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INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE

REPORT OF THE RESEARCH REVIEW PANEL, 9TH JUNE 1972

The panel was impressed by the striking progress already made by IITA. The extensive programme of field experiments together with the excellent laboratories, support services and other facilities cannot fail to make a profound impact on those with experience of agricultural research in developing countries. Moreover, the enthusiasm of the staff and the clarity with which they presented their programmes revealed the extent of the thought and effort that have already gone into formulating imaginative and sound research aims.

In the main, therefore, this report of the Review Panel serves to endorse the views expressed by the various leaders of the research teams and to make comments on those aspects of the programme where precise definition has not yet been possible.

Scope of the Research Programme

The panel noted the more precise definition of the scope of the research programme under the two broad headings of Farming Systems and Crop Improvement and is in general agreement with the associated proposals for staffing. At the same time it is recognized that any research program is dynamic and that the process of evolving the definition of research aims is a continuous one which calls for flexibility in the specification of research posts.

While agreeing that the scope of the research programme is appropriate for the time being, we support the view that the Research Committee should remain open-minded on the question of livestock. Cattle, in particular, have such an important role both in making use of forage crops and as a source of power that there may well come a time when it would be useful to introduce livestock, not as a basis for a separate research programme, but as an adjunct to the work on farming systems.

The panel supports the view that the further development of results and varieties at other places in the ecological areas served by the Institute should primarily be the responsibility of the various national research organizations. This arrangement will also serve to provide valuable feedback of information and ideas that are so important in familiarizing the research staff with the agricultural as well as the cultural background of the regions they serve. In this connection, we are pleased to note the closer association that has been developed with the University of Ibadan.

The panel regards the development of co-operative research projects with other research organizations, such as those initiated with Reading, Durham and Wye, as being of great importance in that they both make use of expensive research facilities that are already established elsewhere, and that they involve additional research personnel in the problems of the tropics. In endorsing this principle, we suggest that it should be given the widest possible publicity because there may well be institutes and universities in other countries, including the developing countries, where possibilities exist for similar co-operative projects. As far as the developing countries are concerned, such co-operative projects would help in the process of building up the image of IITA.

It also seems logical that the principle of co-operative research within the scope of the IITA programme should be applied in reverse, as with the special projects that are being formulated on what amounts to a contract basis with various countries and with organizations such as UNDP, FAO and WARDA.

Crop Improvement and Crop Protection

The work in crop breeding will provide nucleus stocks for testing and further improvement in local environments. The establishment of international testing facilities is an encouraging development which implies increasing cooperation from national governments.

Fundamental to the programme is the incorporation of characteristics such as resistance to diseases, pests, drought and lodging, and the improvement of nutritional quality. Improvements of this type are usually of benefit regardless of the level of agronomy practised and the panel supports the priority given to these aspects in the various programmes.

As the work on farming systems develops, however, increasing attention will naturally be given to those characteristics of the plant that make them more easily incorporated into farming systems. Obvious examples are maturation periods in relation to cropping sequences and rainfall distribution, rate of canopy development in relation to weed control and genetic modifications to the plant that facilitate mechanical operations.

The panel recognizes that the plant breeders are already developing comprehensive programmes but that, with some crops, efforts to assemble the desired range of germ plasm are frustrated by existing quarantine regulations. While the panel strongly

emphasizes the need for the greatest possible caution in quarantine matters, it is clear that the movement of plant material from country to country in the tropics will become an increasing problem, not only with respect to the development of effective breeding programmes but also with respect to the wider dissemination of the improved material that emerges from them. There is therefore a clearly defined need for the problems that this situation creates to be tackled on an international basis.

While recognizing the local popularity of yams as a food crop in Nigeria, the panel considers that within the root and tuber crops, sweet potatoes should receive high priority, having regard to the known flexibility of African food habits, the agricultural advantages of sweet potatoes as a crop and to the absence of major biological problems in sweet potato breeding.

In other aspects of crop improvement, vigorous programmes are already well established and the panel was impressed with the scope of the projects and the results already obtained. Similar remarks apply to the work in crop protection and weed control.

The supply of biological information for incorporation in the farming systems programme will require further integration of results from the present lines of research in crop improvement and related topics. In this respect the panel noted that the absence of work in crop physiology is a gap that will shortly be filled when staffing is completed. We also noted that possibilities exist within the experimental areas for observations on the implications of various management practices and cropping sequences that would be important if large-scale arable farming ever became a feasible proposition in the humid tropics. There is, however, a need to work out long term plans for laying out, managing and rotating the areas to be used primarily for plot experiments.

Farming Systems - Physical Factors

Pedology

A thorough knowledge of the physical and chemical nature of the major soils of the lowland humid tropics is recognised as a necessary input in the development of crops as well as optimum farming systems for the area. To meet this requirement and concentrating on the major physical limiting factors, soil erosion and water stress, the pedology programme has placed emphasis on applied aspects of soil classification and characterization which would facilitate location of agro-ecological areas in terms of land use

potential for improved crop production and farming systems. The panel was informed of the proposal to carry out complete studies of bench mark sites throughout the region covered by IITA. It was noted, however, that importation of soils into Nigeria for analysis was not practical and cooperation with other organizations would be essential. Current studies on utilization of hydromorphic soils should yield very useful information.

Soil Physics

Emphasis is correctly placed on soil and water conservation. The panel were informed that two major physical characteristics of soil at IITA, shallow depth and low water retention, are prevalent in the lowland humid tropics. Crops grown on such soils suffer not only from leaching of nutrients but also from severe water stress, requiring frequent rainfall to maintain adequate soil moisture.

There are therefore three major objectives in this study: crop water use efficiency, soil erodibility and movement of agricultural chemicals in the soil. The soil physicist is currently handling all three aspects, developing mathematical models and planning studies on water stress in plants as well. It was however apparent from the report presented that after the present preliminary studies, the whole approach to crop water use studies will need some revision. It is also suggested that further work on this specific investigation be held in abeyance until the agro-climatologist is appointed. In this context, the efforts made by the soil physicist in the preliminary investigations both in field and laboratory are commendable. The panel, however, feel that the chances of achieving major breakthroughs when covering such a wide field with present resources are limited and suggest that some modifications may be necessary. Such modifications should take account of the different soil types within the humid tropics. Studies on soil temperatures, especially as related to mulch and tillage should yield very useful suggestions for the development of tillage and farming systems studies in the near future but investigation of the reason for the inability of roots to penetrate the soil below 30 - 50 cm should continue to be accorded high priority. Members of the Review Panel were shown some of the 24 run-off plots where construction and equipment are capable of very high precision. The staff agreed that in spite of high precision, extrapolation of run-off results from such plots to large areas is seldom a reliable procedure. Although the panel were assured that counterpart large scale investigations will be undertaken by the Soil and Water Conservation Engineer when he is appointed, the panel suggests that if similar run-off plots are to be established throughout the region covered by IITA, opportunities for maintenance of high precision will be limited and simpler methods should be considered.

Soil Fertility

Considering that continuous intensive cropping with higher yielding varieties will put a heavy demand on soil nutrients, emphasis is correctly placed on the chemical and physical properties of the soil influencing the fate of fertilizers, particularly phosphorus. The problem of phosphorus retention in soil is being pursued vigorously and it is especially noted that in recognition of the complexity of the subject cooperative studies with Reading have already been initiated. The panel supports the proposal to investigate more thoroughly the role of condensed phosphates and slow release forms of N and P fertilizers. The cooperative relationship with TVA's National Fertilizer Development Center should facilitate prompt consideration of the implications of these with respect to the manufacture of such materials. It is our understanding that low cost production of items such as sulphur-coated urea will probably depend on establishment of new plants designed for that purpose. In view of the large investment and long lead time for erecting fertilizer plants, it is important to obtain reliable information about the agricultural value of high-analysis, slow release products as soon as possible and to bring such information to the attention of governments and firms planning to expand fertilizer capacity. The proposed survey of micro-nutrient status of the soils of the ecological zone is certainly relevant, but such investigations need to make full use of the possibilities for cooperation with related programmes in the region.

Farming Systems - Socio-economic Factors

The program to develop improved farming systems applicable to the humid tropics poses problems of extraordinary complexity. The importance of the problem justifies a major effort by IITA in this area, but it seems essential to endeavor to achieve results that are valuable in the near future as well as in the long run. Close interaction between the crop improvement programs and the work on farming systems should permit the identification of profitable and feasible packages of innovations that can be incorporated into existing farming systems. At the same time such packages components of systems that will eventually be designed and tested to fit the needs of various physical and socio-economic environments.

The two agricultural economists who are to participate in this effort have a crucial role to play in helping to define criteria that can provide guidance in selecting the innovations that deserve priority attention. The studies of existing farming systems that are now being processed by the agricultural economist, and similar studies carried out in other areas, are especially valuable in clarifying the characteristics of existing systems. We believe that in the future more attention should be given to certain economic and demographic characteristics that apply to most countries within the humid tropics and which will for many years condition the types of change in farming systems that are feasible and desirable. Two features of these economies have such important implications with respect to the modification of farming systems that they merit brief comment in this report.

Factors conditioning changes in farming systems. The rapid growth of population that is a universal characteristic of the less developed countries gives rise to similarly rapid growth of the workforce in these countries. Reduction of birth rates to levels consistent with sharply reduced death rates cannot be expected for a decade or two at the earliest, and it will be an additional decade and a half before a reduction in birth rates will lead to a slowing of the rate of increase in the population of working age. This feature, in combination with the fact that employment in manufacturing and other nonfarm sectors account for such a small fraction of the labor force, inevitably means that the agricultural population and workforce will continue to increase in absolute size for several decades at least, and even the reduction in their size relative to the total population will be slow.

These demographic and structural characteristics affect the potential for modifying farming systems in several ways. Widespread improvement in the economic well-being of the rural population in these countries depends upon expanding the opportunities for productive employment in

agriculture which underscores the need to emphasize innovations that complement their relatively abundant labor resource. Because the number of farm households is so large relative to the limited commercial demand for farm products, the required rate of increase in farm labor productivity is fairly slow although the need to increase output per worker will increase at an accelerating rate as structural change takes place. This structural characteristic also means that the cash income per farm household will be very limited and, apart from agricultural export or import substitution possibilities, the cash receipts of the agricultural sector can only expand as the predominantly agricultural structure of these economies is transformed. Unless change is concentrated in a small sub-sector of typically large farm units that satisfy the bulk of the limited commercial demand, the change to farming systems that rely heavily on purchases of externally produced inputs must be a gradual process. Hence, as much attention needs to be given to the time sequence of innovations as to the "ultimate" farming systems that will provide a more productive alternative of shifting cultivation.

Attributes of innovations. If the IITA research effort is to have a widespread and positive impact, it will also be important to consider the attributes of the innovations that are to be emphasized. This aspect should be considered in depth by the IITA agricultural economists, and it underscores the importance of establishing cooperative relationships with sociologists studying rural communities and agricultural change as well as with other agricultural economists in the region. One important attribute is, however, emphasized by the demographic and structural characteristics discussed above. To achieve the progressive modernization of farm households, it is important for innovations to be highly divisible and neutral to scale so that they can be used efficiently by farm units that are small and subject to a severe purchasing power constraint. It is partly for this reason that high-yielding, disease- and pest-resistant varieties merit such high priority. Usually the combination of fertilizer-responsive varieties and increased use of fertilizers are of high priority, but for some crops equal attention should probably be given to achieving yield increases with minimum use of purchased inputs. It has been correctly emphasized that it is an advantage that grain legumes can usually be grown without nitrogen fertilizer and it seems likely that breeding alone will often permit sufficient increases in cassava production. Herbicides may merit early attention as a component of improved farming systems because of their divisibility and their value in permitting the use of minimum tillage techniques; and the small, simple, inexpensive two-wheel tractors being emphasized in the rice mechanization project seem promising for forest areas where animal draft power is not available.

Certain other attributes of innovations, such as ease of understanding, reliability as well as profitability, and a high degree of visibility of results should also be considered in fixing research priorities. Such attributes tend to make innovations "self-spreading" in the sense that when adopted by a few farmers they can be seen and copied by neighbors, thereby lessening dependence on formal programs of extension and training. Experience in areas in Africa that have achieved considerable agricultural progress emphasize the importance of cumulative change based on efficient sequences of innovations which can become increasingly complex. This suggests that it may be advantageous to emphasize components of farming systems that can be adopted progressively and give less emphasis to alternatives that would have to be adopted as an integral system, even though the latter might have significant technical advantages.

The proposed use of linear programming and other techniques of systems analysis to "optimize" the profitability of alternative systems is undoubtedly appropriate. We would, however, stress the need to bear in mind that the total system that is relevant to designing efficient strategies for agricultural development is probably too complex to be accommodated by computerized models. Work is in progress at several universities aimed at the development of complex simulation and dynamic linear programming models that may be able to accommodate the micro and macro aspects, which are both so important. But those techniques have apparently not yet been developed to the point where they provide much guidance to policymakers. Research workers at IITA will want to keep in touch with developments in this field, but we have some reservations about IITA giving high priority to developing new methodologies for this purpose. We suspect that it will be advisable to rely primarily on less formal methods of reasoned analysis - utilizing economic theory, understanding of past experience and agriculture's role in economic development, and simple benefit/cost analyses - to guide the design of farming system. At that point the systems thus identified can be evaluated by standard linear programming techniques prior to undertaking field comparisons of the most promising.

TRAINING

There can be no doubt of the importance to developing countries of training in research, particularly to foster leadership and to develop the ability to innovate. In this respect, the Panel notes with satisfaction the emphasis that is to be given to training in the future development of the work of IITA.

We nevertheless consider that we must sound a note of caution in relation to the sophistication of the equipment and facilities that already exist at IITA. The panel considers that it will be a long time before

similar facilities can be provided at the home research institutes of most of the trainees from developing countries. There might, therefore, be a case for giving the greatest emphasis in training to catering for the research worker who has already obtained a higher degree and who comes to the Institute to learn new techniques and to gain experience. With the younger man, who will use the training period to work for a higher degree, there should be a continuing effort to guard against the development of a frame of mind that thinks that effective research can be done only when facilities similar to these at IITA are provided.

These comments also serve to draw attention to the lack of many developing countries of personnel who have adequate experience of the technology needed to support an effective research programme. Consideration might therefore be given to providing opportunities for personnel at the technician level to gain experience by working side by side with IITA personnel for worthwhile periods.

Communications and Information.

The panel noted the importance attached by IITA to the development of facilities for the collection, interchange and dissemination of information and to publicising its activities as widely as possible. While entirely supporting the desirability of such things as newsletters, the panel considers that the most effective form of publicity is that which arises from personal contact.

Reaction of personnel who have participated in the various seminars already organized has been universally favourable and the Institute has clearly fulfilled an extremely important need in bringing together scientists not only from the Anglophone and Francophone countries of Africa but also from widely separated geographic areas. It is logical that the work of these seminars should be consolidated by the publication of the proposed series of monographs.

The panel would like to stress the continuing need for broadly based seminars of this type and suggests that further benefits might accrue if ways and means of involving administrators as well as scientists could be found.

Acknowledgements

Members of the panel wish to express their appreciation for the tremendous help and facilities provided by the staff of IITA. The panel's task of evaluating the research programme was especially simplified by the frank and vivid description of both scope and details by the programme leaders and their staff during the panel's tour of the field experiments, laboratory facilities and in the joint discussions in the series of seminars. We are especially grateful to the Director and his administrative staff for the effort put into ensuring our personal comfort right from our arrival at the airport to departure. We hope this comment will be passed on to the team of efficient and extremely courteous drivers who have looked after our transportation throughout the week.

Finally, we are grateful for the opportunities provided by the Associate Director and his wife for members of the panel to meet IITA staff informally.