not yet reached a high technical level. Our work is expanding so fast, and we are confronted with so many new problems, that we must never overlook or underestimate the difficulties and weaknesses.

The Chinese people warmly support enterprises that promote economic and cultural exchanges among the scientists of various countries, for these contacts and exchanges, undoubtedly, are mutually beneficial to the development of peaceful life in all the countries concerned.