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The World Food and Agricultural Situation [and Discussion]

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FORWARD PLANNING: MEETING THE REQUIREMENTS

The world food and agricultural situation

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The world food and agricultural situation in the 1980s must be looked at, as now, in terms of the division between developed and developing countries. While there will still be problems in the developed countries – such as surpluses – the great crisis will remain in the developing countries.

The most obvious feature of the crisis is the balance between the increase in population and the increase in food production. In the 1960s, the balance was extremely precarious and, in the first two years of the 1970s, population actually grew faster than production. Hence, it is imperative to accelerate the increase in production in the developing countries.

In order to achieve this, it is important to see to what extent the obstacles are due to lack of knowledge on how to obtain more from natural resources – primarily a technological problem – and to what extent they are due to the weaknesses of human institutions and of the political will for change. In addition, the prospects for a more rational and hopeful world food and agricultural situation in the 1980s will depend very largely on how the national agricultural production and trade policies of both developed and developing countries can be modified by practical steps towards international agricultural adjustment for the benefit of all.

I am very pleased to be here at a meeting called by the Royal Society and to have this opportunity of talking to you about the world food and agricultural situation. My task today, as I see it, is to introduce your discussions on agricultural productivity in the 1980s by trying to place the subject in a world setting.

Looking through the list of distinguished speakers at this meeting, it seemed to me – although I may be mistaken – that the topics covered indicate a major concern with agricultural productivity in the developed countries. To this, I can only make a modest contribution. For one thing, I am not a technician. For another, my job involves my looking at agricultural matters chiefly in a world-wide perspective.

Clearly, agricultural productivity is regarded in very different ways in different parts of the world. In the developed countries of the West, where the applications of technology to farm practice have developed at such a fantastic rate, the main problem is not that of how to increase production. It is chiefly that of reducing the total number of people in farming and providing those who remain on the land with higher incomes. Thus, research on means for increasing still further the tremendous rise in productivity that has already taken place is largely concerned with lowering costs of production. I do not wish to minimize the difficulties involved. I am merely saying that agricultural productivity in the West must be viewed in a context of its own.

If one takes the so-called centrally planned economies of the U.S.S.R. and Eastern Europe, one finds rather different problems. They, too, have a great deal of valuable research on agricultural productivity and have achieved more viable farming structures, but they tend to be held back in two ways. First, their research has to some extent suffered from lack of contacts with the West, and I would of course urge that these should be increased as much as

possible. Secondly, with the tendency towards centralization that is prevalent in those countries, administrative difficulties have often prevented them from applying the results of their research to the full.

Moving on to another part of the world, there is the unique situation in China, a country which I visited only a month ago. Agricultural productivity there has increased enormously over the last 20 years. Although the limits have not yet been reached, hunger is virtually a thing of the past. It is now possible for this nation to feed its 750 million people without recourse to substantial imports. This has been achieved by what they describe as 'the tiger with two wings'– a combination of revolutionary enthusiasm and scientific technique which will carry Chinese agriculture forward. Vast masses of previously unemployed people have been set to work to help in the general effort to transform the agricultural landscape under the impetus of a whole new ideology.

There remains the large group of nearly 100 developing countries – apart from China itself. It is in these countries that the really immense and urgent problems of agricultural productivity lie. For there it is not only a question of providing a better economic deal for the farming community or improving the applications of research. It is first and foremost a question of increasing production fast enough to ensure the food supplies of millions of people whose numbers are growing all the time. In the 1960s the balance between the increase in food production and the growth of population in these countries was extremely precarious and, in the first two years of the 1970s, population actually grew faster than production. It has been estimated that, with the growth of population and a slow rise in income levels, production will have to increase by an average of about four per cent a year until at least well into the 1980s. In recent years, the increases in most countries have been well below that level.

It is thus imperative to accelerate the increase of agricultural production in the developing countries. Indeed, I regard this as the most important challenge facing world agriculture in the 1970s and the 1980s. I accordingly intend to devote most of the remainder of this speech to the question of how it can be met.

In the past, many developing countries met their needs for food and fodder by the simple means of extending the area under cultivation. Indeed, analysis of the sources of increased output over the last few years shows that expansion of cropped area is still a major contributory factor to production. However, while some countries still have large reserves of uncultivated land which could come under the plough, the pressure of population on natural resources is increasing everywhere. Moreover, in a number of cases, marginal land has been brought into cultivation at the expense of pastures and forests. This has had serious consequences in terms of wind and water erosion leading to a general deterioration of the environment.

Faced with this dilemma, many countries are being forced to turn from increasing the cultivated area towards increasing the productivity of land already under cultivation by the adoption of more intensive agricultural techniques. Probably the most important of these is the more effective use of water resources, since water is often the main factor limiting the potential for increasing productivity.

There is, however, another compelling reason for increasing productivity per unit area which is also related to population pressure. This is the need to provide additional employment opportunities in the rural areas. There is a positive correlation between agricultural intensification and employment, provided that a relatively scale-neutral technology can be developed and made available to small farmers and provided also that mechanization is used selectively

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to increase yields and cropping intensities over the system as a whole without displacing labour. A strategy is needed which economizes wherever possible on the scarce factors of production in developing countries, such as land, water and capital and makes the fullest use of abundant resources such as labour. This is how Japan, for example, has achieved such a high level of agricultural productivity.

Let me now turn to the staple cereals which form the basic item in the diets of people in the developing countries and which often occupy the largest proportion of cropped land. Because of their crucial importance to human nutrition, great emphasis has been placed on improving yields of cereals both by the countries themselves and in international development assistance programmes. We have all heard a great deal in the last few years about the progress made in developing more productive varieties of wheat, maize and rice which has become known as the 'green revolution'.

I do not in any way wish to decry this progress – which indeed I regard as the main short-term hope of increasing agricultural productivity. But I believe that the searchlight of publicity trained on these new varieties was premature. There is no doubt that the principles on which their development was based offers the hope of doubling or tripling yields in considerable areas of the developing countries. But the euphoria that greeted them initially has been replaced by a widespread recognition that a great deal has to be done technically to adapt them to local conditions, as well as in planning and organization, before their potential will be realized.

At the technical level, new problems have actually been created by the very rapid initial spread of the high-yielding varieties in some countries. Where there are large continuous areas of varieties derived from a rather narrow genetic base the hazards from diseases and pests are greater than in more heterogeneous areas. Thus, in southeast Asia the new rice varieties received a setback from the Tungro virus in 1972 which was a contributory cause to the slow growth of cereal production there. A further check to the adoption of the new varieties in some areas can be illustrated by the case of wheat in the Near East and North Africa. There, the varieties introduced had been developed in Mexico. They turned out to be susceptible to two diseases which do not exist in Mexico, and thus require a considerable adaptive breeding programme to introduce factors for resistance. There are still a number of important cereals – sorghum, millet, barley, for example – for which varieties with high yield characteristics suited to conditions in developing countries do not exist. Finally, pressure of population on resources are forcing scientists to think in terms not just of high yield per hectare, but of output per unit of time. This leads to a search for varieties which will combine higher yields with a shorter growing season, in rotations involving two or three crops a year. This opens up an even wider spectrum of possibilities for raising productivity and diversifying food production.

All this has led to greatly increased international support for strong, multi-disciplinary, applied research programmes. Their purpose is not only to improve the quality and yield stability of the current generation of high-yielding wheat, maize and rice varieties, but also to develop similar concepts for other important cereals. These programmes are being supported by enhanced efforts to collect, conserve and evaluate the plant genetic resources on which continuing progress in crop development will depend very heavily. There are also moves for better information networks and accelerated training programmes so as to enable national research stations to adapt and improve on the genetic material supplied by the international research centres, as well as to improve their ability to undertake research on more local problems not covered by the work of those centres.

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However, even where experimental evidence suggests that well-adapted varieties are available, they are not always used effectively – or sometimes at all – by farmers. The reasons for this are often not well understood by policy-makers because of the lack of communication between farmers, researchers and administrators. And they are often – though not always – outside the control of the primary producer. They may involve apparently simple things like objections to grain colour or texture – a particular problem with rice and maize – religious customs, or the absence of a government programme for the seed multiplication of high-yielding material *already* available in a country. Institutional weaknesses – lack of credit, poor fertilizer distribution systems and so forth – are common. They could often be remedied at relatively little cost, through the provision of facilities accessible and acceptable to the farmers. On the other hand, lack of water control by farmers, which has been identified by the International Rice Research Institute as a main impediment to the use of the new rice varieties in Asia, may require substantial investments in irrigation and drainage facilities. The same applies to the improvement of infrastructure and marketing facilities. It is only comparatively recently that the need has been appreciated for the development and supply to farmers of a balanced 'package' of technology which includes all the necessary factors of production and not merely isolated technical components.

Thus the 'green revolution' still has a long way to go. It can be extended to new areas and to other crops, and there is still considerable scope for improving the yield and quality of existing species. But, even with the technology we have, there is a vast gap between experimental and farm yields in many countries. In itself, this suggests that the developing countries have the *means* to maintain their basic food supplies *pari passu* with population and income growth for some years to come. Whether they will in fact do so depends largely on their will and capacity to provide their farmers with greater access to the means of increasing the productivity of land and water resources.

Looking further ahead, I must emphasize that the possibilities of introducing intensive agriculture involving varieties capable of outstandingly high yields and/or multiple cropping techniques are limited, so far as we know at present, to irrigated and high rainfall areas of mild temperatures. These probably do not occupy more than 30 % of the world's potential arable land. While the technical yield potential of these areas is by no means exhausted, attention will have to be focused increasingly on the less favourable ecological zones, both to meet longer-term food needs and to alleviate social inequalities. This may require a different technical focus than that in the high-potential areas. The emphasis would be on *yield-saving* rather than high yields – that is to say, for example, on soil and moisture conservation, physiological resistance to drought, heat or cold, short maturity, integrated pest and disease control, the reduction of post-harvest losses, rat damage and so forth. This type of technology may in fact be more in line with the needs of the developing countries, than is the Western-based, high-input approach. It could also prove less pollutant. The need for a deeper understanding of the physiological processes of growth and of the mechanisms of resistance is underscored by the heavy dependence of agricultural production on the weather, by the enormous losses from pests and pathogens, and by the failure to use our natural resources more effectively.

There is an abundant field here for research to develop new scientific principles – and also to apply existing knowledge more fully. One example of this is the production, through wide crosses, of new man-made crops which are more resistant to adversity. We may have the first progenitor of these in *Triticale* – a hybrid of wheat and rye. Another example is the transference

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of the mechanism of symbiotic nitrogen-fixation from the legumes to the cereals, which could increase average yields without any problems of fertilizer production, transport or increased cost to farmers. While these developments may involve problems of compatibility between cell tissue comparable to those with heart transplants, technical horizons are opening up which make them conceptually feasible, and greater expenditure on them could be infinitely more rewarding in terms of broad human welfare.

Another vital general issue for the developing countries is how to improve the *quality* of the diet. This is sometimes regarded as conflicting with requirements for land and other resources or with meeting demands for basic staples. But this is not necessarily so. The first possible approach, on which a good deal of effort is now being focused, is improving the protein content and amino acid balance of cereals. Since these already supply 70 % of the protein in most diets, the potential importance of this is clear. The high-lysine maize programme and the development of a new high protein cereal in *Triticale* are only first steps in this direction. Secondly, there are the food legumes, where there are real problems of low yield ceilings requiring considerable basic research. Thirdly, there is the improvement of roots and tubers of which only the potato has received adequate attention in breeding programmes. Even this crop offers considerable further potential for improving disease resistance and tropical adaptability to enable it to substitute for less nutritious starchy crops such as cassava. New breeding techniques such as tissue culture offer hope here and there is a wealth of untapped genetic potential. Even in the potato it has been estimated that only 5 % of the world's germ plasm has been utilized in the entire range of existing cultivated varieties.

I should now mention livestock. There is, first, great potential for improving meat supplies from ruminants, especially in Africa, the Near East and Latin America. This would involve improved range management, closer integration of crops and livestock and better use of crop residues and waste by-products. In some cases, usually related to disease control, a technical break-through is required. For example, a vaccine against trypanosomiasis would open up 11×10^6 km^2 ($4\frac{1}{4} \times 10^6$ mi^2) of Africa to cattle raising. And we all know that lack of effective control of foot and mouth disease is a main obstacle to the export of live cattle or unprocessed meat from developing countries to the beef-hungry nations of Europe.

However, in many cases the *technical* solutions are fairly well understood. What is needed is an integrated approach to studying the predominant systems and how they fit into the demand–supply pattern of the country or region. There are considerable opportunities for increasing the productivity of livestock and for raising income and employment from agriculture in some of the poorest developing countries by exploiting complementarities between crops and livestock and between different ecological zones. Because this approach involves the fuller utilization of resources which are now often wasted, it does not conflict strongly with requirements for direct human food.

There are, of course, also possibilities of a rapid expansion in the production of animal protein from pigs and poultry, where the growth rates attainable by the full use of modern 'hothouse' production techniques are much faster than those from ruminants. However, they are also more dependent on the availability of cheap supplies of concentrate feeds from arable land. There is thus an important interaction between, on the one hand, the success of programmes to increase productivity of cereals, legumes, and starchy roots and, on the other, the wider availability of pig and poultry products at prices accessible to consumers in the developing countries.

Prospects for this do not appear to me to be too bright in the short run. But, both in ruminan

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and non-ruminant metabolism and physiology, considerable research is being devoted to the use of less conventional feeds as well as to synthetic sources of protein and amino acids. This could well alter the situation within the next two decades.

Indeed one could look beyond this to the use of non-conventional sources of protein in human foods. Milk substitutes from soya beans are a real possibility for tropical areas where milk production, collection and hygiene are a problem. It was forecast recently that these would comprise 25 % of the milk market by the end of the century. Such processes, even if extended to simulated meat products, are unlikely to put beef or mutton producers out of business, either in developed or developing countries. But they could bring about a real advance in ensuring an adequate diet to the lower income groups.

One other potential source of increasing productivity is from the sea. Generally speaking, the developed countries have benefited most from the technical advances in oceanic fishing, because the equipment required is often sophisticated and expensive. Clearly, the oceans outside territorial waters are a common resource where the prize tends to go to the best equipped. However, fish culture in inland and offshore waters is within the control of national sovereignty, and some of the methods now being evolved make the intensification and scientific management of such fisheries a definite possibility. These are quite labour-intensive and should offer comparative advantages in the longer term to developing countries with abundant labour resources.

While we lack solutions to some of the problems I have mentioned and while the developing countries still depend too heavily on agricultural techniques which originated in a Western economic framework and are not really appropriate to their needs and factor availabilities, I believe that we have enough knowledge to take us a good deal further towards increasing agricultural productivity over the next 20 years if this technology could be *applied* more effectively. Among other things, this will involve more research on major agricultural *systems* alongside work on individual technical components of the system. This implies multi-disciplinary and more costly research, but one may hope that there would be a higher pay-off as a result of the more rapid and effective application of technology. International support can accelerate progress here, and this has been a main reason for the establishment of the Consultative Group on International Agricultural Research which F.A.O. co-sponsors with the World Bank and the United Nations Development Programme. However, much will also clearly depend on building up national capabilities. This may require new concepts of 'extension', moving away from the individual farmer towards an integrated 'development-oriented' service to groups of farmers in relation to their major problems. Finally there is growing recognition that technical progress depends on a chain which is as strong as its weakest link and which involves research, extension, pre-investment and investment. A major difficulty facing development planners is to strike the right balance here. Adequate attention is not yet being paid to the phasing of the development of new technology with investments required to make it work.

As I mentioned earlier, these investments may be required within the agricultural sector itself. However, they may also be needed in other sectors of the economy if a viable agriculture is to be developed. I am thinking not so much of fertilizer factories or tractor assembly plants as of mobilizing the abundant human resources of developing countries for truly integrated rural development. For example, investment in infrastructure can be extremely important in opening up new avenues for a more productive and labour intensive agriculture. It can also, given the adoption of suitable techniques, provide increased employment opportunities in

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construction works. Further multiplier effects may be generated through settlement and related services. Thus development depends on technical progress, but technical progress is only likely to achieve its full impact within a framework of integrated planning. This has important implications for the criteria we adopt both for research and development. There is a significant wind of change in international development assistance which recognizes the need to give greater weight to social factors, compared to purely technical or economic criteria, in assessing priorities and approaches to development.

While I am hopeful that the application or adaptation of known scientific principles within this sort of framework will permit the developing countries to make faster progress towards their nutritional, social, and economic goals during the next two decades, it is clear that more and more countries with high populations and limited natural resources will be pressing the limits of yield and intensification by the end of the century. There is thus an urgent need for more basic research to open up new technical horizons for agriculture in the developing countries. Such work may have to be done largely in the developed countries, and I would plead for a planned allocation of their scientific resources to this end. This is something which the Consultative Group and other aid mechanisms have not yet addressed themselves to, and it represents a challenge both to the generosity and the imagination of the developed countries.

This brings me to the central issue of the way in which the world as a whole faces up to the problems of agriculture in both developed and developing countries. There is no doubt that the world agricultural scene is chronically and heavily unbalanced. On the one hand, there are the developing countries with all the problems I have described. On the other, there are the developed countries, themselves plagued by recurrent crises in their agriculture, often due to the sheer overabundance of production but also accentuated further by inadequate farming structures, farm income problems and sometimes aggressive national trade policies.

It is because of this that I have made frequent calls for concerted measures of international agricultural adjustment by the nations of the world. To over-simplify somewhat – and to speak in relative terms – resources must be taken out of agriculture in developed countries and augmented more rapidly in developing ones. The developed world should be ready to become a little more dependent on the developing countries for agricultural supplies. At the same time, both groups of countries should undertake continuing mutual action to ensure that additional economic supplies become available on a more reliable basis from the developing world. This is fundamentally what *international* agricultural adjustment is about in a fully global context. I stress the word 'international', since countries are of course taking national adjustment measures all the time. But these, as often as not, help to worsen the problems of other countries.

I might say at this point that F.A.O., which naturally has a central concern with all matters such as adjustment which can benefit world agriculture, has already undertaken a number of studies in preparation for our biennial conference in November this year, when international agricultural adjustment will be the major theme.

However, although the moves towards adjustment as I have just outlined them are related chiefly to the economic aspects of agricultural production and trade, I would like to suggest here on this occasion that there are also very good grounds for international agricultural adjustment in matters of technology. What I mean by this is the sharing of accumulated knowledge and experience so as to bring about a more rapid and effective transfer of technology than is possible at present, with the general lack of coordination and direction for this purpose.

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An indication of the present imbalance is provided by a recent estimate that almost 90 % of total expenditure on agricultural research is concentrated in the developed countries. Even a relatively small adjustment of this situation would greatly improve the prospects for agriculture in the developing countries and allow them to build up their own scientific capabilities. It would bring the scientists of the developed countries into closer touch with the real agricultural problems in the developing world of which they are often only dimly aware at the moment. All can learn from one another. Might it not be possible to envisage some kind of specific new international initiative to mobilize and apply the knowledge of agricultural science in both developed and developing countries in a way which would be mutually beneficial?

To sum up, it is clear that there are enormous problems facing the world's agriculture and the natural environment in which man produces the basic requirements of life. It is also clear that these problems are not just for today or for the 1980s but will continue on into a more distant future. On the other hand, I do not believe that we need to be pessimistic on this account. The technological possibilities which reflect the adaptability of the human genius are there. What is needed is a corresponding effort of the human will.

Discussion

A. R. Melville (*Chief Natural Resources Adviser, Overseas Development Administration/Foreign and Commonwealth Office, Eland House, Stag Place, London, SW1E 5DH*). I would like to thank Dr Boerma on behalf of this large audience for an address of great interest; indeed it is quite remarkable how much valuable information Dr Boerma has been able to cram into the very short time available. It is difficult to pick out individual items for discussion in an address as comprehensive as this where all the points touched on are interrelated in the development process. There was welcome reference to the importance of research but the results of research must of course be applied by farmers if hoped-for progress is to be made. I know well that Dr Boerma himself attaches great importance to the need to develop human resources in developing countries because it needs people to put the new technologies to work. Success will not come unless we have effective agricultural development administrations which can organize all the help and resources needed, including fully effective extension services to instruct and help the farmers on the land. I know that Dr Boerma is aware of all that needs to be done in such directions and of course the importance that has been accorded to the development of human resources by F.A.O. I am left wondering, however, if enough attention is being given to the changing attitudes of rural communities themselves as development proceeds. I believe that this aspect of rural sociology needs much more attention. I remember one situation in which I was involved as Director of Agriculture in Kenya which illustrates what I mean. I was visiting a Kikuyu farm on which the farmer had reached an exciting stage in the development of milk production. His farm had been improved for the purpose of feeding a few exotic dairy cows and he had found that he could get a very good whole-milk price if he could get his milk to the nearby township very early in the morning. This meant milking the cows at 3 a.m. He told me that his wives did the milking and he had no worries on that score. I asked him how long he thought this happy situation would prevail, and he clearly thought it would go on for ever. When I visited this same farm two years later the milking was being done by hired labour because this farmer had gone up in the social scale. It is this kind of change that we need to think more about when we do our planning.

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