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Agriculture in Developed Countries: Competition for Resources [and Discussion]

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Agriculture in developed countries: competition for resources

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Any consideration of the competition for resources facing agriculture in developed countries must be related to the supply and demand for agricultural products; the impact of technological advance on output and prices; the interaction between domestic agriculture and international trade; and farm incomes.

Possible future developments will be directly affected by the impact of the common agricultural policy on farm incomes and supplies in the United Kingdom. In turn these will have an impact on the resources used in agriculture: land, capital, labour, both manual and managerial, intellectual investment on behalf of agriculture and public expenditure.

Attainment of economically optimum results for agriculture is inhibited by policies designed to take account of social and political considerations, especially in the six founder countries of the E.E.C. Policy objectives can also be in conflict, for instance, between commitments to lesser developed countries and policies for domestic agriculture. The latter can give rise to high-cost production and encourage retention of resources in agriculture even though returns are not necessarily high and restrict market access for exports from developing countries.

On the supply side, agriculture is dominated by many small units. This results in the need to pay high prices for products to support incomes. The high prices encourage production, frequently in excess of the need of the market, the demand for food being highly inelastic. Surpluses then have to be sold at salvage prices and real returns to resources will be low.

New technology and improved management and organization can both contribute to higher productivity if conditions are suitable. Generally, the process is hindered by poor size structure, and the gains are greatly reduced. Again, returns to resources will be lower than would prevail if farm structure were more favourable.

Two important results emerge: if developed countries are to meet their commitments to lesser developed countries, market access in the former will have to be eased to encourage development in the latter. Secondly, solving the low income, social problems of agriculture should be separated from price policies to achieve a more favourable supply/demand balance for agricultural produce.

Finally, full benefits from the possible contribution of science to agriculture will not be realized if progress in modernization of the industry is not achieved. In the last resort, if policies lead both to surplus and to sustained high prices for food then consumers will both react against them politically and turn to substitute foods at cheaper prices.

Agriculture in developed countries has been in a state of rapid change in the last two decades. This change has affected the structure and organization of the industry and has included the adoption by farmers of substantial technological advances. The transformation has been part of a much wider pattern of change and growth in the whole economy and, at the outset, the important interdependence between agriculture and the rest of the economy should be stressed.

While much of this conference is concerned with the nature and impact of further improvements in techniques in the 1980s, the opportunity is welcomed to relate such changes in the agricultural sector to the economy as a whole. It is in effect to this interdependence that the title of this paper refers. Competition for resources basically relates to land, capital and labour, both manual and managerial, as well as intellectual investment on behalf of agriculture,† and government revenues. All of these are scarce and valuable resources in that all have varying degrees of alternative and competitive use outside agriculture.

† It has been estimated that public and private expenditure in this area in the U.K., i.e. on research and development, education and extension in agriculture amounted to almost £52 million per annum even in 1965/66 (Ashton & Lord 1969).

The national and international framework

In the long-term, economic theory postulates, *ceteris paribus*, that in the perfectly competitive world all these resources will be used for those purposes which generate the best return to the economy. Other things, of course, are not always equal, and political and social considerations, as well as market imperfections, will interfere with the movement towards the optimum economic position. At the present time, the main factor inhibiting any rapid adjustment towards the optimum position – and it will continue to be inhibited during the rest of the 1970s and into the 1980s – are prevailing agricultural policies and the factors which give rise to them. To an increasing extent, for the industrial countries of Europe, this policy is the common agricultural policy (c.a.p.) of the European Economic Community (E.E.C.). In the remaining developed countries, there are varying degrees of protection. In New Zealand, dependent on agriculture for over 80% of export earnings, support for agriculture is extremely limited (N.Z.M.E.G. 1970). In the U.S.A. and Japan support tends to have been comparatively high. For most of the rest of this paper, primary attention will be paid to European countries when referring to developed economies.

At this stage it is particularly appropriate to reflect on national objectives, especially as this paper follows immediately the review of the world outlook for agriculture by the Director-General of F.A.O., the specialist international body concerned with problems of food and agriculture in the world generally. In his paper, Dr Boerma has emphasized the sharp division between developed and developing countries and the urgency for the latter of developing their indigenous supplies of food to meet the needs of their rapidly expanding populations, and also to expand their trade. He suggested that there was much room in relation to trading policies for improved access to markets in developed countries for primary produce from the developing countries to enable them to earn the means to finance their development.

The question of divided responsibility in relation to agricultural policies is at the heart of the agricultural adjustment problem in developed countries. Most developed countries acknowledge their international responsibilities towards the less developed countries. These can be in conflict with national self-interest although generally the two are reconciled. Less amenable to reconciliation are the conflicts between the responsibility towards a sector such as agriculture and the general national and international responsibilities of a state. Traditionally, the continental countries of Western Europe have operated autarkic policies for agriculture for a century or more. These are the founder members of the E.E.C. In contrast, Britain pursued a free-trade path from the mid-nineteenth century and international trade developed rapidly between the U.K. and the newly developing countries of Australia and New Zealand, as well as with the countries of North and South America. With the impact of competition and periodic recessions in the economy, the free-trade pattern gave way increasingly to greater protection for British industry and, from the 1930s onwards, to agriculture as well. Most of the post-war period has been characterized by a marked protectionist flavour in farm policies in practically all the developed countries. This flavour has become heavily emphasized since the emergence of the E.E.C. in the early 1960s.

Professor Gale Johnson (1973) of the University of Chicago, has recently drawn attention to the widespread effect of these policies in encouraging high-cost production with little or no regard for its effect on the citizens of a country as taxpayers, consumers or producers. In other words, even the pursuit of national self-interest has not been satisfied by the policies. As a

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result, trade between countries has been adversely affected with the consequential movement towards inward-looking policies. The problem of competition for resources in developed countries should consequently also be viewed against the problems for the developing countries of having to cope with diminished access to markets in the years ahead.

Turning specifically to the question of the efficiency of resource use in agriculture, the problems that arise can only be tackled from an economic point of view within a market framework both for the end-products of agriculture and for the resources used. In the longer term there will always be continuing pressure to ensure that resource use moves towards the optimum even though, in the short term, there will tend to be many distortions in the pattern of this resource use. The price mechanism has an important part to play in the process, and of course it has played it in the past. In a change of resource use it has to be remembered that it is at the economic margin where the shift occurs. If the value of the marginal product is low, or even negative for the industry as a whole, with some types of pricing, it is not surprising if there are more profitable alternative uses for the resources employed. As far as the economy as a whole is concerned, the dynamics of growth are felt at the opposite extreme where the value of the marginal product is high with corresponding returns to resources employed. In the process of economic development, adjustments in resource use in agriculture or any other activity will depend in the long-term on the returns they earn in the industry in relation to the return available in the best alternative use. This pattern can, of course, be distorted by political artefacts, for example the subsidized credit schemes in the E.E.C., or for that matter many of the post-war policy measures. In the longer-term, however, this merely postpones the problem of adjustment in agriculture although the distortion may be aggravated by it.

The supply and demand for food

Before dealing in more detail with the problem of resource use in agriculture, it is necessary to consider the organization and structure of farming in relation to the demand for food by largely urban and industrial consumers. The latter do not tend to increase very rapidly in number – in the U.K. the rate of population increase is rather less than 1% per annum. Moreover they tend to react to increases in the supply of food in a way unhelpful for food producers. Typically, the price elasticity of demand for food in general at retail level is -0.5, so that an increase of 10% in output will give rise to a 20% fall in price and a reduction in the total value of sales of about 12%. If incomes increase, consumers spend slightly more but with only limited benefit for the farmer. Thus the income elasticity of demand is less than $+0.2$ so that a 5% rise in incomes generates under a 1% rise in expenditure on food. Most of this represents services incorporated into processed and convenience food products, rather than a real increase in the physical quantity of food purchased at the farm gate. Taking account of the distribution and processing costs, as well as changes in taste with rising incomes and increasing sophistication in the food processing industries, the reaction on the demand side is not favourable. In other words, the size of the market is highly constrained.

As far as production is concerned, endowment of natural resources in relation to economic and social development has largely determined farming structures and patterns. Thus, the U.K., Canada and U.S.A. tend to have a relatively favourable size-structure in agriculture, although in varying degrees they all have problems with farms that are too small to provide a reasonable livelihood. For instance, in the U.K., official statistics show that in June 1972 there were 37500 large farm businesses which provided employment for four or more men (M.A.F.F.

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1973). In addition, there were 55100 medium-sized farm businesses providing employment for two to three men. In contrast, there were 72300 farm businesses which provided full-time employment for only one man and many of these will be on the margin of viability. There were also 128500 holdings which did not provide full-time employment for their occupiers; these can be regarded as part or spare-time farms.

The founder countries of the E.E.C. in contrast, are essentially countries with farms predominantly diminutive in size. The number of farm businesses in these six countries is estimated to be 4.2 millions (Rogers & Davey 1973). According to recent estimates by the E.E.C., only 700000 of these can be regarded as viable commercial units, the remaining 3.5 million falling into the marginal and non-viable categories. This size pattern gives rise to the main distortion in E.E.C. agricultural policies, i.e. commodity prices set at such a level to underwrite the incomes of producers of, at best, modest quantities of output. Generally, labour is underemployed because there are not enough other resources of land and capital for each person concerned to produce with efficient methods and thereby generate a satisfactory income, especially in comparison to non-farm incomes. As will be discussed later, this feature is especially marked in relation to new technology which requires in most cases increases in the scale of operation and in the sophistication of management to gain full advantage from the innovation.

In this respect, as a recent study has shown,† the E.E.C. shows no sign of achieving one of the stated objectives of the common agricultural policy: 'to ensure . . . a fair standard of living for the agricultural population, particularly by the increasing of the individual earnings of persons engaged in agriculture' (Article 59, Treaty of Rome). In fact, this policy objective is based on a false and static premise and, in a system committed to the free market, appears to show misunderstanding of the role of prices and profit, in bringing about efficient use of resources. To achieve the policy objective with the existing number of farmers would mean that prices would have to be set at even higher levels than at present. Such prices would stimulate still further output of products already in ample supply, with one or two exceptions, and, at the same time, discourage consumption. The difficulty is that with the characteristics of demand for food, and the limits to subventions from tax sources, there are usually too many farmers at any one time for all of them to achieve the income objective. The ultimate solution to the income problem involves a major change in resource use in agriculture, and particularly a substantial reduction in the labour input, and the redeployment of the displaced manpower elsewhere in the economy.

Agricultural productivity and resource allocation

The question of agricultural productivity in the 1980s, the theme of this meeting, will be related to the effectiveness with which the resources in agriculture are used in relation to national and international considerations. Improvements in productivity can be achieved by technological and scientific innovation. They can also be achieved from organizational and management changes in the industry in terms of how the land is farmed, the size of units, the effectiveness of management and the efficiency with which market requirements are met. Much of the programme for this meeting is concerned with technological and scientific change. It is important to remember, however, that technical efficiency is not synonymous with economic efficiency and to achieve the latter will involve organizational and policy changes.

† Over the period 1968–71 farm incomes in the original six members of the E.E.C. increased on average by 4% per annum. Over the same period incomes in the other sectors increased by 4.2% per annum (European Report, no. 22, 1973).

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This is not a criticism of the programme. Rather, it is to draw attention to a conflict. Low prices for farm products will depress production levels and limit the adoption of new technology. Prices high enough to keep production buoyant and encourage innovation will tend to generate surpluses. In turn, these will lead to costly intervention measures and probably to trade disruption as a result of the subsidized export of the surpluses. Neither of these approaches satisfactorily solves the problem.

Substantial gains can be achieved from further technological advances, but there are important factors which will tend to govern the rate and effectiveness of their application. New technology is expensive and usually can be expressed in terms of the substitution of capital for labour. Even a new plant variety, to be produced in an economically optimum manner, with appropriate mechanization and fertilization, may require more land and capital fully to exploit its advantages. This process of substitution can be seen in the transformation of British agriculture between, say, 1955/6 and 1970/1 (Cmnd 109, 1957, Cmnd 4928, 1972). In that period, labour has declined from 25 to 17 % as a proportion of the expenses of British agriculture, with 45 % reduction in the hired labour force. On the other hand, expenditure on purchased inputs has increased from two-thirds to three-quarters of the total with a correspondingly large increase in the inventory of farm machinery. At the same time there has been a tendency towards farm enlargement. For instance, the number of holdings over 120 hectares (ha) (300 acres) in size in the U.K. has increased from 15000 to 20000 between 1955 and 1970 (Davey 1972). This is not nearly as much as would have been justified by the technological changes which have occurred, nor as much as the more dynamic farmers could have managed.

The exploitation of the full advantages of technology is, in fact, inhibited by the already observed unfavourable farm-size structures. It is especially marked in founder countries of the E.E.C. where, apart from the predominance of small units, they are often highly fragmented. After all, if a central objective of farm policy is to generate reasonable incomes for farmers, and if, in spite of the technological advances of the past two decades, farm incomes are still as unsatisfactory as ever, there is no reason to suppose that new technology alone will alter the situation in the coming decade, given the existing farm structure. In spite of improved technical performance, the unit size of the operation generally tends to be too small and the farm income problem is perpetuated.

It is also necessary to emphasize that if agriculture is to compete on an equal footing with other industries then the resources it uses need to earn a return comparable with those in the rest of the economy. In this context, it is accepted that such a return in the case of agriculture might include certain non-monetary rewards which are generally attributed to farming. It is apparent that, allowing for some fluctuations, the farmers and hired workers in Europe do not achieve rewards comparable with those in other sectors of the economy. This is largely because there tend to be too many people in farming, even in developed countries, in relation to the market for agricultural produce. Equally, fixed capital tends to earn low rewards in farming, judging by the need for various forms of capital assistance to agriculture in terms of capital grants or, in founder countries of the E.E.C., subsidized interest rates. Land itself has a poor record in terms of returns to capital and at the current high levels of value the annual return is minimal. Part of the reason for low returns to capital in land stems from the process whereby agricultural support measures and special concessions for land ownership, e.g. abatement of death duties, are automatically converted into capital values. There is also a relatively small turnover in land in relation to many and diverse demands both as a long-term hedge against

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inflation and for other uses. The other uses are varied: some complementary to, and some competitive with, agriculture – forestry, water collection, recreation and amenity use as well as urban development. In all, some 20000 ha (50000 acres) or so go out of farming in the U.K. each year, but this loss is well within the productivity gain of the rest of the industry. Increasingly, changes in land-use will be subject to more precise scrutiny and analysis. As the technique of cost/benefit analysis is improved and applied more critically and generally, agriculture may well find itself at considerable disadvantage in justifying the retention of the present amount of land in production when compared with other conflicting uses with substantial extra value to the community.

Various projections have been made of the supply situation for temporate zone products in the enlarged E.E.C. by the end of the 1970s. Thus the study conducted by Michigan State University in cooperation with the Universities of London and Newcastle indicated that for most products internal supplies would be at least adequate by 1980 and that for some important products, there would be a chronic over-supply (Ferris *et al.* 1971). This would represent a serious misallocation of resources in both a national and international context. More particularly in the case of cereals in the U.K. the work of Sturgess (1973) at Newcastle has suggested that there will be a surplus of U.K.-type cereals for the U.K. market of $4\frac{1}{2}$ million tonnes by 1977–8. The projected surpluses have to be viewed against the high product prices under the C.A.P., strong protection against imports and the policy of export dumping to clear the surpluses.

The point that should be drawn from these projections is that the return to resources in agriculture in a situation of over-supply will be low, in spite of the C.A.P. Moreover, to produce a surplus and then to have to store it gives rise to further misallocation of resources in a national sense. When this happens in other sectors of the economy resources tend to shift. Thus in the Northern Region of the National Coal Board between 1962 and 1972 the number of pits worked has gone down from 169 to 50 and the labour force declined from 116000 to 61000 (N.C.B. 1973). The relationship between structural change in an industry in the context of its role in the economy can be seen in the textile industry (Textile Council 1969). Here the labour force declined from 710000 in 1912 to 265000 in 1958 and 126000 in 1968. Over the same period exports declined from 5700 km^2 of fabric to 188 km^2. These structural changes are dramatic and in much of the past they have had harsh effects in social terms. In a country as wealthy as the U.K. this need not be the case today. If the problems of the longer-term adjustment of agriculture are fully understood, the processes of change can be influenced to lead to a smoother, less painful and more efficient adaptation to new conditions.

This conflict between the efficient use of resources and the slow rate of adjustment in agriculture should be viewed in terms of the poor conditions for peasant farmers in say, France, Germany or Italy compared with the very high standard of living in other sectors of these economies. It is suggested that even if allowance is made for structural lags in the system which inhibit rapid adjustments, policies to ameliorate conditions in agriculture should be at least as neutral as possible in the context of resource use. Thus, if it is necessary, incomes could be supported with social payments so that market prices can more closely reflect the effectiveness of resource use in agriculture compared with elsewhere. Even the U.S.A., which could well afford lavish spending on its agriculture, could not tolerate the surpluses it generated in the 1950s and instituted major programmes to withdraw land from agriculture. Last year there were more than 24×10^6 ha (60×10^6 acres) of land which were totally withheld from

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production and for which the farmers received income payments. This represents a massive withdrawal of resources, not just from farms, but from related industries as well. It is contended that in Europe such a move will have become even more necessary by the 1980s in view of the outlook for future levels of supply.

In this context, it would now appear that the U.S. is prepared to lower the level of support for agriculture generally, and to take up a more competitive posture internationally on the basis of those parts of its agricultural industry which can perform for export at lower price levels.

Finally, it is submitted that the developed countries have a major role to play in fostering the development called for in Dr Boerma's paper on behalf of the developing countries. The enlarged E.E.C. cannot be divorced from the world economy. For instance, in the case of both Britain and West Germany, exports represent 22% of the g.d.p. (U.N. Yearbook 1972). This demonstrates for these developed countries that there is a substantial degree of interdependence with the rest of the world economy. It would also appear that the wish to support and encourage development in the less favoured countries is not just a meaningless shibboleth. In fact all the developed countries have special policies for this work and, for industrial products, have pursued the logic of the situation by adopting multilateral trading policies. Similar logic has not been pursued in respect of trade in agricultural products – to the detriment of the developing countries. It is expected that there will be continuing and vigorous attempts in the international forum to move in this direction. There will be much resistance but some ground will be given – just as the E.E.C. have committed themselves to give some accommodation to Commonwealth sugar producers who have hitherto relied so heavily on the U.K. market.

Sugar is of course a commodity which epitomizes the general problem; there are a number of poor, single-export-commodity countries dependent to a high degree on sugar. They have low opportunity cost for the resources used in producing it, compared with developed countries producing beet to excess with high opportunity cost for the resources so used. This case has recently been analysed with effect by Harris & Smith (1973) who have drawn attention to the need for a more outward-looking policy on sugar by the E.E.C. with gains thereby to the developing countries and gains to themselves from the opportunity to make better use of the resources used in sugar production. Even the present high international prices for sugar are exceeded by the E.E.C. price which has generated a surplus among the Six. In fact, at present, the E.E.C. is imposing a levy on sugar exports, supposedly to safeguard stocks. In the last resort in all the developed countries, the cost to the taxpayer and consumer and the opportunity cost of resources used as a result of this type of policy will be too great for a country or a trading bloc to leave such policies undisturbed and the agricultural structure unimproved.

Conclusions

In conclusion, the question of competition for resources in the 1980s can be considered in relation to each main resource used in agriculture. In the case of labour there is obviously no shortage in terms of quantity and, at any rate in the U.K., in terms of quality. There will be a continuing need and benefit from a special educational provision for those in farming, especially in relation to management. Problems of immobility will require new forms of policies. In human terms this may mean better provision for retirement for the elderly, and better training for non-farm employment for young farm people, as well as the opportunity for alternative employment, especially in the more disadvantaged farming areas.

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In the case of land there is an imperfect market with many competing uses and, especially with the supply outlook, policies will have to be evolved to encourage farm production where it is more worth while and discourage it, or stop it, where it is too costly. So far as agriculture is concerned, capital availability becomes a problem when the return is low and it can be used to better advantage elsewhere. In many situations in agriculture this is undoubtedly the case, reflecting the structural and market problems of the industry.

Then there is the question of public expenditure, the claims made on it, and equity of treatment between different groups within the community. In some cases, it is possible to justify a subvention from the State to encourage or initiate change and adjustment. It becomes open to question for how long the assistance should be rendered, given the wide range of national problems requiring attention. Continuing Government subvention to agriculture is now coming under increasing scrutiny, for example in the U.S.A. Here commodity price supports tend to go in disproportionate amounts to the relatively few large producers while the more numerous poorer sections of the farming community, who only produce a low level of output, benefit little from the support. Such a pattern of disbursement of public funds is bound to attract criticism and eventually some reform of the policy concerned.

The last important resource is intellectual investment made in the industry. In effect most of the remaining papers in this discussion are concerned with the application of intellectual investment to the resources in agriculture in the 1980s. Provided that the appropriate structural and marketing adjustments have been made, there will be benefits from improved productivity not only from innovations still to come, but also from the application of advances already achieved. If agriculture does not respond in this way then it will face increasing competition from substitute foods. Appropriately enough this subject is considered in the final paper of the meeting. Certainly, if the adjustment process is too slow, the stimulus to industrial producers of these foods will be great. In the last resort, highly priced agricultural commodities open the door to manufacturers of substitute foods by providing them with the incentive to enlarge their production to meet the market requirements of both food processors and manufacturers and domestic consumers.

References (J. Ashton)

Ashton, J. & Lord, R. F. (eds.) 1969 *Research, education and extension in agriculture*. Edinburgh: Oliver & Boyd.

Cmnd 109 1957 *Annual review and determination of guarantees*. London: Her Majesty's Stationery Office.

Cmnd 4928 1972 *Annual review and determination of guarantees*. London: Her Majesty's Stationery Office.

Cotton and allied textiles: a report on present performance and future prospects. 1969. Manchester: The Textile Council.

Davey, B. H. 1972 *Agriculture in the United Kingdom*. Agricultural Adjustment Unit, University of Newcastle upon Tyne.

European Report 1973 no. 22 Tuesday, 13 February 1973.

Ferris, J. N. *et al.* 1971 *The impact on U.S. agricultural trade of the accession of the United Kingdom, Ireland, Denmark and Norway to the European Economic Community*. East Lansing: Institute of International Agriculture, Michigan State University.

Harris, S. & Smith, I. 1973 *World sugar markets in a state of flux*. London: Trade Policy Research Centre.

Johnson, D. G. 1973 *World agriculture in disarray*. London: Fontana/Collins in association with the Trade Policy Research Centre.

Ministry of Agriculture, Fisheries & Food 1973 Statistics of Farm Structure in the United Kingdom.

New Zealand Monetary and Economic Council 1970 *New Zealand and an enlarged E.E.C.* Wellington: Government Printer.

Rogers, S. J. & Davey, B. H. (eds.) 1973 *The common agricultural policy and Britain*. London: Saxon House.

Sturgess, I. 1973 The prospects of U.K. cereal surpluses. *National Westminster Bank Quarterly Review*. February 1973, 34–35.

United Nations 1972 *Yearbook of national accounts statistics* 1970, vol. 1. New York.

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Discussion

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Professor Ashton's review of the position in developed countries contrasted with Dr Boerma's summary of the problems of the developing world. In the first case we have a steadily declining proportion of the population actively engaged in agriculture, while the productivity of farms rises steadily. Size of farm, size of field and size of equipment were all rising. The greater productivity and improving techniques of scientific agriculture made increasing demands for capital and for recurrent inputs. In Britain these trends combined so that the output per farm had doubled in the last decade.

In contrast F.A.O. had already estimated that six-sevenths of the increase in the world's population, as it doubles in the next 25 years, will be born in areas of subsistence agriculture. Here there were already too many people on the land, so that introduction of improved soil and water conservation and more scientific farming methods, including the use of fertilizers and pesticides, was obstructed by fragmentation and poverty. We do not have, at present, any really effective solution to this dilemma.

While the traditional picture of Britain was an island which imported much of its food and exported manufactured goods, we already grow some 60 % of our own food and could, if we made it a national objective, grow a great deal more. In view of the anticipated difficulties in the developing world the developed countries should exert their full potential for food growing. Would this cause any insuperable economic difficulties in Britain's balance of payments?

Professor Ashton replied that underlying Dr Pereira's question was the assumption that there was a long-term problem in the developing world with regard to meeting their own needs for food. Many observers took a more optimistic view. While the 'green revolution' might not have the sudden and dramatic results that had, perhaps, been first anticipated there was no doubt that technological advances were greatly enhancing the food-producing capacity of the developing world. A substantial number now take the view that, subject to short-term imbalances, the food–population equation can be balanced. To the extent that there is a problem in the developing countries, it relates to the need for income growth and improved channels of distribution.

Then there is the question of what economists call comparative advantage. Although the international pattern of comparative advantage has been blurred by protectionist policies, it is clear that many developing countries have an advantage in the production of certain foods which if realized can be an important, sometimes the only, source of import earnings. The diversion of such imports, resulting from expansion of production in developed countries is immensely harmful for the countries concerned. Already the U.K., as a member of the E.E.C., is contributing to the disruption of international trade. What is required for the developing countries is a lowering of the levels of protection in the E.E.C. in particular and in developed countries generally.

Finally, as far as the developed countries are concerned, it is necessary to distinguish between 'full economic potential' and 'full technical potential' in relation to Dr Pereira's reference to 'full potential in food growing'. Undoubtedly, all that is technically possible in, say, British agriculture is not necessarily economic in terms of resource use. In fact, there would be those who would argue that the present size of British agriculture represents an over-commitment of resources and that we would be better off with a small industry with higher average efficiency.

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Generally, contributions to a country's balance of payments from domestic agriculture should be that which can be sustained in terms of economic viability. In any case, however, with more flexible exchange rates, the balance of payments problem as such diminishes in its significance. Movements in the rate of exchange will adjust for imbalances as they occur.

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