

FAO "OVERVIEW"Major Weaknesses in Present Agricultural Production
and Related Research Efforts in Developing Countries1. The Task for Agriculture in the Second Development Decade

The overall goal of an average growth rate of 6% per annum in the economy of the developing countries proposed by the United Nations, implies a growth of around 4% in the agricultural sector; a substantial improvement over the 2.8% annual increase in gross value of agricultural production achieved over the ten-year period 1955-65, and higher even than the objectives suggested in FAO's Indicative World Plan.

The nature of the objectives to which agricultural research and related development programmes will mainly have to be directed if the DD2 targets are to be achieved are largely defined by the declining land/man ratio in many developing countries, and the need to mobilize both domestic savings and foreign exchange earnings if any solution is to be found to the problems of providing adequate food, income, employment and social services against the background of a soaring population growth. First and foremost is the race between food and population. In 1965 there were approximately 1,500 million people living in the developing countries. This excludes Mainland China, whose population then was estimated at between 700 million and 800 million. By 1985, assuming the 2.6 percent UN medium-growth projection, population in the developing world will have risen by 1,000 million to 2,500 million. ^{1/} No impact of present efforts in family planning or of income growth in developing countries is likely to make a significant difference to this by the end of DD2.

This growth of population alone would require an 80% increase in food supplies by 1985 compared with 1962, without any improvement in quantity or quality of individual diets. Success in raising income levels along the lines proposed in the "high variant" of the economic model used in the IWP with consequent improvements in purchasing power, would increase demand for food by 142 percent above the 1962 level, an average rate of increase of 3.9% a year. ^{2/} As against this, the trend in food production over the decade 1956-66 for the developing countries taken as a whole was only 2.7% per year.

An unchecked continuation of this trend would result in a gap between demand and supply which, if it had to be filled by imports from other parts of the world, would by 1985 cost developing countries approximately \$26 billion a year (assuming constant 1962 prices). The shortfalls would occur

^{1/} This has now been raised to 2.8%

^{2/} The figures quoted here are basically those used by the IWP 1962-85 time-scale; 1970-80 adjustments to demand projections are now being calculated.

particularly in supplies of staple cereals and animal protein. For Asia, the Near East and North-West Africa cereal imports exceeding 90 million tons would theoretically be required - nine times those in 1962; or alternatively a hundred million hectares would have to be diverted from other crops and livestock leaving virtually no land for any other purpose than growing cereals in some countries. Only a quarter of the extra animal protein required by 1985 could be produced domestically if livestock production continued to grow at current slow rates (around 2.3 percent per annum over the period 1960-68) and could not be more than doubled by policy changes over the plan period. Failure to achieve this objective and to raise yields and protein content of the staple food crops which in 1962 supplied for developing countries 66% of calories and 59% of protein intake would not only have serious repercussions on the health and working ability of the adult population but incalculable long-term effects on the physical and perhaps also on the mental status of future generations.

In fact, import requirements of the magnitudes above would be unlikely to eventuate since the developing countries had considerable difficulty in finding even \$3 billion for food imports in 1962; but scarcity would drive food prices up, economic growth would slacken and demand would fall. Not only would real incomes fail to grow as desired but the rise in food prices would cause severe hardship on the poorer sections of the community.

Of the one billion extra people mentioned above perhaps 400 million would be in agriculture. These would have to be found work in a sector where un- and underemployment is increasingly serious; and where pressures of population on scarce resources of arable land in Asia, the Near East and North-West Africa (where some 70% of total population of developing countries live) are already critical. Without more positive policies towards employment leading to the creation of additional jobs both in agriculture and in related industries, many of these people would be unable to find productive work and so would depress per capita incomes, slow down economic growth and add tremendously to social problems and discontent.

If the most immediate and urgent problem may appear to be to accelerate food production in order to prevent widespread famine and starvation, a sober analysis of the potential for expanding food output and that for providing work for a rapidly increasing number of young people in the developing countries suggests that the latter may prove the more intractable problem. In fact, a crucial dilemma may be that the very measures which might raise productivity and economic growth most rapidly both in agriculture and in many industries could also lead to a reduction rather than an increase in requirements for human labour.

A difficult problem of planning is therefore to distinguish between objectives which can only be achieved by a capital-intensive approach and where failure would lead to aggravated social and/or economic problems (i.e. attaining the level of demand for animal products by factory pig and poultry production); those where a judicious application of capital would lead to the employment of additional labour (i.e. irrigation, or the use of farm machinery to facilitate multiple cropping); and those where a labour-intensive approach could effectively substitute for capital without sacrificing a vital economic aim. Guidance as to which strategy to adopt should be an important research objective.

Although the contribution of capital and labour to development will vary widely between countries, a substantial increase in the inflow of foreign capital as well as in the rate of mobilization of internal savings is inevitable in all developing countries if the DD2 growth targets are to be achieved. The FAO Commodity Projections indicate that at constant prices exports of agricultural products from these countries could be expected to grow at only 1.8% per annum over the period 1962-75, and probably even less rapidly during the second decade covered by the IWP. This would make it extremely difficult for many countries to finance imports of machinery, agricultural inputs, and other requisites for economic expansion, let alone massive food imports. By contrast, the overall economic frame within which the agricultural objectives of the plan have been set would require an annual increase of 3.4% in exports compared with around 2.5% over the period 1955-67, while agricultural imports could be allowed to grow at only 2.8% compared with a past growth of around 5% per year.

Research will have an important part to play in meeting this challenge also; but because the constraints on increasing export earnings are largely exogenous the emphasis has to be less on technical and more on economic factors than in the case of food production and the development of domestic agriculture.

2. The Continuing Need for Agricultural Research in the Light of Recent Trends in Food Production in Developing Countries.

At the technical Bellagio meeting held in February 1970, a main conclusion was that (despite the progress recently achieved in raising output of wheat and rice in former food deficit areas), major weaknesses remained in current agricultural research effort in and on behalf of the developing countries, and that the coverage both geographically and problem-wise was extremely uneven. There was an uneasy feeling amongst many of those present that not only was this not fully recognized by policy-makers in both developed and developing countries, but that the somewhat sensational and conflicting publicity which had followed on the very real successes of research in relation to wheat, maize and rice might have given rise to some sense of complacency as to the security of future food supplies, which could lead to reduced support for further research work.

While it was accepted that no research programme was immutable and that priorities have to be shifted both in time and space to meet new challenges, it was certainly not felt that this point had yet been reached in respect of basic food crops. In the first place there are a number of imperfections even with regard to the existing high yielding varieties, particularly in the case of rice; while large areas - for ecological, economic or social reasons - remain outside their orbit altogether. Quite apart from this, their impact on increasing food supply has been small outside Asia; and, when set against the remorseless growth of population in nearly all developing countries, can only be looked on as providing a breathing-space in the present area of greatest pressure of people on food supplies, whilst a broader and more secure foundation is established for the long term.

This is confirmed by the analysis of recent trends and the medium term outlook for food supply in FAO's State of Food and Agriculture 1970 (SOFA), which shows that whilst 1969 food production in the Far East, including India and Pakistan, rose substantially (4%) for the third successive year since the disastrous 1965-66 harvests, the situation in the Near East, Latin America, and Africa was much less satisfactory. Recent growth of food production in those regions has been below the 2.6% average annual increase over the past decade (which itself barely kept pace with population growth), and as a result per capita food supply has fallen since 1967 in all three. Admittedly comparisons between regions are difficult and liable to be misleading, since ecological conditions and pressures on land vary so widely; moreover the physical potential for development in the long term is high in some countries where the past growth of production has been low because of social or economic constraints. Nevertheless, until such constraints are resolved (and research has a major part to play in the solution of socio-economic as well as technical problems), their impact on holding down economic demand for food can have implications for human nutrition as severe as technical obstacles to increasing food supply.

Even in the Far East, the outstanding exception to this general trend, where alarms have already been raised about impending cereal surpluses and other later generation problems as a result of the "Green Revolution", the recent FAO Regional Conference strongly emphasized the need for continuing priority to research and related technical programmes to maintain the impetus of the existing work on development of high yielding varieties, and to spread their use to wider areas. Although they recognized the need to step up economic and social research on "second generation" problems, most delegates felt that there could be no cause for complacency on the technical side whilst productivity remained generally low and so many "first generation" problems remained to be solved.

In this connection it is worth noting that this issue was deliberately put before them in a provocative secretariat paper, where the real uncertainty of which way the balance of food production in Asia could swing was illustrated by trend analysis. Although the possibility of emerging cereal surpluses was recognized and some disquiet was expressed by export countries such as Thailand about recent trends in rice prices, the bulk of the countries represented was not willing at this stage to adopt policies which might put their precarious and long-awaited advance towards security in staple cereals at hazard. The endorsement by the Conference of the need for unremitting research effort in the medium-term to build on the existing high yielding varieties programmes, with particular emphasis on widespread adaptive field research, is particularly striking in that it comes from the region where a tendency to rest on hard-won laurels might have been most natural.

It highlights the crucial point which emerges alike from the Indicative World Plan, from the Bellagio meeting, and from the 1970 SOFA analysis, that what is really needed now is not a shift in research priorities from cereals to other crops, but rather a strengthened overall agricultural research programme in which national and international effort would be mutually supporting. 1/

3. Some Major Weaknesses and Priorities for Future Research Effort

(a) Increasing yields of the staple cereals: a priority objective of such a programme should be an across-the-board effort to raise yields of the main staple cereals, not only because they provide the bulk of both calories and protein in the diet of most developing countries, but also because they also occupy the major part of the arable area. A relatively small shift of land out of cereals could therefore have a disproportionately large influence on increasing the output of the other annual food and fodder crops urgently needed for improving the quality of the diet. The withdrawal of cereal cultivation from marginal areas could also facilitate their more rational use for grazing and/or forestry.

A two-pronged approach appears necessary here. The first, and perhaps most immediately attainable goal would be to maintain the impetus and spread the extent and benefits of the high-yielding varieties already developed of wheat, maize and rice, by improving their consumer acceptability, increasing their resistance to pests and diseases, and making them more readily available together with an appropriate input 'package' to all classes of farmers. This implies both continued multi-disciplinary research; and expanded 'outreach' programmes and pioneer projects to sort out and overcome the technical problems encountered in the field and the socio-economic obstacles to the wider adoption of successful new techniques.

In parallel a major long-term programme has to be launched to fill some of the major gaps not adequately covered by existing research effort. These concern first rice, and secondly the cereals grown mainly in the less favourable environments where cold and/or heat and drought are important limiting factors.

1/ See also Item 8, Table 1, to which FAO contributed.

In the case of rice a number of problems of quality and pest and disease resistance still restrict the success of the IRRI and other high-yielding varieties; but these are rather well recognized now and the subject of intensive research. Perhaps even more urgent is the need to develop better varieties and cultural methods in respect of upland, swamp, and deep-water rice. Only about 20% of world rice output now comes from land adequately equipped with controlled irrigation and protected from deep flooding and thus suited to the cultivation of "high yielding" varieties. This area will increase under the impact of development projects, but there will still be large areas where conditions are less favourable, and which are largely neglected in current research programmes.

There are also serious gaps in the research coverage of other important cereals. Comparatively little has yet been done to improve varieties of barley (a crop which covers around 17 million hectares of the drier areas of India, Pakistan, the Near East and North Africa), or to raise yields of the winter hardy and durum wheats, although these are now receiving increasing attention in Turkey. Perhaps the highest priority of all is to increase yields of sorghum and the various species of millet, which occupy 40 million hectares in India and Pakistan (double that under wheat), and over 30 million hectares in Africa, largely in relatively unfavourable environmental conditions where they cannot easily be substituted by other crops. They provide the staple diet to an estimated 400 million people, and also make an important contribution to feed-grain supplies.

(b) Starchy roots, tubers and plantains: With the exception of white potatoes these crops are grown and consumed almost entirely in developing countries, and hardly enter into world trade. They have therefore received little attention in research programmes in developed countries and whilst some good work has been undertaken in developing countries, particularly in Africa, much remains to be done. They provide the basic staple for some 80 million people in tropical Africa alone, and are also of great dietary significance in South East-Asia and Latin America.

Despite their low protein content (particularly in the case of cassava), they are capable of giving very high yields in terms of energy when properly cultivated; and varieties of certain species, for example sweet potatoes, are rich in vitamins. Further work is required to improve yields, both through breeding and cultural practices, to raise vitamin and protein content, to improve keeping qualities and culinary habits in respect of the more nutritious species such as yams, and to develop rotations with protein-rich crops, such as cowpeas. A carefully planned programme along these lines could transform the diet in some of the worst areas of malnutrition where it is difficult to grow cereals and could lead to a rethinking of the role of these undervalued, high-energy crops.

(c) Improving Nutritional Standards and Meeting Economic Demand for Other Foods

Over and above the primary aim of ensuring an adequate calorie intake there is an urgent need to improve levels of nutrition and to meet the changing priorities of an increasingly market-oriented economy, particularly in respect of protein rich foods. Here again research has a major role to play, both in raising protein content and quality of the major cereals, and in developing high yielding - or at least better yielding varieties of food legumes and fodders for livestock.

A significant step forward in improving protein quality of cereals has been the development of the high lysine maize mutants opaque-2 and floury-2, and back-crossing programmes have now resulted in relatively high yielding, high protein varieties of this crop. Similar progress in narrowing the gap between primary and secondary amino-acids may be feasible in wheat, millet, and sorghum: in the case of rice where the amino-acid balance is better, the major task lies in raising total protein content. India, in particular, has made improvement in protein content and quality a main objective of its cereal programme, but the problem is a major challenge to international research.

In respect of the leguminous crops, research on grain legumes is still far from adequate, and, as a result, yields of these crops have hardly increased since the mid-fifties. High priority needs to be accorded to chickpeas and pigeon peas (mainly in drier areas of the Near East and South Asia), to cowpeas (mainly in tropical latitudes) and to haricot beans (genus phaseolus) especially in Latin America. Significant progress on groundnuts has been made as a result of research and extension programmes in some countries of Africa, but yields in India (the world's largest producer) have long remained static; and whilst that country has recently had considerable success with experimental introduction of soya beans, average yields of this crop in Indonesia, the largest producer in Asia have shown little improvement. These two crops are of particular importance because of the contribution which their direct consumption makes to the diet, the value of their oil for exports or import substitution, and the indirect value of protein-rich cake to livestock nutrition (assuming that a higher proportion of oil will in future be processed in the country of origin), and also because of their potential significance as sources of formulated protein foods and dietary supplements. The promotion of such products could not only create additional industrial employment opportunities, but might also offer a way out of having to develop dairy industries in tropical areas where milk-drinking is not traditional and/or production and collection of milk is difficult, or alternatively of avoiding importation of milk products.

At present these leguminous crops are often grown in the areas of lower ecological potential, to which they are increasingly being pushed by competition from more profitable high yielding cereal varieties in the better areas. This is likely to continue unless their yields can be improved as a result of research,

and the serious nutritional implications must be viewed with concern. This makes it all the more important to seek additional approaches to diversifying the diet, and probably the most promising of these, where moisture and temperature are not limiting, is via multiple cropping, based on an almost continuous cycle of crops, each holding the land for a comparatively short period.

Research workers in India and the Philippines have been obtaining 20 tons of dry matter per hectare by the use of this technique, whereas the most which could be expected from a conventional double-crop rotation based largely on cereals would be around 10 tons. Quite apart from the much better nutritional balance obtainable from the varied range of crops, including quick-maturing food legumes, which can be fitted into a multiple cropping system, economic studies have shown that significant increases in income and employment are also possible through the introduction of intensive systems. Moreover, so long as adequate credit and institutional support can be provided, these appear best suited to adoption by the smaller family-sized farmers who can give the close supervision and year-round care essential to success. So far, however, only the fringe of the potential has been explored, and there are many technical and economic problems to be overcome, as well as a major task of farmer education, before multiple-cropping can be widely adopted.

Multiple-cropping may also offer a practical solution to a further difficult problem facing developing countries - meeting demand for vegetables. In the past it has often been assumed that this would largely solve itself; that farmers would grow enough for their own needs and market the balance. Food consumption surveys show that this is not necessarily true: vegetables (and also fruit) often being marketed at the expense of the farmer's family diet; moreover the rapid growth of urbanization and of processing industries is leading to larger and more sophisticated demands for marketed produce.

To meet this need will require organized rather than backyard production, better standardization of produce, and improved transport and marketing systems. On the other hand it also offers important opportunities for increasing farm income and employment. Nevertheless the range of crops and related problems to be tackled is so wide that it is not easy to know where to begin, or what the role (if any) of international support to research in this wide field might be. So far it has received relatively little consideration at the "Bellagio" series of meetings; perhaps it might not rate a priority as high as cereals, but it certainly merits greater attention than has so far been devoted to it in discussions on future research needs.

(d) Increasing Export Earnings

So far this paper has dealt almost exclusively with the research needs of foodcrops required to meet domestic demand. This has been done deliberately; not because there are no such needs in respect of commodities for export, but because - on the whole, the research on these commodities is much better organized. There are a number of reasons for this, which need not be gone into here, but the result is that (despite weaknesses in individual countries), technical standards are higher both in respect of production and processing than with crops grown largely for domestic food use. High yielding planting material has been developed for most major perennial export crops; sophisticated research has been undertaken on fertiliser, micronutrient, and crop protection problems, and in most cases the problem is not so much one of expanding production but of finding a market at an economic price.

For this reason a number of countries are now more concerned with diversification of their production than with continuing to increase output of a very narrow range of export crops. In this connection several tropical countries are looking to livestock and particularly to beef, as a possible source of new export earnings, but there are formidable problems of pasture development, animal management, disease control, and marketing to be overcome.

It is perhaps here, rather than in further research on production of traditional export crops, that internationally supported research might play the most valuable role in increasing trade both between developing countries and with the developed countries. The latter, however, could assist materially in widening markets for agricultural raw materials from developing countries by end-use research, as well as through adjustments in their own production and trade policies.

(e) Improving Productivity in Difficult Environments

Much of the work of existing international research stations, and indeed of national research programmes, as well as the allocation of extension, credit, inputs, and other scarce resources, is concentrated on developing high yielding varieties, and the adoption of modern technology suited mainly to areas of relatively high agricultural potential with the object of raising productivity as rapidly as possible. This is understandable, and probably correct priority setting in the light of the desperate need for food and for foreign exchange earnings in many developing countries. However, it is leading to a widening income gap between farmers in areas of higher potential (which probably cover only around 30% of arable land), and those elsewhere. Much higher priority needs to be given to the admittedly tough problems of these more difficult areas, which have both benefited less than others from the "Green Revolution" and would suffer more from eventual price cuts in cereals, if dangers of social upheaval are to be avoided.

Two broad areas appear to be of primary concern: first, how to develop more productive and profitable systems of rain-fed agriculture in the semi-arid to sub-humid zones of erratic rainfall immediately north and south of the Sahara in Africa and also covering much of the Near East, West Pakistan and North-West India; secondly, how to develop stable arable farming in the difficult soils of the humid tropics.

Although there are considerable differences in ecology, cropping patterns, and socio-economic conditions between the Sahelian zone of Africa and the Mediterranean/Near East region, there are also broad similarities in the approach which may be required to their future development. In neither does it seem feasible to adopt a 'spearhead' approach based largely on achieving a breakthrough with a single key crop; in both, livestock plays a vital role and the integration of crops and livestock is poor. In Africa, south of the Sahara, the development of livestock, indeed, agriculture in general, is seriously impeded by diseases, in particular, Trypanosomiasis; but even if an effective solution were to be found to this high-priority problem, much would remain to be done to improve range management practices, nutrition, and animal breeding, and to create the incentives to practice proper commercial livestock husbandry and to overcome traditional attitudes towards the possession of cattle. In North Africa and the Near East, where disease is less limiting, there is (at least in theory) no technical reason why the Australian wheat fodder-sheep complex should not have been introduced, but the Mediterranean species on which this system largely rests are still regarded mainly as weeds in their home environment. It is therefore unlikely that technical advances alone will provide the necessary impetus to developing a more forward-looking pattern of agriculture in either zone.

In the humid tropics, where climate and the physical and chemical nature of the soils pose particularly difficult cultivation problems, shifting cultivation (the basic cropping system), is becoming inadequate under increasing population pressure both from the social and the economic viewpoint. Solutions must be found to the management problems of fertility and water-holding capacity of these soils before they can be brought under permanent cultivation for annual crops on any large scale. Because of their highly erodable nature, and the high rainfall of the humid tropics, soil conservation measures aimed at controlling run-off must be just as much a part of the improved management patterns as the goals of fertility management. Permanent tree crops can offer a partial solution, but the food needs of the local population and the absorptive capacity of the world market for produce from tropical tree crops set limits to this.

It must be faced from the outset that any programmes of research in these difficult areas have to be looked at in the long-term and are unlikely to yield quick and spectacular results. Nor can they be narrowly based, since it seems likely that improvements will only be brought about by a combination

of a number of factors, which might include development of varieties suited to unfavourable environments; measures to improve the environment to enable more responsive varieties and related inputs to be used economically (i.e., raising the yield ceiling imposed by limiting conditions of moisture, temperature, or topography); improvement of natural grazings and range management; and the establishment of systems of "stratified" livestock rearing and fattening in conjunction with marketing measures and other economic links between high and low rainfall zones or uplands and plains. Difficult problems of nomadism, transhumance, and shifting cultivation have to be faced, and the people involved are some of the poorest and least advanced in the world.

Such problems will only be successfully solved by strongly supported multi-disciplinary research programmes, continued over a number of years, and it is probably beyond the capacity of any of the countries which would be the main beneficiaries to support such an effort. This, together with the wide area affected, constitutes a strong case for internationally supported research.

(f) The Problem of Employment and Some Implications for Research

One other problem of surpassing importance is that of creating additional employment opportunities within the agricultural sector of developing countries, and in its linkages with other sectors. FAO's Indicative World Plan showed that, taking only the eight countries covered in its Asian Regional Study, total population would rise (on current population trends) from an estimated 830 million in 1962 to over 7 billion by the year 2050. Agricultural population represented approximately 70% of the 1962 total, and even if this figure fell to only 9% by 2050, the population dependent on agriculture for its living then would still be higher than in 1962. If anything the growth of population has shown an upswing since 1962, and the potential magnitudes of the problem for overall economic development are quite staggering.

As far as the orientation of agricultural research is concerned, it indicates the need to concentrate more attention on developing techniques and systems of farming which will both increase productivity and create additional employment opportunities within and in relation to agriculture. Particular problems within this broad field of research relate to the future role of mechanization and how to provide the smaller (and particularly the tenant farmers) with relatively scale-neutral techniques and the means to adopt them, since this group with their families form the bulk of employed agricultural population in many developing countries. Alternatively some completely new, revolutionary, and possibly not yet conceived system of land use must be developed to employ more people. While FAO strongly supports the general case for more socio-economic research, we therefore believe that this should, first and foremost, be directed towards creating employment, a problem which both transcends and yet is closely related to most other aspects of socio-economic development.

4. Links Between Research and Development

Both of the last two problems on which this paper has touched take us into the half-way house between research and development. Not only is there a need to achieve a balance between international and national research, and between so-called basic and adaptive research, but also between putting too many eggs into the research basket, and not enough into testing research ideas widely within projects or other field programmes. (The reverse, of course, can also be true, and this has been a prime cause of failure of development projects in the past.)

Even where the high yielding cereal varieties are in wide use by farmers, much field research remains to be done to determine optimum economic rates of water and fertilizer use, crop protection requirements, suitability to intensive rotations, and the possibilities of new techniques such as ratooning which gives promise of very high rates of feed-grain production per annum. The Green Revolution has also sharply highlighted the fact that technical research alone is not enough: there is need both for a parallel effort in economic and social studies, and for a close dialogue between technical and socio-economic research.

A potentially valuable means of achieving a marriage between research and development in respect of certain problems, for example improving water use and management, may be to utilize existing projects as testing grounds, or possibly to set up special projects with this end in view. IBRD, UNDP and FAO could certainly play a valuable role in this respect. However, there are many ways in which links need to be forged before research findings can be successfully applied, as aptly pointed out by IRAT at the recent New York "Bellagio Group" meeting. The supply of inputs, and particularly of seed of improved varieties is one critical factor which has received insufficient attention in the "Bellagio" meetings so far; but there is a need to construct a whole working methodology to ensure the effective application of research to development.

5. Some Further Thoughts on Reinforcing Research Effort for Developing Countries

(a) Strengthening links between national and international research: There is clearly a major task of research to be undertaken if the ambitious goals of the Second Development Decade are to be achieved, and one which will involve many disciplines and organizations, both national and international. It is therefore important to emphasize that multi-disciplinary international research programmes are not alternatives but are complementary to national research and development efforts, with which they should have a symbiotic relationship, sharing responsibilities and activities according to a mutually agreed plan. This makes it particularly important to know what is going on in national research programmes, where, and with what resources, so that the maximum degree of complementarity can be achieved.

FAO has a detailed proposal worked out for a Computerized Agricultural Research Information Service, on which test runs have already been undertaken in Africa and which was submitted in outline form to the April Bellagio meeting. Although this is at present hampered for lack of funds it could provide the answers to many of these questions. We understand that USAID may shortly be launching a review of agricultural research establishments in Africa; the IADB reported a similar study for Latin America at the "Bellagio Group" meeting held in New York in December 1970. UNESCO have an even more ambitious two-year plan on the stocks to review the institutional base in all sectors in all developing countries. There is obviously a need to synchronize approaches, timing, and methodology on these studies and to feed their conclusions into a central data bank. This could provide a most useful base for determining the immediate contribution which might be expected from national resources, and to deciding the optimum combination of national and international research effort in any programmes which might be financed by an International Agricultural Research Consultative Group. It would also help the developing countries to strengthen and coordinate their own research programmes over the long-term, and would guide international and bilateral assistance agencies in supporting them. While it is probably not envisaged that this group would finance national research per se, there is clearly everything to be gained by achieving a good balance between national and international programmes: indeed, to strengthen the latter to a level beyond the absorptive capacity of countries for adaptive research and demonstration might prove self-defeating.

In the past national research programmes have not always reflected national priorities, nor have national planners always appreciated the problems research workers have to face or the time and resources required to produce results. There is a clear need to develop a more effective dialogue between national planners and research workers, and both FAO's activities in providing assistance to development planning and additional international support to policy orientation in Asia should contribute to this.

(b) Regional Research: Both at Bellagio and in subsequent meetings some speakers seemed to regard regional research with caution, if not suspicion. There have certainly been poor results from some regional efforts in the past, but this may have been because the original decisions as to organization and management (for reasons which may have been difficult to avoid) led to excessive interference in their implementation. Provided this can be avoided, however, and a genuinely independent programme established with international support (whether by building around an existing institution, creating a new one, or adopting some other appropriate machinery for its implementation), the distinction between "international" and "regional" seems to FAO to be largely semantic. An internationally supported research effort might have its main impact in the long term a long way from its centre of origin (as in the case of the work of CIMMYT on the Mexican wheats); it might largely be concentrated on a specific ecological grouping of countries as with the proposed upland crops centre in South-East Asia based on IRRI, or the West African Rice Development Association (WARDA) programme; or it might work through an economic grouping of countries along the lines suggested for socio-economic research in Asia, with a small international core staff acting in a catalytic and coordinating role. These groupings can

essentially be regarded as regional programmes; however, the main criterion of choice should be the potential impact of the work and not the terminology used to describe it. Because of the wide and varied range of problems to be tackled it is essential to be flexible, both in the approaches to new programmes and in developing the means to undertake them.

(c) Research by developed countries on behalf of developing countries: In conclusion it might be worth considering what steps could be taken within the research effort of the developed countries to help the developing countries. Of course it is arguable that a great deal of what is going on in research institutes in developed countries has application, directly or indirectly, to the developing countries. However, this may only be effective in the distant future, and a good deal of it is too shrouded either in military or industrial secrecy to be of obvious application within, for example, the Second Development Decade. Moreover, some of the results of past research, for example the development of synthetics, have had disastrous effects on the agricultural economy of developing countries. There is a good case for more deliberate planning, and possibly for coordination of, research effort being undertaken in developed countries on behalf of developing countries, as well as for stepping up expenditure on such research. The latter is, in fact, envisaged by the UN World Plan of Action for the Application of Science and Technology to Development during DD2, which calls for an expenditure of 5% of non-military research expenditure in developed countries on behalf of the developing countries.

A number of objectives can readily be suggested for such research, which might be undertaken either through government agencies or under contract to universities or industry. Some programmes already under way might be strengthened, such as work on trypanosomiasis, or on the development of a cheap, effective replacement to DDT with neither immediate toxicity to mammals or fish nor long-term chain reaction effects. Research on the application to the needs of developing countries of new techniques requiring highly sophisticated equipment such as remote sensing is a further example. Improvement of storage, processing, and end-uses of agricultural raw materials from developing countries is another possibility. Raising protein quality and content of cereals is another. In the econometric field an attempt might be made to develop techniques of evaluating ex-ante (rather than ex-post) the probable benefits of research projects. OECD have already done some pioneering work along these lines using discounted cash-flow techniques.

The opportunities are clearly legion, and although FAO does not envisage an international research consultative group financing such work there might nevertheless be some tasks worth further exploration which could be undertaken in appropriate developed countries to complement a research programme which the group might at some time finance in the developing world. It would certainly be worthwhile to know about any ongoing activities, and it would be a pity to let such a unique opportunity as this for international collaboration in agricultural research go past without examining future possibilities, even if more detailed consideration were to be deferred to a subsequent meeting, and after further time for study.

Rome
January 12, 1971