



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

THE FUTURE OF AGRICULTURE

*Technology, Policies
and Adjustment*

PAPERS AND REPORTS

FIFTEENTH
INTERNATIONAL CONFERENCE
OF AGRICULTURAL ECONOMISTS

*Held at Parque Anhembi
São Paulo, Brazil*

19–30 AUGUST 1973

OXFORD
AGRICULTURAL ECONOMICS INSTITUTE
FOR
INTERNATIONAL ASSOCIATION OF AGRICULTURAL
ECONOMISTS
1974

OPENING SESSION

THE PRESIDENT opened the session by ringing the Cow Bell.

ADDRESSES OF WELCOME

Speech of Mr LAUDO NATEL, Governor of the State of São Paulo

Rarely in the history of mankind has agriculture been the subject of such concern as it is today.

Problems related to the production of food and raw materials are the focus of attention in both the developed and developing countries.

It is common to talk of the 'agricultural crisis' in the international markets as being the major factor in the current condition of food scarcity and the consequent effects on the prices of agricultural goods.

We do not agree with the pessimistic outlook which is likely to prevail in both the technical and political spheres of influence. On the contrary, we have strong confidence in *the future of agriculture* the general theme of this Fifteenth International Congress of Agricultural Economists. To the eminent participants of this Conference, we extend the welcome of the people and government of São Paulo.

We do not ignore or underestimate the bottlenecks of the process of agricultural development, but we think they are only temporary and can be eliminated through the efforts of our technicians, farm operators and businessmen. All over the world these integrated efforts in the search for a modern agricultural technology will provide the basic conditions for solving the problems of the farm sector, and so land will continue to be a significant source of wealth.

The theme of this Conference is a useful example of this challenge. Further, it represents the strong disposition of the IAAE to discuss the implications and adjustments demanded by the future.

Here you are together, researchers, professors and agricultural economists of many countries, with your tools and knowledge, fired with the same purpose. And, surely, your contribution will be necessary to achieve the social welfare and the economic stability which are final goals of any society.

We are, indeed, very pleased at your decision to hold this Conference in our State, and we hope that here you will find an attractive and stimulating body of economic facts to be observed and analysed. We will have the benefit of your knowledge and, in turn, our experience and efforts will be useful to you all.

In this sense, we must say that the agricultural sector is a first priority for our government. This option resulted from a long study and mature reflection of the real needs of our people and taking into consideration, of course, the responsibilities of our State in the Brazilian society.

We understand that agricultural development is an essential for

accelerating and consolidating the growth of the general economy and, therefore, for raising the level of living and welfare of the people.

In other words, the State of São Paulo understands that our industrial leadership in the country imposes strong public and private responsibility that must concentrate on the agricultural sector as a whole. There is always a very positive correlation between industry and agriculture.

As a result of these principles, the State Government has defined and put into practice a broad body of policies with the general aim of gaining a firm footing in new markets and, simultaneously, promoting technological changes that will raise the productivity of rural labour, land and capital.

For the first time, the State Government has a set of agricultural programmes selected and defined on the basis of these economic goals. Planning the locational and economic use of inputs in the State's regions and the improvement of economic efficiency in allocating resources at the farm level are examples of such programmes. Investments in research extension and credit are also a major concern of the government.

In summary, the rural population is receiving very special attention in the State of São Paulo. The development of the rural areas is the final goal of my government.

So far, important results have been achieved through this co-ordinated action with significant increases in total agricultural income and in productivity.

Furthermore, and as expected, farm operators have responded positively to the policy incentives of the Federal and State Governments.

Once again, I am sure that the participants of this Conference will have an excellent opportunity to learn about important aspects of agricultural development in São Paulo as well as of the government programme as a whole.

Finally, I extend to all of you, participants of the Fifteenth Congress, my warmest welcome and wish success and a pleasant stay.

Speech of Dr RUBENS DE ARAUJO DIAS, Secretary of Agriculture in the State of São Paulo and Chairman of the Brazilian Organizing Committee for the Conference

To supply foods in quantity and quality for a rapidly growing population is one of the major challenges to the agricultural sector.

Today, one of the most difficult tasks of agricultural economists is to indicate feasible and economical solutions for the problems of production, distribution and consumption of agricultural goods.

As I understand it, the Fifteenth International Congress of Agricultural Economists is an excellent opportunity for the agricultural economists of the world to discuss some of these economic and social problems.

The decision of the IAAE indicating our country for this very relevant Conference, in which we will discuss adjustments and issues in relation to 'The Future of Agriculture', is at the same time an honour and a very strong incentive for Brazilian agricultural economists.

As a matter of fact, in recent years the economic policies in our country, both at state and private levels, have provided the necessary conditions for the attainment of high rates of economic growth and, what is also important, the agricultural policies have been quite effective in the search for new markets and national economic integration.

I am sure that the papers and discussions of this Conference will be extremely helpful for the Brazilian Government and agricultural economists in finding out the future of our agricultural sector in the world's economy.

To the State of São Paulo this Conference has a very special meaning because agricultural growth is one of the priorities among our current economic objectives.

In this general picture, it was not difficult for the Brazilian Organizing Committee to obtain the necessary support of the Federal Government, through the Ministry of Finance and Ministry of Agriculture, of the State Government and also of the private sector. In this sense, the distinguished presence of Governor Laudo Natel in this opening session, and of the Minister of Finance, Professor Delfim Netto, in the closing session, are strong evidences of the Brazilian interest in accelerating the growth of agriculture.

However, hard work had to be done by the Brazilian Committee, especially by Paulo F. Cidade de Araujo and V. J. Pellegrini. Without their efforts it would have been difficult to accomplish our purposes.

Finally, I welcome the agricultural economists from all over the world for this Conference and their stimulating presence.

PRESIDENTIAL ADDRESS

The future of Agriculture

S. R. SEN

SINCE the modest beginnings that this Conference made forty-four years ago at Dartington, England, it had to travel a long and rather tortuous path through North America, West Europe, South Asia, Central America, Australia and the Soviet Union before it could come to South America and evolve into an assembly of such magnificent proportions that we are attending today.

In the first Conference the participants numbered only fifty and came from only half a dozen West European and North American countries. Today they number around eight hundred and come from more than seventy countries spread all over the world. And they no longer comprise a narrow group of specialists but represent a wide spectrum ranging from economists and agriculturists to policy-makers and planners.

Horace Plunkett's forecast about the first Conference that 'it is destined to be historic' has, therefore, proved to be true in more senses than one. But we have not yet been able to surmount what Plunkett described as 'the "lag" which normally arises from the slow processes of nature as compared with the ever-accelerating response of mechanical development to the underestimated and ill-requited scientific researcher's toil'.

That is why, even after all these years, we have to take up once again today that basic issue, what is going to happen to this 'lag' over the decades to come and what needs to be done if the general objective of surmounting this 'lag' which Plunkett put before us forty-four years back is to be achieved, not merely from the rather narrow 'mechanical' aspect that he mentioned, but from broader technological and institutional aspects as well.

THE THEME

That is the *raison d'être* for the selection of 'The Future of Agriculture' as the main theme for discussion in this Conference—a theme that is important both for developed and developing countries, capitalist as well as socialist, not only from the relatively narrow perspective of the United Nations Second Development Decade but a much longer perspective of world development—a perspective that goes well beyond the limited horizon of the 'down to earth' men of affairs and enters into the long-term vision of social philosophers and natural scientists alike.

And in this context, it is perhaps more meaningful to cover by the term 'agriculture', the 'agricultural system' as a whole in its broad modern

sense of exploitation of replenishable or renewable resources of the earth and related business, industry as well as research and education, rather than mere 'farming' in the narrow traditional sense.

To what extent the unfortunate 'lag', which Plunkett talked of, can be overcome by the 'scientific researcher's toil', effectively supported by educators, decision-makers and managers at different levels, is one of the main issues that is for our consideration today.

And here *man* enters equally with *nature* into our considerations, as our Founder President, Leonard Elmhirst, has emphasized over and over again.

Ever since man became curious about the future, there have always been prophets of doom as well as dreamers of Utopia in every age. The present age is no different. The pessimists have emphasized nature's niggardliness and the optimists have extolled man's ingenuity. History has so far proved that both the extreme formulations have been incorrect. The course of events has usually taken a middle, although a somewhat undulating, path. In some areas and for some periods man has taken the lead and the course has been upward; in others nature has been dominant and the course has often been downward.

Today we have entered an era when once again the course is such that the pessimists appear to command greater attention. The current food and fuel shortage has tended to strengthen their case.

The pessimists of today may be speaking in a somewhat more sophisticated language than the simple arithmetic and geometric progressions that their precursors talked of a hundred and fifty years ago. But the question is, are their forecasts going to be confounded by a 'knowledge revolution', that my predecessor in this office, Nils Westermarck, mentioned at Minsk, somewhat in the same manner in the coming decades that the forecasts of Thomas Malthus were confounded by the 'industrial revolution' which was gathering momentum at the very time that he was making his dismal prognosis. What are the factors that are likely to help or hinder this 'knowledge revolution' in producing a benign, instead of a malign, effect, on the material as well as social aspects of agriculture, which is the main concern of our profession?

DIFFERENCE IN OUTLOOK

As we look round the world today, we find that the outlook varies widely between the developed and developing countries.

In several developed countries the agricultural system has become increasingly more productive per man-year employed in it. There is an overall surplus relative to the basic needs of the citizens, and the agribusiness (including agro-industry) part is becoming progressively more significant than the farming part of the sector itself. The relative position of the farming part in the economy is much less important than it used to be in the past. Full-time farming is becoming increasingly more capital-intensive and large-scale. But small-scale part-time farming also appears to

be getting a new lease of life through the introduction of labour-saving machinery and various supporting services provided by large-scale agro-business and agro-industry.

The situation is very different—almost the opposite—in many of the developing countries. However, market forces as well as modern technology (which has been usually evolved in developed countries) are constantly pushing the developing countries to follow the footsteps of the developed countries, and impelling them to make the same kind of demand for capital and other factors of production irrespective of the fact that the relative supply positions is quite different.

The important points to be considered at this stage are: (i) is that necessarily a desirable or inevitable course taking the world as a whole and the long-term time horizon, (ii) what are the alternatives possible, (iii) whether through human ingenuity a better alternative could be discovered and followed and (iv) how?

In this debate about the future of the agricultural system, a basic fact that is sometimes lost sight of by modern economists, somewhat in contrast with the classical economists, is that agricultural products are essentially replenishable or renewable and in some cases recyclable, while most non-agricultural products, which are of mineral origin, are non-replenishable and in several cases non-recyclable.

Because it has been organizationally more convenient and financially more profitable to exploit the mineral resources on a large scale, the bulk of the R & D (Research and Development) effort has been applied to mineral resource use in recent times in marked contrast with agriculture, where the scale and intensity of R & D operation have been relatively much smaller, in spite of efforts made by certain public authorities to the contrary.

But it has now become imperative for us to appreciate that there is an urgent need for R & D effort on a massive scale in the field of agriculture, especially from the standpoint of long-term ecological, social and economic consequences for the world as a whole.

Recent experiences of R & D effort, in defence, space, nuclear, petrochemical and biological fields have shown what human ingenuity can do even in a relatively short time, if properly encouraged, purposefully mobilized and adequately financed. The same ingenuity, if it were applied intensively enough to the development of replenishable and recyclable products, as distinct from non-replenishable and non-recyclable products, could in the long run be not only more desirable but also more profitable for the human society in general.

And, as mentioned earlier, agricultural products have a special importance in this context and deserve urgent attention from those who are responsible for creating conditions which will determine the future course of R & D efforts.

The relatively dispersed character of agricultural production, in marked contrast with the very skewed and concentrated distribution of most minerals, may have also considerable social advantage in an age in which,

thanks to developments in power, transport and communication technology, dispersion has tended to lose much of its disadvantage.

Unfortunately, relatively short-term market forces or narrow defence considerations determine to a large extent the directions in which R & D efforts on organized and large-scale take place today. Therefore, the long-term and broader economic, social as well as ecological considerations often tend to be at a discount.

It is through informed deliberations in conferences like this that the much-needed emphasis can be put on the maintenance of a proper balance between the long-term and short-term interests of the human society as a whole and the attention of the policy-makers, research workers, development promoters and entrepreneurs purposefully drawn to the steps that need to be taken if this balance is to be ensured.

ISSUES FOR DISCUSSION

In the plenary sessions of this conference we shall (i) look at the future of agriculture in terms of new technologies as well as new policies, (ii) examine not only the growth of income but also the distribution of income and its effect on the market for agricultural products, (iii) study the problem of allocation as well as use of that basic natural resource, land, which is a main concern of our profession, (iv) analyse the allocative arrangements that obtain in different types of economy and the improvements that can be brought about in them, (v) take an intensive look at whether the analytical tools available to us for this kind of study are adequate and what improvements are needed, (vi) consider a number of related economic, demographic, institutional and environmental issues not only in the world perspective but also in the perspective of our host country, Brazil, described by many as the 'country of the future', and (vii) discuss all these aspects in such a manner as may enable us to foresee the future, prepare for the future, adjust for the future, and live with the future in a better and more meaningful way than hitherto. This last discussion in particular will be followed up in greater detail in a series of 'special group' meetings with a view to opening the floor to a larger number of participants.

Simultaneously, in a few sectional meetings arranged to consider 'contributed papers', as distinct from invited theme papers, and in a dozen and a half 'discussion groups', as well as in the corridors and lounges we shall be exchanging our views during the next nine days not only on the different subjects listed in the programme but also a number of other related items.

We have thus a rich fare laid out before us. I do not think that I should do anything this afternoon which may detract attention from the course of discussion during the next few days. But I would be perhaps remiss in my duties if I did not take this opportunity to share with you in a general way some of my thoughts on a few broad aspects of the large family of

problems that we will be discussing in considerable detail over the next few days.

SECULAR DEMAND

Let me first take up the question of secular demand, as distinct from current demand, for agricultural products.

Five factors

- (i) trends of population growth,
- (ii) volume of national income,
- (iii) distribution of national income,
- (iv) developments in the field of trade and
- (v) inter-commodity substitutability, both technological and economic,

will determine over time the nature of secular demand for agricultural products collectively as well as individually.

If the secular demand tends to be either too much or too little, it should not be beyond human ingenuity, provided it is encouraged, mobilized and focused in an appropriate manner and with requisite anticipation, to vary these factors in such a manner as to secure the desired volume of demand.

The practical question is if one or two of these factors prove to be too inflexible over a certain period of time, what can be done with the others during the same period to compensate for this inflexibility so as to ensure that the actual demand does not go beyond the socially tolerable limits.

Market forces may be good enough to determine the level of effective demand (personal and institutional) within these limits in relatively short periods. But social action will be called for whenever there is a threat that these limits may be seriously transgressed over the long period. For too little demand, in the secular sense, causes social stagnation and distress, too much demand, in the same sense, causes social strain and discontent.

To what extent, how and by whom secular trends of demand should be steered or influenced in long-term social interest rather than in short-term private interest are the moot points in this context.

Whenever a situation arises that (i) population growth needs to be curbed as in some countries suffering from heavy population pressure or (ii) growth in per capita income needs to be decelerated as in some other countries suffering from chronic inflation, adverse balance of payments, shortage of mineral products or pollution, the desired volume of secular demand for agricultural products can be maintained (a) up to a limit, by removing barriers to trade and geographical specialization in these products and (b) beyond that limit, by intensive R & D effort aimed at substituting agricultural products for mineral products and finding other new uses for them.

Reverse action will have to be taken, of course, if the secular demand for agricultural products has to be kept down.

So long, however, as billions of people, especially in the developing countries, have to depend on agriculture for employment (and that is likely to be the case for a long time to come considering the leeway that

needs to be made up both in population control and industrial development programmes), the adverse effect of a demand constraint on future development of agriculture, in developing countries in particular, needs to be carefully borne in mind.

In this context, it may be noted that in the past additional demand arising out of either growth of population or growth of per capita income has been a major force for stimulating agricultural development and rural employment.

If for certain important socio-economic considerations, population growth in general and income growth in the richer countries in particular need to be curbed in future, as is being advocated by a number of influential scholars, it is mainly through (i) intensive R & D effort of the type mentioned above, along with measures for (ii) removing trade barriers and (iii) transfer of income from rich to the poor in general and relatively higher rate of income growth of the poorer sections of the population of the developing countries in particular that the demand for agricultural products can be maintained and agricultural development and rural employment kept up at sufficiently high levels. In regard to the last item, it may be worth noting here that the rich have, at least today, a tendency to spend a larger proportion of their income on agricultural products which are relatively more land- and capital-intensive or on mineral products which are not replenishable.

SECULAR SUPPLY

Next I may take up the question of secular supply, as distinct from current supply, of agricultural products.

In a non-innovative society there are obvious limits to agricultural growth set by the scarcity of land. But these limits need not be either very serious or unduly proximate in an innovative society, which is capable of making up for the shortage of land by greater inputs of not merely labour and capital but also of knowledge and innovation, as has been recently demonstrated by several developed countries.

To the extent that the innovation depends on inputs of a non-replenishable mineral product, its application will no doubt be limited by the supply of the latter. But this limit will often be less than proportionate of the relative scarcity of a particular mineral product and more so if there is some substitutability between different mineral products. Further, many of the inputs may be of a replenishable type being of solar, atmospheric, nuclear or biological origin and may not pose such a constraint.

It is important that in discussing the question of agricultural supply, we should consider agriculture not in the narrow sense of mere crop and animal production but, as mentioned earlier, in a broader sense, which would include, on the one hand, the production of other replenishable natural products, e.g. of forests and the sea, and on the other, the various activities which are directly linked with it, e.g. agri-business and agri-industries.

Further, we should consider not only products which we can use today, but also some of the so-called organic wastes which with appropriate R & D effort can be utilized to meet important human needs.

To give an example, a large part of the cellulose produced in our farms and forests is wasted today because of our lack of ability to collect and process it into usable forms, technologically and economically. Some research work recently undertaken in the U.S.A., induced by apprehensions regarding future supply of fossil fuel—but done on a rather limited scale—has already helped develop certain alternative processes by which such part of the agricultural, forest and urban wastes in the country, as contain cellulose and as are not too difficult or costly to collect even under present unsatisfactory arrangements, could be converted into pipeline gas or liquid fuels at costs which do not compare unfavourably with those obtained from imported fossil fuel and on a scale which could meet a substantial proportion of the United States' requirements of these fuels.

Other research work indicates that material obtained from agricultural sources can be converted into products which can be used as substitutes for certain metals and other minerals, stocks of which are getting unduly depleted. The cost is no doubt still relatively high. But there is no reason why if the same kind of massive R & D effort that is currently being put on, say, defence or petro-chemicals research, is devoted to replenishable agricultural products, a substantial breakthrough cannot be achieved soon in terms of both technology and economics. In some sense, it may be even less massive. For, in many cases it will mean not exploring the completely unknown but merely reversing a process of substitution between agricultural and mineral products that has been going on for the last few decades.

The phenomenal increase in per acre output that has been made possible in wheat could be also repeated in a number of other crops and utilized after appropriate processing to meet part of the growing food and fibre needs of the world.

Intensive research is also required from a longer-term perspective on the possibilities of converting inexhaustible solar energy, especially in the tropics, into suitable plant materials which can, after appropriate processing, be used as substitutes for some of the key non-replenishable products, which threaten to be in seriously short supply in future.

Even if the substitution in all these cases is only partial, or usable only in mixtures, the overall relief obtained could be quite substantial.

ROLE OF INNOVATION

The key to the 'Future of Agriculture', the basic theme of this Conference, therefore lies not so much in the usual statistical calculus of the trends of demand and supply of agricultural products over the next decade or two as in that incalculable factor, the enterprise and innovative capacity of man, over the secular period.

This innovative capacity refers not merely to science and technology but also to management and socio-economic adjustment; and not only to doing new things but also to adapting readily to new working situations.

To the extent that the bulk of the people, especially in the developing countries, continue to be non-innovative the long-term future, not only of agriculture but also of the world economy as a whole, cannot but be regarded as rather bleak.

The developed and richer countries will continue to consume a disproportionate share of the scarce, especially non-replenishable, resources of the world, disturbing its eco-balance and multiplying their own environmental and supply hazards.

The developing and poorer countries will face an intolerable shortage of non-replenishable as well as replenishable products, including foodstuffs, resulting from their growing demand as well as the larger share of the world's resources appropriated by the richer countries.

The gap between developed and developing countries on the one hand and rich and poor sections of the population within the developing countries themselves on the other will increase sharply, giving rise to acute international as well as intra-national social and political tension which, added to the resource crisis that the distinguished members of the Club of Rome have warned us about, will certainly make the end result even worse.

But such a nemesis can be avoided if the innovative spirit of human beings, can be developed in a purposive and organized manner at all levels and appropriately institutionalized so as to counteract effectively these undesirable tendencies. An important step would be to put organized R & D efforts on more or less the same massive scale as is being currently done in a number of countries for defence purposes in the public sector and for exploitation of, and finding new uses for, mineral resources, especially petro-chemicals, in the private sector, to the development of replenishable resources, especially agricultural resources, in a selective manner.

Days are past when such effort, which has to exceed a certain critical mass to be really effective within a relatively short time span, could be left to the genius of stray individuals or inadequate efforts of relatively small-scale and isolated research institutes. There is simply no time available to us any longer for such slow processes, which might have sufficed until recently.

There is an urgent need now for concerted and timely action to be taken in this regard by various governments and international agencies.

Among other possible measures, serious consideration needs to be given, on a national as well as international basis, to the imposition of heavy taxes on the use of non-replenishable and non-recyclable products and provision of adequate financial support for R & D effort of the type mentioned above. What other measures need attention and how their relative priorities may be determined deserve the careful consideration of economists and other policy advisers. The important point is not merely to invent substitutes but also to make them economically acceptable.

In agriculture in particular, where conditions vary widely from region to region, 'technique-based' and 'product-based' research of basic and applied types will have to be supplemented by 'area' and 'problem' based research of both applied and adaptive types, specially designed to identify various constraints which hold up desired developments and finding ways and means of overcoming them. In this context, especially in 'area' and 'problem' based research in underdeveloped regions, socio-economic research and reform effort will need no less attention than technological research and development effort.

The more backward a region is, the more important social constraints are likely to be relative to economic constraints and the sociological part of socio-economic research and reform will have to be paid correspondingly greater attention. Institutional innovations may have to play a special role in this context.

Similar considerations will apply to the population problem also, which differs widely not only from region to region but also between different communities within the same region, especially if it is under developed. Intensive organized effort will have to be put on 'physiology' and 'technology' as well as 'community' and 'problem' based research. Of all the people, the poor need family planning most. But they are also likely to face special problems about adopting it unless appropriate conditions are created for the purpose.

In both fields there will be need for closely linked and mutually supporting chains of international basic research, national basic and applied research and local applied and adaptive research types of R & D organizations, if any effective impact is to be made in a relatively short time. And the *inter se* priority will have to be very carefully formulated and periodically reviewed from the economic angle if the best use is to be made of the relatively scarce resources in general and research talent in particular.

In this context some thought needs to be given to institutional or other means of getting sound decisions which depend on criteria in different disciplines. We have given a good deal of lip service to inter-disciplinary activity. But in some of the frontier areas, we seem to have still great difficulty in ensuring that an evenly presented case from all sides is laid out before decisions are taken. It is for consideration whether there is not a need for economic/biological 'bridgers' in the fields of agriculture and population, somewhat comparable with the profession of 'planners' which is coming up in the physical planning field. It is doubtful that co-ordinating committees will do this without having people who are by training and temperament well placed to ensure that the several groups of specialists contributing to a decision place their information on the table not only in a reasonably fair manner but in terms which convey the significance of the issues to those who have to make decisions.

EXTENSION OF THE INNOVATIVE PROCESS

In a number of developed countries—where agriculture has already become capital-intensive and closely linked with modern science and industry and directly employs a relatively small proportion of the population and the latter in its turn has already acquired a reasonable standard of living and modernizing education—the provision of adequate R & D effort at government, research organization and major corporation levels would perhaps suffice. The spread of the result to the farm and family levels may not itself pose serious problems or undue delay, although considerable educational extension effort will be needed to make the common people in these countries understand properly the realities of the world at large and willing to make the necessary adjustments.

In most developing countries, where farms are small and labour-intensive with little or no direct linkage with modern science and industry and bulk of the people have a very poor standard of living and lack modernizing education, the situation will be much more difficult. However great the R & D effort may be at the government, research organization and corporation levels, and whatever may be the response of a limited number of elites, that would not produce the desired results on a large enough scale and within a short enough period, in terms of either agricultural development or population control, unless it is supplemented by:

- (i) sufficiently massive educational and extension effort to modernize the outlook of the common people, make them innovative, enterprising and willing to adapt readily to changing situations and new technology, whether in agriculture or in family planning;
- (ii) effective socio-economic reforms calculated to ensure for them a minimum standard of living which will enable them to strive for progressively better standards and
- (iii) a series of economic, educational and organizational 'ladders of advancement', as it were, which will make it possible for them, and also induce them, to climb step by step to a higher quality of life and culture and adopt such agricultural technology and family planning measures as would facilitate such advancement.

*It will be a mistake to assume, as is occasionally done by some policy-makers, that these are only 'marginal people', who basically pose a problem of relief rather than of development. In fact, they represent at least 40 per cent, if not more, of the people of developing countries.

In the past, most R & D effort, partly because it could be undertaken only by the elite, has tended to by-pass these people, increase the gap between the rich and the poor, and induce many undesirable distortions in the society. This possibility has, therefore, to be explicitly recognized and adequate countervailing measures have to be provided against it at the same time that plans are made for the type of major R & D effort discussed earlier.

Otherwise, the so called 'dualism', which has accompanied development efforts in so many countries, with very undesirable social consequences, will become increasingly more acute and frustrate our efforts to promote agricultural development on sound lines and in a fairly distributed manner and maintain the overall size of population, as well as its distribution between rural and urban areas at optimum levels. The ever-growing rural poor will increasingly migrate to the city slums in search of employment with disastrous consequences all round.

One obvious step would, of course, be to make adequate provision for organizing supplementary R & D effort which would enable the small farmer as well as the small entrepreneur to take direct advantage of some of the major advances in science and technology. This may not sound so utopian if one considers the steps taken until recently in this regard in Japan, although she may be fast growing out of this stage now, and the facilities which it has been found practicable to provide to the modernized part-time farmers and small-scale and dispersed entrepreneurs in some other developed countries.

PUSH FROM BELOW

But an essential step would be to undertake an imaginative programme of 'push from below' type of measures, especially for rural (and small town) development. The aim should be to improve the employment opportunities and income levels of the poorer sections of the people in a dispersed manner and away from the big cities and to make them innovative and enterprising through the provision of (i) modernizing education, (ii) efficient extension, credit and marketing services, (iii) closer backward and forward linkages between agriculture and industry, (iv) rural electrification, (v) efficient land and water-use facilities, (vi) agrarian reforms, (vii) greater geographical and social mobility and (viii) improved public health, child nutrition and family planning measures. This would be an important counterpart of the two types of R & D effort mentioned above.

The special role that the modernizing type of mass education has to play in this context perhaps deserves a few words here. The general importance of education is now well recognized and most developing countries are spending a substantial proportion of their rather meagre resources on it. But the results have often been disappointing and sometimes even disturbing. The reason is that the education provided has usually been of the wrong type—tradition-bound rather than innovative, literary rather than scientific, and bookish rather than experimenting, especially in so far as the bulk of the population is concerned. Such modernizing education as exists has usually been confined to elite groups. This has not only increased the gap between the elites and the masses but also stood in the way of general socio-economic development on sound and balanced lines.

If the rural masses in these countries have to accept and adapt frequent

innovations in fields like agriculture and population in particular, where their full collaboration is a basic requirement, then it is essential that they should be provided with the kind of education which would enable and induce them to do so.

The solution to this problem will, however, have to be sought in new techniques and patterns of non-formal mass education facilitating a continuous learning process, instead of in the formal classroom education and traditional curricula that most of the developing countries are concentrating on today. Here again is a field which calls for careful research and experimentation.

The greater the dependence on the non-farm sectors, especially for supply of inputs and marketing and processing of output, and the closer the linkage with industry and various research and technical services, the more responsive the farm people are likely to be to modernizing education and the more innovative in their own attitude to life.

Recent experiences of part-time farmers in developed countries and full-time peasants in developing countries, where the new seed-fertilizer technology has been successfully adopted, tends to indicate that small size by itself need not inhibit the spirit of dynamism and the process of innovation, provided certain basic facilities, and services are available to the farm people.

The 'pull from above' which most measures for general economic development (including R & D effort) usually provide will have to be effectively complemented by a strong 'push from below' through carefully planned measures of the type mentioned, above, directly aimed at, say, the poorer 40 per cent of the people in every country, if optimum results are to be obtained. While the former often tends to increase the gap between the top and bottom layers of the society at least initially, the latter helps reduce this gap from the very first impact. The higher layers of the society will undoubtedly secure in due course their share of the resultant benefit through an upward transmission effect, as it were. But it will not be such a large proportion as it usually is in the 'pull from above' process in which much of the benefit tends to stick to the upper layers for a long time to come.

It is obvious that if the innovations of the scientist, whether in agricultural production or in family planning, have to be accepted by the masses, then the latter must be shaken out of their traditional ruts and themselves become innovative in spirit, even if it may be in a rather modest way. Major innovations, which are rather lumpy and infrequent by their very nature, will be then supplemented by a large number of minor, but no less necessary, innovations and adaptations at the grass-root level much more frequently.

From the national down to the village levels in most of the poor countries, traditional institutions have developed over time a strong bias in favour of security and against innovation, especially in so far as the rural masses are concerned. There is urgent need for taking effective measures from outside and encouraging appropriate pressures from within

which would help reform these institutions so as to change their bias in favour of innovation. This is an area where the 'political' aspects of 'political economy' (which agricultural economics basically is) will require no less attention than the purely 'economic' aspects.

Once we can bring about basic changes of this kind, the agricultural system in the developed as well as developing countries will become flexible and adaptive enough to adjust itself readily to most of the basic changes in the overall economic situation that may emerge from time to time. We need not have then serious misgivings about the long-term prospects of agriculture.

Before I conclude, I would like to read out to you a message that I have received from our Founder-President, Leonard Elmhirst.

'Would you be good enough', he says, 'to convey to the Conference my keen regret at not being present and my wishes for lots of "down-to-earth" discussions at the grass roots with plenty of vision for the future, and with the boots of the Economists firmly rooted in the soil and their heads in the skies.

The encouraging results from the Plant Breeders should be applauded but economic analysis and sound statesmanship will still be needed.

May the computers be kept properly in their place as servants of, and not masters over, humanity.'

There could be nothing more appropriate for a conference, the main theme of which is the 'Future of Agriculture'.