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India

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Fertilizers and Pesticides as Weapons in the Fight against Peasant Misery

GUISEPPE MEDICI
University of Rome, Italy

THIS very brief opening statement is concerned with one particular aspect only of the main theme of our discussion, and that is: to what extent can the use of fertilizers and pesticides contribute to a *rapid* increase of agricultural production and thus become a powerful instrument not only in fighting hunger and malnutrition among the peasants of Asia but also in bringing about an economic development which is inconceivable before Man has been freed from the yoke of hunger.

Of course, we know by experience that the success of any measures designed to improve the production methods of traditional agriculture will depend not only upon the physical environment, but also upon the prevailing economic and social conditions. The mere application of fertilizers, and particularly of pesticides, therefore, will be of but little avail, unless it is combined with such other measures as will create at least a minimum of the social and economic balance and harmony needed for economic development.

This does not exclude the possibility, however, that in the rice-growing countries of Asia, for example, the application of fertilizers and, to a minor extent also, of pesticides may prove perhaps to be the most economical means for bringing about agricultural development. Examples from Italy illustrate this.

Since this statement will deal mainly with the rice-growing countries of Asia—India, China, Indonesia, Burma, the Philippines, and Pakistan, just to mention the most important ones—it might be useful to refer briefly to developments in the irrigated areas of Italy. It is a known fact today that the implementation of large-scale programmes for the increased use of fertilizers, particularly of nitrogen, in the irrigated areas has brought about, *ceteris paribus*, the conspicuous increase of 30 to 50 per cent in the average per-hectare yields of literally all crops. Leaving aside the possible influence of other production factors, the mere use of nitrogenous fertilizers has, in fact, doubled the output of certain crops. Were we to

compare, at equal prices, the value of this increase in crop production with the costs involved in fertilizing, we could find that the value of the increase amounted to at least twice, in many cases even to four times, the cost of fertilizing.

It should be mentioned in this connection, however, that Italy is a country with a chemical fertilizer industry of its own, producing nitrogen and other fertilizers at world market prices, and that it has a dense communication network which facilitates their distribution. In addition, a large-scale extension service and adequate technical assistance and information programmes have largely contributed to spreading the knowledge of the beneficial effects of fertilizers. It is true that this has been a great advantage, but it is equally true that even under the less-favourable conditions in the rice-growing countries of Asia, it should not be too difficult to distribute and apply nitrogenous fertilizers, where these are available. There are millions of smallholdings where the rice land is adequately irrigated and, consequently, ready for the application of fertilizers which will ensure the peasants considerably higher yields. In spite of the poor communication system, it should not be an impossible task to transport to every one of these holdings the five or ten hundred-weight of fertilizers needed.

Another feature of the Italian experience is that the strongly increased use of nitrogen was confined, almost exclusively, to the irrigated areas in the plains. In the hilly regions, where water is the limiting factor for crop cultivation, fertilizers were applied to a limited extent only.

A more general feature in Italy, which we ought to mention, is the fact that land distribution and tenancy conditions in large areas have called for an agrarian reform which, by breaking the land monopoly, has made possible the introduction of radical changes in the agricultural pattern. However, of the 16 million hectares of agricultural area in Italy only 1 million hectares have been directly subject to agrarian reform measures and another million or so may be said to have been influenced indirectly by the progress achieved in the reform areas. In other words, only 12.5 per cent of the country's agricultural area enjoys the benefits of an agrarian reform. For Italian agriculture, therefore, although the role of mechanization in promoting progress should not be underestimated, the application of fertilizers constitutes a dynamic element of fundamental importance for increased production.

In our rapidly changing world, agriculture in industrialized countries has ceased to be one of the major problems, since it benefits from the large capital resources made available by industry and, in addition, is no longer subject to heavy taxation. The most acute problems today are to be found in the developing countries of Asia, where an age-old traditional agriculture is faced with the task of providing sufficient food for a rapidly increasing population, of which far too great a part live at the level of starvation.

Developments in my country, particularly as regards the poorest peasant holdings of less than two hectares of agricultural land, may prove

useful in tackling this problem. For more than 600,000 such smallholdings in the plains of Italy, water for irrigation and fertilizers are the factors limiting production. But in years of adequate precipitation, when water ceases to be a limiting factor, the proper application of fertilizers, all other conditions being equal, increases the crop yield by 30-50 per cent. This, in turn, increases not only labour productivity and the supply of foodstuffs on both the domestic and world markets, but also secures a higher income from farming which improves the living standard of the peasants and makes it possible for them to apply some, at least, of the most important modern techniques, such as machinery, selected seeds, and pesticides.

In his paper Dr. Bawden supported what I have just said. To meet the exigencies of the expected doubling of the world's population within the next thirty years, Science and Technique, in fact, offer us the means also to double world agricultural output. In view of the urgent need to tackle the problem of hunger, it is of vital importance to determine which of the technical means at our disposal are most likely to achieve the fastest increase in production per unit area at the lowest possible costs.

Our experiences in Italy suggest that, under the given conditions in many of the developing countries, fertilizers and pesticides are the technical means on which we ought to concentrate. And this for two reasons.

First, because they can bring about a 30-50 per cent increase in the yields per unit area without involving more than a modest initial expenditure. This should be of particular interest in the vast rice-growing areas of Asia, where, generally speaking, water is not a limiting factor, but where yields, nevertheless, are extremely low.

Secondly, because the use of fertilizers—and often also of pesticides—is not dependent upon the establishment of infra-structures and the introduction of those technical, social, and structural changes, which otherwise are preconditions for economic development.

Although it is true that the major problems with which Italian agriculture, for example, is faced today are no longer confined to the selection of the most potent fertilizers and the most effective pesticides and herbicides, but rather concern improvements in farm structure, mechanization, and market organization, it is equally true that under the backward conditions in many developing countries, a rapid break in the *status quo* may be achieved by the widespread use of fertilizers. I am fully aware that land improvement and irrigation works will also have to be carried out; but these may be postponed to a later date, not only because they take time and involve considerable capital outlay, but also because the large investments required are unlikely to produce any profit for several years to come, whereas the capital invested in fertilizers and pesticides may be repaid in the course of one agricultural year.

We may add that in the most advanced countries the fundamental agricultural problems are no longer in production, but in marketing. In other words, in the industrialized countries it is becoming easier to produce and more and more difficult to sell. In the poor rice-growing countries of Asia, on the other hand, production is the fundamental, often

even the only, problem to be solved, since the population consumes all the foodstuffs produced.

John Russell has shown that, contrary to current opinion, the largest increase in production is not obtained in primitive agriculture, but in those rural areas where generations of peasants have improved and irrigated the fields, organized the farm structure, developed marketing, and created a conscious peasant class. Consequently, even the worst conditions in a country like India, for example, should not present unsurmountable difficulties, since here we are not dealing with virgin land to be tilled or deserts to be irrigated, but with an old agriculture which, in a certain way, is already in a position to utilize the technical means which *immediately* will increase crop production without the long, difficult, and costly preparations of land reclamation and structural changes. Achievements in the narrow coastal plains and valleys of Japan during recent years confirm the truth of this statement. The Japanese, in fact, with only 3 million hectares of irrigated land at their disposal succeeded in increasing rice production to such an extent, that today they are able to meet the demand of a population of almost 100 million inhabitants. The painstaking work of the Japanese peasants was supported by only a few simple instruments, but, above all, by the large-scale application of artificial fertilizers, such as nitrates and phosphates, the most efficient weapon against the threatening hunger in Asia.

With the modern techniques of today, a few large factories would be able to produce millions of tons of nitrogenous fertilizers from comparatively small amounts of crude oil which is available at relatively low prices in almost unlimited quantities. Provided that other conditions remain the same, the mere application of two quintals of nitrates, and possibly also of phosphates, to each of the 70 million hectares of rice land in India and China would be enough to raise production by at least 30 per cent.

All that is needed, therefore, are 14 million tons of nitrates—one factory alone is capable of producing 1 million tons. So, why not choose this road? It is futile to think in terms of economic development, if the peasant is short of food for living and working. And is not this the most important and urgent problem?

From Pakistan to Korea, from Burma to the island of Java, there are millions of hectares of irrigated land under rice, the staple food of the entire population in these parts of the world. And it should no longer be an impossible task to increase the production of this life-giving cereal by means of the modern artificial fertilizers which are relatively cheap, easy to transport, and not difficult to employ. And, certainly, there is no need to fear that the extra production will cause an over-supply of foodstuffs on the domestic market, since it will inevitably be used for home consumption and thus contribute to raising the labour productivity of the peasants who today are so frequently undernourished.

Although their effect might be less conspicuous than in the irrigated areas, nitrogenous fertilizers ought also to be applied as soon as possible

to *all* areas under cereals and other major food crops, at least in those regions where precipitation alone provides sufficient water for crop production and where the lack of nitrogen is still the limiting factor. At a later stage, with the dissemination of technical know-how and improved technical assistance, it should also be possible to increase the use of pesticides, at least against some of the most common and devastating plant diseases.

Before concluding my statement, I would like to draw attention to one more point of interest and that is, the help which is being extended to the countries threatened by starvation. To date, this help has consisted of shipments of foodstuffs and most likely it will have to be continued for several years to come. But we ought to keep in mind also that making available artificial fertilizers, or the means for producing them locally, would be of considerable importance. There can be no doubt, in fact, that the best way to promote the use of fertilizers would be to produce them on the spot. In many countries of Asia, the establishment of a local fertilizer production industry should not prove too difficult a task, particularly if supported by an adequate and effective distribution of international aid.

CATALYSIS BETWEEN THE TWO AREAS

SHUJIRO SAWADA

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THE four main papers presented are closely related to each other in content, each making an analysis of different phases of our theme, 'The Economist and Farm People in a Rapidly Changing World'. I would like to summarize their contents very briefly making a few comments, laying stress on the relationship between the papers, and paying attention mainly to the contact between developing areas and developed areas in the world.

When the populations of many Pacific Islands were exposed to contact with European people for the first time they were often decimated because they were not immune to the diseases which the Europeans brought in. But recently, the situation appears quite contrary. The application of Western techniques of public health and medical sciences has considerably reduced mortality in today's developing areas. Professor Borrie pointed out that during the period between 1935-9 and 1960, the number of deaths of infants under 1 year per 1000 live births decreased from 182 to 57 in Ceylon, from 149 to 69 in Malaya, and from 144 to 33 in Taiwan. However, the social and cultural patterns of many Asian countries seem to place fewer restraints upon fertility than is the case in Europe. Consequently, growth-rates of population have tended to increase rapidly, and in some countries exceed 3 per cent a year—a rate which will double a population every twenty-three years. According to his estimates, the population will increase by 136 per cent between 1960

and 2000 in South Asia, by 181 per cent in Africa, but by only 24 per cent in Europe. Some brakes are, he said, needed promptly in such high growth-rate areas, unless disaster is to overtake them.

Here Professor Borrie pointed out that the motivations for control of fertility were widely assumed not to operate until economic development had achieved a substantial measure of urbanization and literacy, but by the second World Population Conference held in Belgrade in 1965, population control was discussed as a prerequisite and aid to economic and social development. This point is, I think, very important. Governments in many developing countries had already initiated family-planning programmes, and he said that when the motivations were strong enough, a quite sudden and revolutionary change could occur as the recent history of many countries including Japan showed. On occasion, abortion has played a big role in some countries, but in many developing countries, new and cheap devices, easy to use even by illiterate people, have been provided by national programmes after the Second World War, and a considerable rate of diffusion was being seen in each country.

Professor Borrie estimated the present rate of natural increase of the world population as 1.8 per cent a year, which is the highest in human history. Going back very far from the present, he showed interesting estimates of past rates for different areas, all of which were very low compared with the present rate. The present world population is about 3,200 million, and if the present rate continues, the world population will be 7,000 million by the end of this century. The population growth in developing areas will be enormous but that in developed areas will also be large because of their low level of mortality. He pointed out that even with a substantial reduction in growth-rates, there would still be 6,000 million people in the world by A.D. 2000. How to cater for such an enormous population will be a serious problem.

Such are, I think, the main points of Professor Borrie's presentation. They are very closely related to the contents of other presentations, particularly that of Dr. Kristensen. For the world-wide food problem, Dr. Kristensen illustrated in his presentation a world-wide projection backed up with economic trends including population growth. My comments will be stated later.

Dr. Kristensen presented an analysis and forecasts for economic developments and trade of the two groups of countries in the world, i.e. *D.C.s* (developed countries) and *L.D.C.s* (less-developed countries) by his terminology. Most of his analysis was done excluding centrally planned countries. He pointed out that, in recent years, some of the *L.D.C.s* have increasingly become net importers of food from the *D.C.s*. According to his illustrative projections of the future demand and supply of food in the two regions, the surplus in the *D.C.s* will be 12 in 1980, and 36 in 2000, and the shortage in the *L.D.C.s* 12 in 1980, and 35 in 2000, each in billions of dollars. This is, he said, not a simple forecast, but for that speculation he considered many factors composing both production and demand in the two regions.

Concerning production, the most decisive factor is labour. According to his estimates, agricultural workers will decrease to less than half of the present number and down to 5 per cent of the total number of workers in the *D.C.s* by the end of this century, while in the *L.D.C.s* they will increase substantially, though they will decrease relatively. Thus in the *D.C.s* the area of arable land per head of farm people will be 7.40 hectares by the end of this century compared with the present 3.22 hectares, while in the *L.D.C.s* there will be only 0.46 hectares per person compared with the present 0.74 hectares. The farming in the *D.C.s* will become more labour extensive, and that in the *L.D.C.s* more labour intensive. In Kristensen's view, as the *D.C.s* excel in capital, knowledge, and environment, the production per man will increase remarkably by the end of this century. According to his estimates, the growth-rate of such productivity will be 4.3 per cent a year in the *D.C.s*, while only 1.4 per cent in the *L.D.C.s*. Accordingly, in spite of a substantial decrease of farm people in the *D.C.s*, the total production will increase substantially.

Assuming that the relative share of non-food products in the total agricultural production, which stood at 12 per cent in 1965, does not change significantly, the situation in food production also will be almost the same as stated above. Concerning demand, on the other hand, the high income elasticity will, he said, invoke a large increase in food demand in the *L.D.C.s* along with a high population growth-rate, though the high ratio of children to the total population, the income disparity between urban and rural populations, and relatively high food prices will check the increase to some extent. In the *D.C.s*, the future demand will not increase so much, mainly because of the low income elasticity. The trends of production and demand in the two regions as stated above will, he said, lead the *L.D.C.s* to become large importers of food and the *D.C.s* to become large exporters. The question is whether such a trade pattern is likely to turn up in practice. Here, Dr. Kristensen referred aptly to the developments of non-agricultural industries in the *L.D.C.s*. The abundant and cheap unskilled labour will, he said, be available for industries there. Modern techniques fostered in the *D.C.s* are more easily transferred to the *L.D.C.s* in industry than in agriculture. Private capital is also more easily attracted from the *D.C.s* to the *L.D.C.s*. The exports of manufactured goods from the *L.D.C.s* are rapidly increasing already. They will grow further. Thus, the *L.D.C.s* will be able to import their mounting needs of food.

The income gap between farm people and other people will, in Kristensen's view, be reduced in the *D.C.s* in the future, while it will be widened further in the *L.D.C.s*. If policies aim at raising the general economic level and reducing the relative income gap, the *L.D.C.s* should, in his view, have development plans paying more attention to agriculture. Here he referred to several important measures, i.e. to introduce entirely new methods to break the traditional agriculture, to develop the so-called agro-allied industries, to acquire knowledge particularly of adaptive research, to give incentives to farmers through improvements in

land-tenure system and price relations, and finally trade and aid policies between the two regions. As for the last point, he suggested that the densely-populated *L.D.C.s* should not maintain misconceived ideas about the virtue of producing all their food at home instead of putting manpower into industries where their competitive position was stronger. He suggested that food aid was not something very desirable, but that sufficient general financial aid was better so that the *L.D.C.s* could purchase food, machinery, and other things abroad on a commercial basis.

Such are the economic consequences of the development of the two areas and some advisable measures outlined by Dr. Kristensen. In a word, as a result of the economic developments the two areas will be more closely related to each other in the future. Professor Borrie proposed that as the population growth in many developing areas was very large, increasing proportions of the population should move into non-agricultural sectors along with extensive use of some rational control of fertility. Dr. Kristensen showed that, not as a postulate but as economic consequences, non-agricultural sectors would develop in those countries mainly because of the existence of abundant labour and the regional mobility of industrial techniques and private capital. Whether or not such a breakthrough can easily be attained by many developing countries may be an important subject to which we should pay attention in the future.

If the international allocation of industries, including agriculture, should occur more extensively in the future, as Dr. Kristensen stated above, what would be the relation between manufacturing industries in the two areas? Dr. Kristensen did not really touch this point in his presentation. If an international allocation of industries should proceed without big obstacles, e.g. as labour-intensive industries in the *L.D.C.s* and capital-intensive ones in the *D.C.s* the pattern as illustrated by him would come smoothly into being. However, comparative advantages will be modified more or less by the amount of resources available, their mobility between industries, in each region, and rapid technological changes which never occur evenly. If so, some obstacles may occur reaching a desirable allocation in the end. Mutual understanding between the two regions is needed for the development of the whole economy. If the *L.D.C.s* should give up the self-sufficient policy for food, the *D.C.s* should also do the same concerning manufacturing goods.

It was suggested to me by Dr. Kristensen's presentation that agricultural products might occupy a considerable part of national product again at the well-developed stage of a national economy. Speakers have suggested also that the agricultural population would show only a slower relative decline at the final stage of economic development than at the former stages, but we have believed in a continuing and straight decline of the relative importance of agriculture in the whole economy of each country. Can I take these suggestions as a new phase of the theory concerning the relative importance of agriculture?

Dr. Bawden expressed his view from the standpoint of a natural scientist. If, as is widely predicted, human populations do soon outstrip food

production, this will, he stated, not be because agricultural research workers have failed to find out enough about how to produce food, but because knowledge has not been fully used. Here he suggested that local research, i.e. that for adapting established knowledge to local conditions, would be very important to increase production. In most other industries knowledge is likely to apply everywhere, but the agricultural case is quite different because of the difference in soils, climates, and crops. Such local research, as he pointed out, if it takes economic and social conditions into account, will be very effective for increasing production on developing areas. Dr. Kristensen pointed out also that adaptive research by his term would be one of the high priorities of the next few decades to increase food production in the *L.D.C.s*.

Dr. Bawden pointed out, taking British agriculture as an example, that agriculture in developed countries has also developed rapidly. Change at this speed is almost a kind of revolution but even with such remarkable progress official figures for average wheat yields in Great Britain are, he stated, little more than half the three tons of grain per acre often harvested at Rothamsted. Therefore, even in such countries as Great Britain, the potential for increases in production is still high. Dr. Kristensen stated that agriculture in the *D.C.s* would develop further owing to the predominancy in capital, knowledge, and environment they could utilize. Dr. Bawden may be said to have pointed out the possibility of such developments from the point of technology.

Coming back to the first point, Dr. Bawden stated that although adapting to local conditions and applying methods already well established would raise some technological problems, the greater ones would be sociological and economic. Even if a new technology were well known in a district, its application would often be checked because of economic or sociological reasons. Cocoa's case is related to imperfect competition in the world market. More cases are, I think, concerned with the problems of farm management. A farm is a totality of which the elements are closely related to each other. Some types of farm have survived through hundreds of years and may well be said to be in equilibrium in a sense. Technological change concerns ordinarily only a part of a totality. Economically, a new technology deserving of adoption has to give an effect which would at least offset the disadvantage of disturbing the balance, including the cost of reaching a new equilibrium. Many new techniques have stayed unused because of this. Most of the difficulties in applying well-established techniques to traditional agriculture seem to lie here. The farm economist is, I think, very important here to suggest plans for raising agricultural production in developing areas. Dr. Bawden pointed out that practice for increasing yields needed to be combined—when the reward was likely to be much greater than when each is used alone. This is really in the field of farm economics.

The same is true from the sociological point of view. I would like to tell a story. Many years ago a good husband of a Japanese farm family wanted to buy a washing-machine for his wife, but she said, 'No, thank

you'. He wondered very much why. She said she would feel sad if she lost the happy hours she could have at the riverside washing clothes, free from the eyes of her mother-in-law! A new technique could not enter this farm family as it was checked by a sociological factor. There still remain many rules and customs in villages, particularly in developing areas, which have provided, since ancient times, wisdom to support their communities, but now sometimes they hinder innovations.

Dr. Bawden referred to the job of the natural scientist, saying that the role of the experimental scientist was to identify the factors limiting yields and find how to overcome them without being trammelled by considerations of the possible economic consequences of his work. Such limiting factors vary with localities. After they are overcome by adaptive research workers, there still remain economically and sociologically limiting factors to be overcome. Here are the fields of economists and sociologists. Their work, including that of the technological scientist, is closely related. I would say that adaptive research workers in the technological field have to be largely economists and sociologists, and vice versa.

Dr. Bićanić presented an interesting model of agricultural development illustrated as one developing through four stages, i.e. subsistence agriculture, marketing agriculture, entrepreneurial agriculture, and contract or planned agriculture. That transition relates closely to changes of relative and absolute numbers in the agricultural population. He explained precisely the characteristics of the four ideal types of agriculture. For instance, they each have a different kind of maximization. The first maximizes production per hectare, the second production for sale, the third that of the production unit as such, and the fourth production per man occupied in agriculture. Not only the kind of maximization but also the main role of operator, main risk, optimalization principle, upper and lower critical policy lines, and main instrument of taxation were described as different according to the type of agriculture. Regarding policies, the first seeks life parity, the second price parity, the third income parity, and the fourth technical parity. He referred to the specific role of the political scientist, stating that he could act as a research worker, an adviser, an apologetic lobbyist, or an arbiter in a conflict of interests.

Dr. Bićanić did not refer to the problems which could occur in the technological, economic, social, and political fields when regions at different stages of development had contact with each other. As Dr. Bawden pointed out, agricultural techniques born in developed areas can hardly be transplanted to developing areas. Dr. Bawden explained the reason from the point of the difference of regional conditions which meant not only soils, climates, and crops but also economic and sociological ones. By deduction from Professor Bićanić's theory, those differences including even some natural conditions could be explained as differences in development stages.

Most social stage or type theories are wanting in the element and principle for connecting different stages. But Dr. Bićanić gave the cardinal point as changes in absolute and relative numbers in the agricultural

population. From this point, his presentation is closely related to those of Dr. Borrie and Dr. Kristensen.

Lastly, I would like to tell of a Japanese experience. Several decades ago some large-scale farming methods using large machinery were introduced by the government from Western countries. But, in vain, the large implements are still sleeping in a museum. Japanese farmers are now using small tractors, over 2 million in number, throughout the country. But such mechanization began just a decade ago when the exodus from villages to urban areas became remarkable. But the time will come when Japanese farmers can use large machinery, if the agriculture develops according to Dr. Bićanić's theory.

REPORT OF QUARTER CONFERENCE 4

EARLY in the discussion, doubt was expressed whether the authors of the four main papers had focused effectively enough on the theme of this Conference, namely 'The economist and *farm people* in a rapidly changing world'. The question was whether or not the economist felt concerned with farm people, particularly with their decision-making functions, and with their problems in production and marketing. In support of this doubt it was pointed out that in some countries farm decisions are made by non-resident owners and that more information is needed about the actual operating unit of the land holdings and about the decision-making processes of farm people. Speakers also expressed some reservations about the underlying assumptions on which some of the population and food supply projections rested. Some also would have preferred the abstract treatment with more specific examples. In other words they would have preferred to approach generalizations much more slowly. Speakers stressed that peasants have usually been very adaptable and there was much to learn from the study of the structure and experience of specific developing societies.

As the discussion developed the opening thesis was broadened along the lines that, while more intensive cultivation of land is the chief aim, its achievement is limited both by natural features and by the economy of the country concerned. The absence of the social anthropological approach in this conference was seen as a major limitation and gap in its organization. Rural sociologists and social anthropologists have devoted considerable attention to the economic problems of agricultural and peasant societies in recent years and have shown that socio-cultural factors are often crucial in acceptance or rejection of an innovation. Both economic development and population control are interlinked as basic problems; neither should be regarded singly.

Dr. Bawden's apparent belief that the natural scientist was responsible to science and not to society met some opposition. The view prevailed that science could no longer afford to be neutral; the scientist must take

into account the socio-economic consequences of his work and participate in its effective and positive applications in human society.

Dr. Kristensen's view that basic research should be left to developed countries and adaptive research to developing countries was challenged. In many instances it was not only difficult but impossible to isolate the basic research from the adaptive research.

Contributors stressed the need for immediate action to meet the problems of Asia, referred to in Senator Medici's presentation. Immediate inflow of capital to the farm sector through the building of fertilizer plants, provision of improved seeds, pesticides, etc. must be of such a magnitude and so concentrated in time that the attitudes of the farm people about family and fertility preferences can really change and lead to a reduction in the average crude birth-rate. This would be the result of improved farm incomes. Other action should include international, political, and economic devices to improve terms of trade in favour of the less-developed countries.

Speakers saw the purpose of agricultural economics in this context as to increase the total supply of agricultural products. This can only be done if technical and social scientists apply themselves to local conditions and local solutions in the developing countries. Regardless of socio-cultural attitudes people have a desire for improved ways of life; therefore, the agricultural economist has a responsibility to work with people to manage and organize factors and marketing operations to lead to this object. In order to do this, the agricultural economist must look at organizational and managerial skills and their effect in boosting agricultural production. Incentives to producers must be explored and central to this is price and market policies in developing countries.

The contribution of the political scientist was as an analyst of the power structure. He should study the structure of political parties and how this related to agricultural policy. In directing approaches such as this a better idea should emerge of the decisions which governments were making with regard to agriculture. When asked what occurs to make society shift from one to another of the types classified by Dr. Bićanić, he said that although the answer lies in the field of demography, the precise reason was not known. Malthus and Marx had suggested reasons but that these had been supplanted by factors concerned with urbanization and industrialization. In his opinion an understanding of the man to land ratio was more important than such factors as the proportion of population engaged in agriculture in the country. He reminded the group that, though such concepts as electricity and development may not be very easily defined, they could nevertheless be used.

Among those contributing to the discussion in addition to the opening speakers were: R. G. Wheeler *U.S.A.*, C. Vanzetti *Italy*, D. P. Sinha *India*, G. Gaetani-D'Aragona *Italy*, T. Yajima *Japan*, Sol Sinclair, *Canada*, A. Weber *Germany*, T. N. Sandor *Australia*, R. Bićanić, *Yugoslavia*, A. S. Thomas *U.K.*, H. H. Stoevener *U.S.A.*, H. C. Trelogan *U.S.A.*

F. C. BAWDEN, *in reply*¹

I have only a few points to add. First, I think perhaps the theme of this conference has not been clearly enough defined. It has not always been obvious whether we are most concerned with improving the lot of farm people or ensuring enough food for an expanding world population; although these could be one and the same thing, with present social systems they are not. Indeed, the lot of some farm people is often better when food is scarce than when it is abundant. Also, there has been much talk about developed and under-developed countries as though these are separate categories in which wholly different things happen. This is not true in agriculture, for it is easy enough to find backward agriculture in developed countries and advanced agriculture in under-developed countries. Economists seem prone to underestimate the speed with which change can happen, so I was pleased to hear several speakers stress that change can be very rapid in countries where many people seem to think it must inevitably be slow. Our speaker from Kenya especially illuminated this when he said that since they had introduced new varieties of maize and had used fertilisers, their problem was no longer one of shortage, but of how to market the larger crop. Change from scarcity to surplus can be rapid when methods are improved.

Though it is true that applying existing knowledge generally would transform the world food situation, the work of the natural scientist is far from complete. Not only is there still much to learn about crops and stock, but introducing new varieties and changing crop nutrition may not continue to give increases unless methods are continually modified. Nature has ways of hitting back, and we must expect new problems from pests and diseases that will demand new solutions.

Dr. Helen Abell reported a speaker who understood me to think that natural scientists were responsible to science only and not to society. This is far from anything that I have ever said or thought; of course, natural scientists have a great responsibility to society. What I said in my paper was that the natural scientists could only experiment in natural science, and that in finding how to increase yields they must not be handicapped by the fact that doing so might cause temporary economic problems.

To turn to another subject, where should agricultural research be done? As a visitor to Australia, it would be inappropriate for me to comment on arrangements here, so I shall not discuss Mr. Colin Clark's apparent desire to abolish the C.S.I.R.O. I am prepared to comment only on arrangements in the United Kingdom, and I agree with one point he made. Our research institutes contain some of our best research workers and it is regrettable that these have so little contact with undergraduates and research students. However, I would not be happy to suggest that research directed at improving agriculture should be the sole prerogative of our universities. University departments rarely undertake a continuing commitment to a given subject or line of work, but what is done largely reflects the personal interests of the head of the department. There is a need for continuing

¹ *Editor's note.* Professor Borrie was unable to be present to reply to this discussion.

teams of workers in many practical subjects and at present this need can be met only in research institutes or organisations.

My final comment refers to Professor Aziz and the need for animal proteins. It is simply to say that human beings do not need animal protein. It is true that many people like them, but what they need is a given amount of protein containing the aminoacids essential for health. These could be provided by plants, from legumes, leaf protein or micro-organisms, but if we accept that animal proteins need to be increased quickly, then it must be mainly by eggs, broilers or pork, because beef—which many people would prefer—inevitably can be increased only much more slowly.

THORKIL KRISTENSEN, *in reply*

I think two points have been made, namely that I am too pessimistic about agriculture in the developing countries and too optimistic about manufactured exports from these countries. May I make a few remarks on these two points? First, let there be no doubt that everything should be done to develop agriculture in the developing countries in a rational way, both on the part of the government of these countries and on the part of the donor countries of aid, including the international organizations. The tables which I distributed are somewhat more optimistic than my paper drafted nine months ago. This is partly because, like other people, I have heard about the success stories of high-yielding crops. However, the problem remains to what extent our knowledge about these things can be applied in practice throughout the immense developing world. Let me remind you that in the new Indian Five-Year Plan draft it is only envisaged that such crops will be applied to about 10 per cent of the cultivated area during the next five years and in the meantime population will be rising fast. Whether we need animal protein or not, practical experience in Japan, Italy, Greece, Spain, and other countries, shows that when incomes reach a certain level, animal-product consumption rises fast and that means a great demand for feeding-stuffs.

Turning now to manufacturers, studies in O.E.C.D. and elsewhere have shown that over about the last fourteen years exports of manufactured goods from developing countries have increased by some thirteen per cent per year in value terms, 11 per cent in real terms, and the growth has been accelerating. Today about 9 per cent of the imports of industrial countries are manufactured products from developing countries and most of it comes from East Asia. This was exactly the region about which I expressed concern, because there is such a dense and rapidly growing population and in countries like India and Pakistan there are no large resources of minerals, and the like, to be exported. It is true that Hong Kong is the biggest exporter of manufactured goods, but India is number two, and by far the largest part of these exports come from Asian countries. And this in spite of the restrictions on such imports in the rich countries. This is why I am more optimistic than some other people on this question. Let me add one remark. There is a shortage of labour in the rich countries, to the extent that in Europe no less than 4 million people

have moved northwards from the less-developed southern European countries to the more highly-developed northern European countries to work in their industries. Either workers must move northwards towards the developed countries or capital must move the other way. I suggest that it is easier for capital to move than for workers. Therefore, when it is a question of, say, South-East Asia, it is easier and more attractive for capital to move from the northern countries and establish industries in these countries and it is fairly easy for the governments of these countries to get such capital if they are prepared to allow it to come in—that has been the obstacle so far.

R. BIČANIĆ, *Yugoslavia*

I think that we have missed a unique opportunity; here in Sydney there are two conferences discussing the same problem at the same time. So far as I know, the population congress has taken a rather pessimistic view with regard to the future of the population and food-supply relationship; here we have seen a more optimistic view. It is a great pity that these two great congresses have not had the chance to discuss the problem together. I find that the association of optimism with the agricultural side and pessimism with the population side, is very characteristic indeed. Turning to comments on my paper, one was concerned with my summary table. The problem was how to go from so many case studies to some general conclusions which would help us when analysing specific case studies. This, in a way, follows our usual tradition in this Conference of trying to widen the views of agricultural economists to take in the maximum approach. To my mind the Conference has made a great step forward by introducing not only a range of economists but also the natural scientists, the population experts, and the political scientists. I am glad that a statement has been made here that every agricultural industry is at the same time developed and under-developed. It is a case of diverse types. There are always diverse types, the question is 'Which is dominant?'

Dr. Ringer has raised a very important point in the relationship between the economists and the politicians in the decision-making process. I would stand for the politician and not for the expert in the decision-making process. It is a politician who is able, who is fitted, and who is willing to take the risk. After all if they are not prepared to make the decisions what other social functions do they perform? They have to take the risks which every cautious civil servant tries to avoid. They back the decisions with their political lives. At a previous conference in Paris they had the chance to present a paper precisely on this matter of the division between the politician and the planner; we can extend the idea to the expert. There are customarily four approaches to the division of responsibility. First we may say that where there is a major controversial problem to solve the politician should act. Where there is a neutral field the experts should have the final say of what to say. A second basis might be that the technical problems should be solved by the experts and the

political problems by the politicians. A third approach argues that the major problems should be solved by the politicians and the minor problems by the technicians. Finally one can see the leading decisions being made by the politicians and those which follow by the experts.

I noted the reaction of the researchers in the audience when I mentioned 'the major and the minor'. The trouble is that it is very difficult to decide what is technical and what is political. I have seen in an international conference the leading French economist saying that the income distribution is a technical problem, but the leading British planner said that this is a highly political problem, e.g. bearing on how much of the income will be saved and how much will be spent.

When I said that I favour politicians making the ultimate decisions I do not mean that politicians are free agents. They have to make their decisions according to the rules of the game, but there are certain principles of science which we would have liked to have introduced to guide the politicians when they make their decisions.